An Empirical Investigation of the Corporate Debt Maturity Structure

by

James R. Morris*

Working Paper No. 5-75

RODNEY L. WHITE CENTER
FOR FINANCIAL RESEARCH

University of Pennsylvania

The Wharton School

Philadelphia, Pa. 19174

I. Introduction

A major part of the research in finance has dealt with the firm's decision regarding the debt-equity financing mix, and there is growing awareness that the decision regarding the maturity of the firm's debt is an interesting and important problem. Some authors have considered the debt maturity decision only as an incidental issue in the context of the debt refunding problem ([7], [12], [14], [15], [23]), while others ([8], [9], [18], [22]), have dealt with the debt maturity decision in a more direct manner.

With the exception of the aggregate time series studies of Anderson [1], Bosworth [3] and White [24], and the cross sectional study of Boot and Frankfurter [2], there has been little empirical investigation of how financial managers actually determine the maturity structure of the firm's liabilities. This paper represents an attempt to fill this gap and expand our knowledge of the factors that influence the maturity structure of the firm's liabilities. Here are presented the results of a cross sectional study of corporate debt financing which explores the factors which influence the average maturity of corporate debt.

When firms issue new debt they presumably choose the maturity of the debt by considering the prevailing level and shape of the interest yield curve, expected future interest rates, debt flotation costs, and, in an effort to hedge asset and liability maturity, the life-time of the assets financed with the new debt, and finally, the operating characteristics of the firm. Yet, between companies or industries there is relatively little variation in the maturity of new bonds, with most new bonds typically issued with maturity of 25-30 years.[1] This suggests that either the above mentioned factors do not influence the maturity decision, or, the maturity decision involves more than just the maturity of newly issued bonds.

The latter alternative is the basic premise of the present study, where it is assumed that firms are concerned with the total structure of liabilities, rather than the maturity of a particular debt issue, and the liabilities are structured according to the operating and financial characteristics of the firm and industry.

Our present concern is with the maturity structure of the firm's liabilities, and ideally we would want to examine all aspects of this structure, including the distribution of maturities from short term to long term. But, in order to narrow the focus of the paper, we will explore only one parameter of liability structure: the average maturity of the firm's debt.

This paper develops a hypothesis regarding the factors which influence the average maturity of corporate debt, and the hypothesis is tested with a cross sectional sample of large industrial firms. The sample consists of 159 companies from the Fortune 500 list of the largest industrial firms as of 1971. A linear regression model is developed with the firm's average debt maturity expressed as a function of the firm's asset maturity, size, variability of income, growth, and the proportion of debt in the firm's capital structure.

II. Factors Which Influence Average Debt Maturity

It is widely accepted that firms will follow a hedging policy whereby they match the maturity of their debt to the useful lives of their assets. Hicks [10, p. 146] postulated that producers with long production processes would hedge with long term loans, and Culbertson [4, p. 494] observed that "the general rule in business borrowing is to relate the maturity of debt to the period of time that the funds are needed for a particular purpose, or the type of physical assets to be purchased with the funds." Grove [8], [9] develops a model of the firm in terms of the maturity structure of its assets and liabilities and shows that risk averse managers will hedge asset and liability maturities when they expect stable interest rates. He also shows that the firms will depart from the hedged position to take advantage of expected changes in interest rates.

Consistent with this previous work, it is the hypothesis of the present paper that firms generally follow a hedging strategy by matching their debt maturity to asset maturity. This is not to say that firms with longer term assets will necessarily issue bonds with longer term to maturity. Rather, the total portfolio of liabilities will be structured so that the average maturity of the portfolio of liabilities is greater for firms with longer lived assets. That is, a firm with longer term assets may not necessarily issue longer term debt, but its long term debt will constitute a greater proportion of its debt financing so that the weighted average maturity of the firm's debt is greater than for firms with assets with shorter lives.

In order to test whether or not firms follow such a hedging strategy we compute the firm's weighted average Debt Maturity (DM) as

$$DM = \left[(CL/TD)\ m_{CL}\right] + \sum_{i=i}^{N} (LD_i/TD)\ m_i$$

where

CL = current liabilities outstanding on the date of the study, which in this case was year end, 1971;

LD_i = the total amount outstanding of the i^{th} issue of long term debt;

m_i = years to maturity of the i^{th} debt issue;

TD = total debt outstanding as of the study date, equal to

$CL + \sum_i LD_i$;

N = number of issues of long term debt outstanding.

It is hypothesized that the differences between companies in average debt maturity can be explained by the firm's operating and financial characteristics, and, of course, the average maturity of the firm's assets.

The primary independent variable used to explain the variation in average debt maturity across firms is the average asset maturity. In order to test this hypothesis we would ideally want data on the useful lives of the firm's assets in order to develop summary statistics for average asset maturity and the distribution of asset maturities. Such data is not generally available, but we can obtain a rough estimate of the average maturity of long term assets from the ratio:[2]

Net Long Term Assets/Annual Depreciation Expense.

This estimate of long term asset life is then used to calculate a weighted average Asset Maturity (AM) where

$$AM = \left[\left(\frac{\text{Current Assets}}{\text{Total Net Assets}}\right)\cdot m_{CA}\right] + \left[\left(\frac{\text{Net Long Term Assets}}{\text{Total Net Assets}}\right)\cdot\left(\frac{\text{Net Long Term Assets}}{\text{Annual Depreciation Expense}}\right)\right],$$

where current assets have an average maturity of m_{CA}. The difficulties of using available data to compute Asset Maturity will be discussed subsequently.

While it is expected that asset maturity is an important determinant of the firm's structure of liability maturities, other factors would be expected to influence the firm's debt maturity structure. It would be expected that operating characteristics peculiar to the firm or industry would influence the maturity structure of the firm's liabilities, and we will obtain a more accurate estimate of the relation between debt maturity and asset maturity if we take these other variables into account.

The variables we must consider are those which would account for a firm systematically departing from the "normal" relationship between debt and asset maturity. It is hypothesized that the more important variables which must be considered are

(a) the financial leverage of the firm,

(b) the variability of the firm's income,

(c) the rate of growth of assets (which influences the pattern of financing requirements), and

(d) the size of the firm.

It could be expected that there would be some trade-off between debt maturity and the firm's financial leverage. Boot and Frankfurter [2] found that utility firms with higher debt-equity ratios tended to use long term debt as a higher proportion of total debt. Johnson [11] noted that more risky firms were more likely to face a "crisis at maturity" if they issue short term debt, and his data shows that riskier firms (as measured by the bond ratings) often encounter higher interest costs for short term borrowing than for longer term borrowing. Thus, there is an incentive for more risky firms to issue longer term debt. Since an element of the risk associated with the firm is the risk due to financial leverage, we would expect that firms with higher debt ratios would tend to attempt to lengthen the maturity of their debt. Discussions with managers support this view that if a firm is already highly leveraged, management will attempt to extend the maturity of debt in order to decrease the burden imposed by the necessity to refund or repay maturing debt. For the present study, it is hypothesized that the average debt maturity will be greater for firms that are more highly leveraged.

Firms with cyclical revenues may be hesitant to engage in very long term borrowing since they will be uncertain that there will be sufficient cash flows in future periods to service the debt. In addition, lenders may prefer not to engage in long term lending to very cyclical firms and will demand higher interest returns to make such loans as compared to less cyclical firms. Thus, the firm in a cyclical industry will use relatively more short term debt so that their debt service costs will vary with their business cycle.[3] The present hypothesis is that the greater the variability of the firm's revenues, the shorter the average debt maturity.

A rapidly growing firm typically finances its growth with short term borrowing, particularly interim financing which is to be refunded at a later date with longer term " permanent" financing.[4] Thus, it is hypothesized that the firm's average debt maturity will be inversely related to the firms' rate of growth in total assets.[5]

Finally, it is hypothesized that there would be a positive relation between size of firm and the average maturity of the firm's debt. It would be expected that larger firms would find it easier to issue long term debt, particularly publicly issued long term bonds. That is, ceteris paribus, firms want to issue debt with as long maturity as possible, but smaller firms may have difficulty marketing longer term debt. Due to high flotation costs it is inefficient to publicly issue bonds in small amounts, and the small firm could not (or would not) issue bonds in large amounts. Thus, the smaller firm may deal primarily with banks which provide short to intermediate term credit, or the smaller firm may engage in private placements.

The private placements would tend to be intermediate term except for very large firms.[6] Thus, the average of the maturities of the smaller firm's debt may be less than the average for the larger firm.

In order to test these hypotheses the following linear regression model was formulated:

$$DM = a + b_1 AM + b_2\left(\frac{TD}{TA}\right) + b_3\sigma + b_4 g + b_5 \log(TA) \;, \tag{1}$$

where

DM = weighted average debt maturity,

AM = weighted average maturity of assets,

TD/TA = the total debt to total asset ratio,

σ = variability of income (or profitability),

g = average annual growth rate of total assets,

log(TA) = measures the size of the firm in terms of total assets, and

where it is hypothesized that

$$b_1 > 0,\ b_2 > 0,\ b_3 < 0,\ b_4 < 0,\ b_5 > 0.$$

III. <u>The Sample Data</u>

In order to test (1), data was gathered on a cross sectional sample of 159 companies from the Fortune 500 as of the end of fiscal 1971. Data for average debt maturity was obtained from Moody's Industrial Manual, 1972, and the rest of the data was from the COMPUSTAT computer tapes.

There are many problems in using this data, and the methods used may have affected the validity of the results. The major problems occur in calculating weighted average debt maturity, and the average asset maturity.

Probably the biggest problem relating to the debt maturity is the fact that the data available is the debt of the parent company, but data on the debt maturity of the subsidiaries is often unavailable. That is, the terms (maturity, etc.) of the debt issues of the parent company are available in Moody's, but only the total amount of the subsidiary debt is disclosed, with little detail regarding the maturity of subsidiary debt. Perhaps this would not be a problem if we could consider only the assets and liabilities of the parent company, but the financial statements are normally consolidated so that the assets include subsidiary assets, and this affects the calculation of average asset maturity. The approach used in this study was to calculate the weighted average maturity of the firm's long term debt for which data was available (for most companies this was the major part of their long term debt), and use this weighted average maturity of this "disclosed" long term debt (denoted by m_{LTD}) to calculate an overall average maturity according to the expression

$$DM = \left[(CL/TD) \cdot m_{CL}\right] + \left[(LTD/TD) \cdot m_{LTD}\right].$$

Note that total debt (TD) and long term debt (LTD) both may include the debt of subsidiaries for which no explicit maturity calculation is possible, and m_{LTD} is calculated only for debt for which data is available. Thus, it is implicitly assumed that the subsidiary debt has average maturity equal to that for the rest of the firm.

Some rather rough, and perhaps unsatisfactory approximations were necessary in calculating average debt maturity. First, maturity data on "Revolving Credit" and "Term Loans" was often undisclosed. Assuming that revolving credit agreements typically would run for a maximum of about 5 years, and that the average maturity would be about half of this, the revolving credit was arbitrarily given a maturity of 2.5 years, unless otherwise disclosed. Assuming that term loans normally run from about 3 to about 7 years, the average of 5 years was arbitrarily selected for term loans, unless otherwise disclosed. Second, data on "Other Long Term Debt" often did not include details on maturity. This was given a maturity of 3 years unless otherwise disclosed.

The maturity of current liabilities was calculated as the ratio

$$m_{CL} = \text{Current Liabilities/Cost of Goods Sold},$$

which is the reciprocal of the annual rate of turn over of current liabilities.[7]

The calculation of average asset maturity also raised some difficult problems. First, the ratio (Net Long Term Assets/Annual Depreciation Expense) is an acceptable measure of expected remaining long term asset life if the company uses straight line depreciation. To the extent that accelerated depreciation is used the average asset life may be understated. The exception to this is that if the company is not growing rapidly, then even with accelerated depreciation, the total depreciation expense will approximate the straight line amount. This problem may not be particularly serious, since most companies use straight line depreciation for public reporting, in contrast to the accelerated depreciation used for tax reporting.

Second, ordinarily the figure given for depreciation expense includes depletion on mineral income, and depletion is not necessarily related to the life of the mineral producing property. Thus, since the disclosed expense is depreciation and depletion, use of this figure in the calculation of average asset maturity understates the average asset maturity. There is no solution to this problem using available data. In order to determine if this made much difference in the regression results, the regression was run with and without oil companies; the results were basically the same in both cases.

A third problem involved in calculating asset life is the treatment of intangibles, patent rights, and good will which are included in most balance sheets as long term assets, and which are normally amortized with the amortization expense being included in depreciation and depletion. We would like to focus on tangible assets in calculating asset maturity and the available data distinguishes between tangible and intangible assets, but, since the data combines amortization of intangibles with depreciation expense, we overstate the depreciation attributable to the tangible assets. Nevertheless, the measure of asset maturity which was used included only tangible assets in calculating the proportion (Net Long-Term Assets/Total Net Assets), and the depreciation in the ratio (Net Long-Term Assets/Annual Depreciation Expense) included any amortization of intangibles.[8]

The maturity of current assets was calculated in a manner similar to that for current liabilities, using the reciprocal of the turnover rate. That is,

$$m_{CA} = \text{Current Assets/Cost of Goods Sold.}$$

The measure of leverage used in the study was the ratio

$$TD/TA = \text{(Short Term Debt + Long Term Debt)/Total Net Tangible Assets.}$$

This leverage ratio excludes trade payables from Short Term Debt, and intangibles are excluded from the denominator.

This measure was used simply because it provided a better fit in the regression than alternatives such as

$$\text{(Current Liabilities + Long Term Debt)/Total Assets.}$$

This suggests simply that firms are concerned primarily with interest bearing debt in considering leverage, where the numerator in our TD/TA ratio is the firm's interest bearing debt.

The variability of revenues, denoted by σ, was measured by the variability of the ratio

Annual Operating Income/Total Assets

around its time trend over the period 1953-1971, where we divide by total assets to adjust for the size of the firm. That is, the regression

$$\log (OI/TA) = a + bt + \varepsilon$$

was estimated with time series data for each company in the sample, and the standard error of the regression, σ_ε, was used as the measure of variability of income.[9]

The measure of growth, g, used in the model was the average (geometric mean) annual growth rate of total assets over the period 1953-1971.

IV. Results

Using a final sample[10] of 159 industrial companies, a cross sectional regression was estimated where debt maturity, DM, was regressed on asset maturity, AM. The estimated equation is

$$DM = 3.23 + .74\ AM$$
$$t = (5.19)\ (6.67)$$
$$R^2 = .21.$$

Debt maturity and asset maturity are significantly positively related, and our hedging hypothesis is supported.

Then, the multivariate regression (1) was estimated with the same sample of 159 firms, with the result

$$DM = -1.16 + .56AM + 11.93(TD/TA) - 5.96\sigma - 7.1g + 1.18(\log TA)$$
$$t = (.72)\ (5.53)\ (7.42)\ (3.00)\ (2.6)\ (2.23)$$
$$R^2 = .43 \text{ (adjusted for degrees of freedom)}$$
$$F_{5,153} = 25.03.$$

The variables are all significant at (at least) the 5% level, and the signs of the coefficients are all as hypothesized. There was no serious colinearity between independent variables, although σ has a correlation coefficient with both TD/TA and g of about .35, and the correlation between g and TD/TA was about .43.

Due to possible measurement error and the fact there is a certain amount of randomness in the relationship between debt maturity and asset maturity and other variables with a cross sectional sample of individual companies, the estimates we obtain are biased toward zero. In order to reduce the unsystematic measurement errors and to minimize the bias in our estimates, our regression was estimated using industry averages. That is, simple averages were computed for the various variables, where the average for each industry is the average of the variables for each company in the industry which was in our original sample of 159 industrial companies. The industries were defined according to broad SIC classifications, although some broad SIC categories were partitioned into finer divisions where it was appropriate.[11] The industry averages for debt and asset maturities are shown in Table 1 for the 24 industries represented by the sample of 159 companies.

In order to test the hedging hypothesis, debt maturity was regressed against asset maturity with the resulting estimates:

$$DM = 1.93 + .95\ AM$$

$$t = (1.94)(4.92)$$

$$R^2 = .51,$$

with 24 observations.

The results are improved over those obtained from company data, and provide stronger support for the hypothesis that firms use a hedging policy of matching debt and asset maturity.

Table 1

Industry Averages of Debt Maturity and Asset Maturity

Industry	Number of Companies	Average Debt Maturity	Average Asset Maturity
Food Products	15	5.8	5.7
Tobacco	3	8.6	4.0
Textile Mill Products	3	8.3	4.8
Textile Apparel	8	4.2	2.4
Forest Products	3	9.0	9.3
Paper Products	3	11.1	7.2
Publishing	1	6.4	5.5
Chemical & Allied Products	21	8.6	5.6
Petroleum	17	9.6	7.4
Rubber	5	8.6	4.0
Leather	1	2.5	2.2
Stone, Clay & Glass	7	8.4	6.8
Primary Metals	9	10.7	8.5
Fabricated Metals	4	6.5	5.3
Machinery (Non Elect.)	6	4.7	2.9
Business Machines & Computers	6	7.9	2.3
Electrical Machinery (Major)	3	6.2	3.3
Electrical Machinery (Other)	13	3.9	2.4
Auto, Trucks, & Parts	12	4.0	3.6
Aerospace	6	2.6	1.9
Instruments	2	1.9	3.2
Miscell. Mfg.	3	5.2	3.1
Wholesale Services	1	1.4	4.2
Conglomerates	7	8.2	5.6
Total:	159		
Average:		6.45	4.27
Standard Deviation:		2.75	2.06

The industry average counterpart to (1) was estimated as

$$DM = -2.02 + .77AM + 7.50(TD/TA) - 10.7\sigma - 3.88g + 1.7(\log(TA)$$

$$t = \quad (.88)(5.87) \quad (3.32) \qquad (3.28) \quad (1.71) \quad (2.0)$$

$$R^2 = .80 \text{ (adjusted)}$$

$$F_{5,18} = 20.46.$$

The estimates are significant at (at least) the 5% level, and are of the same sign as obtained with our company sample. This also provides quite strong support for our hypotheses. Note that with the industry sample this model explains a very high proportion of the variation in Debt Maturity across industries.

It should be noted that growth (g) adds very little to the explanatory power of the model with the industry sample, in contrast to the company sample. Estimating the same equation but without g results in a slightly higher F statistic and adjusted R^2.

For this sample of 159 industrial companies, and given our definitions of average Debt Maturity and average Asset Maturity, the sample average and standard deviations were

$$DM = 6.90 \text{ years, and } \sigma_{DM} = 4.11 \text{ years,}$$

$$AM = 4.95 \text{ years, and } \sigma_{AM} = 2.60 \text{ years.}$$

Seventy-five per cent of the companies in the sample had asset maturity shorter than debt maturity. Thus, while the regression results support the hedging hypothesis by showing a positive relation between asset maturity and debt maturity, it appears that firms do not attempt to engage in a perfect hedge with average asset maturity equal to average debt maturity.[12]

In order to investigate which variables appear to be associated with the spread between debt maturity and asset maturity, the difference DM - AM was regressed against the same variables (except AM) included in (1), both individually and in multiple regression. In addition, other variables such as the ratio (Net Fixed Assets/Sales) were included; this latter variable was used as a measure of capital intensity to test the hypothesis that more capital intensive firms would be more inclined to hedge. The only variable (by itself) that appears to be highly correlated with (DM - AM) is the Total Debt - Total Capital ratio. The results seem to indicate that firms with a higher proportion of debt financing tend to depart from the hedged position by increasing the spread (DM - AM). In multiple regression, the evidence indicates that more rapidly growing firms and firms that have more variable income have a smaller spread between debt maturity and asset maturity. The multiple regression results which provided the best fit were

$$(DM - AM) = .20 - 5.61\sigma - 6.2g + 11.14 \ \ TD/TA$$

$$t = (.35) \ (2.69) \ \ (2.15) \ \ (6.62)$$

$$R^2 = .21 \text{ (adjusted)}$$

$$F_{3,155} = 15.17.$$

V. Comparison With Boot and Frankfurter

Boot and Frankfurter [2] hypothesized that firms finance their growth with relatively more long term debt as compared with short term debt, and that firms with a greater proportion of debt in their capital structure tend to carry more long term debt relative to short term debt. That is, in terms of our model, debt maturity should be positively related to both growth and the firm's debt to total capital ratio. Boot and Frankfurter tested their hypothesis with a random coefficients regression technique with a sample of 54 utility companies over a 17 year sample period, where they regressed the ratio (Short Term Debt/Long Term Debt) against a measure of the firm's growth rate and the debt-equity ratio, and a measure of the slope of the yield curve. They found the signs of the coefficients consistent with their hypothesis.

In order to compare our results with those of Boot-Frankfurter, the regression model

$$CL/LTD = a + b_1 g + b_2 (TD/TA)$$

was estimated with the cross sectional sample of 159 industrial companies. The results were

$$CL/LTD = 4.65 + 3.55g - 9.58\ (TD/TA)$$

$$t = (6.9)\quad (1.06)\quad (4.82)$$

$$R^2 = .125\ \text{(adjusted)}$$

$$F_{2,156} = 12.28$$

The TD/TA variable is significant and the sign is negative, consistent with the Boot and Frankfurter model. That is, firms with higher financial leverage tend to use relatively more long term debt. Obviously this is consistent with our previous regression model (1).

In this model the growth variable is not particularly significant, and it has a sign opposite to that hypothesized by Boot and Frankfurter. The previous model had growth significantly negatively related to debt maturity. Thus, our results regarding the relation between debt maturity and the firm's growth are directly opposite to those of Boot and Frankfurter. This is probably due to the differences in financing practices between utilities and industrial firms. That is, given the utilities' regulated environment, they are more able to finance growth with long term debt. On the other hand, the industrial firms used in the present study may tend to use relatively more short term interim financing during growth periods, as previously discussed.

VI. Conclusion

The results of this empirical investigation provide support to the hypothesis that industrial firms structure the average maturity of their liabilities according to the average maturity of their assets. That is, they appear to hedge asset and liability maturity.

Other variables also influence the average maturity of a firm's liabilities. The evidence is consistent with the hypothesis that

(a) firms with proportionally more debt in their capital structure tend to use debt of longer average maturity;

(b) firms with more variable income tend to use shorter average maturity debt;

(c) industrial firms with more rapid growth appear to finance this growth with shorter average maturity debt; and

(d) larger firms use longer average maturity debt.

The firms in the sample typically have average debt maturity greater than average asset maturity. Thus, it appears that firms do not attempt to obtain a "perfect hedge" (defined in terms of average maturity). The spread betwen debt maturity and asset maturity was an increasing function of the amount of financial leverage, and a decreasing function of both income variability and growth in assets.

FOOTNOTES

*Assistant Professor of Finance, The Wharton School of the University of Pennsylvania.

Helpful comments were provided by Professors John Bildersee, Hans Stoll, and Joe Vinso. Data was gathered by Messrs. G. Grinchis, M. Odlum, and J. Cooper. The author wishes to thank the Rodney L. White Center for Financial Research for financial support.

1. See Kaufman [13] p.23.

2. For example, assume an asset was purchased 4 years ago for $1000, to be depreciated on a straight line basis over 10 years. Annual depreciation expense is $100 and net book value after 4 years is $600. The remaining life is

$$\frac{\text{Net Book Value}}{\text{Annual Depreciation Expense}} = \frac{600}{100} = 6 \text{ years.}$$

3. Donaldson [5] has noted that firms with cyclical revenues may restrict their investment to a level which can be financed primarily from internally generated funds. This may imply that the maturity of their debt would not necessarily be related to their cyclical nature. Johnson [11] notes that firms which might face a "crisis at maturity" would attempt to delay this crisis by extending their debt maturity.

4. Morris Mendelson pointed out this relation between growth and debt maturity.

5. Donaldson [5] explored the relation between the firm's growth rate and its financing requirements, but he did not relate growth to debt maturity. Boot and Frankfurter [2] found that there was a positive relation between the firm's growth and the proportion of debt which was long term. The present study will be compared with the Boot and Frankfurter results in Section IV.

6. See Soldofsky [20].

7. It was initially assumed that the average maturity of current assets and liabilities was ½ year, and this was used in estimating the regression coefficients. John Bildersee suggested using the reciprocal of the turnover rate, and this resulted in a slightly better fit for the regression.

8. The same regression model was tested where intangible assets were included in Net Long Term Assets, and the results were not quite as good.

9. Various measures of variability of income were used, and all measures of income variability were significantly negatively related to debt maturity. This particular measure is the one which provided the best fit in the regression. For example, the standard error of the regression $\log(OI) = a + bt + \epsilon$ (that is σ_ϵ) was used and provides a good fit when DM is regressed against it singly, but in the multivariate regression does not perform well at all.

10. The sample included 84 companies included in the top 100 of the *Fortune* 500 in 1971, 40 companies included in the ranks of 200-250, and 35 companies included in ranks of 350-400. The original sample included 200 companies, but some were eliminated due to missing data, or due to the fact that they had negligible debt, as in the case of DuPont.

11. Broad SIC industry groups were subdivided when it appeared appropriate. For example, Transportation Equipment includes motor vehicles, trucks, auto parts, and aerospace, this was divided into two industry groups, (1) autos, trucks and parts, and (2) aerospace. The division was based on an obvious difference in DM and AM between the groups.

12. Duration of assets and liabilities would probably be a superior measure of maturity, and perhaps if duration had been used, we would not observe the wide spread between DM and AM. This would be due to the fact that duration is shorter than final maturity of debt, and our measure of asset maturity probably understates the duration of assets. See Grove [8], [9].

REFERENCES

1. W. H. Locke Anderson, Corporate Finance and Fixed Investment: An Econometric Study, (Boston: Harvard University Press, 1964).

2. J. C. G. Boot, and G. M. Frankfurter, "The Dynamics of Corporate Debt Management, Decision Rules, and Some Empirical Evidence," Journal of Financial and Quantitative Analysis, Vol. 7, No. 4 (September 1972), 1957-1965.

3. Barry Bosworth, "Patterns of Corporate External Financing," Brookings Papers on Economic Activity, 2: 1971.

4. J. M. Culbertson, "The Term Structure of Interest Rates," Quarterly Journal of Economics, Vol. LXXI, No. 4 (November 1957), 485-517.

5. Gordon Donaldson, Corporate Debt Capacity (Homewood, Ill: Richard D. Irwin, Inc., 1961).

6. ____________, Strategy for Financial Mobility (Boston: Harvard University Press, 1969).

7. E. Elton and M. Gruber, "Dynamic Programming Applications in Finance," Journal of Finance, XXVI, No. 2 (May 1971), 473-506.

8. M. A. Grove, "A Model of the Maturity Profile of the Balance Sheet," Metroeconomica, Vol. 18, No. 1 (April 1966), 40-55.

9. __________, "On Duration and the Optimal Maturity Structure of the Balance Sheet," Bell Journal of Economics and Management Science, Vol. 5, No. 2 (Autumn 1974), 696-709.

10. J. R. Hicks, Value and Capital, 2nd. Ed. (London: Oxford at the Clarendon Press, 1946).

11. Ramon E. Johnson, "Term Structures of Corporate Bond Yields as a Function of Risk of Default," Journal of Finance, Vol. XXII, No. 2 (May 1967), 313-345.

12. B. A. Kalymon, "Bond Refunding with Stochastic Interest Rates," Management Science, Vol. 18, No. 3 (November 1971), 171-183.

13. Henry Kaufman, "The Anatomy of the Secondary Market in Corporate Bonds," (New York: Solomon Brothers, 1973).

14. R. Kolodny, "The Refunding Decision in Near Perfect Markets," Journal of Finance XXIX, No. 5 (December 1974), 1467-1478.

15. A. Kraus, "The Bond Refunding Decision in an Efficient Market," Journal of Financial and Quantitative Analysis, Vol. VIII, No. 5 (December 1973), 793-806.

16. R. H. Litzenberger, and D.P. Rutenberg, "Size and Timing of Corporate Bond Flotations," Journal of Financial and Quantitative Analysis, VIII, (January,1972), 1343 - 59

17. John R. Meyer and Edwin Kuh, The Investment Decision: An Empirical Study (Cambridge: Harvard University Press, 1957).

18. James R. Morris, "A Model for Corporate Debt Maturity Decisions," Working Paper 13-74, Rodney L. White Center for Financial Research, University of Pennsylvania, 1974.

19. G. E. Pinches, and K. A. Mingo, "A Multi variate Analysis of Industrial Bond Ratings," Journal of Finance, XXVIII, No. 1 (March 1973), 1-18.

20. R. M. Soldofsky, "The Size and Maturity of Direct - Placement Loans," Journal of Finance, XIV, No. 1 (March 1960), 32 - 44.

21. Joseph E. Stiglitz, "Some Aspects of the Pure Theory of Corporate Finance: Bankruptcies and Take-Overs," Bell Journal of Economics and Management Science, Vol. 3, No. 2 (Autumn 1972), 458-482.

22. _______________, "On the Irrelevance of Corporate Financial Policy," American Economic Review, LXIV, No. 6 (December 1974), 851-866.

23. H.M. Weingartner, "Optimal Timing of Bond Refunding," Management Science, Vol. 13, No. 7 (March 1967), 511 - 524.

24. William L. White, "Debt Management and the Form of Business Financing," Journal of Finance, Vol. XXIX, No. 2 (May 1974), 565-577.