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THE CHANGING CAPITAL STRUCTURE OF THE U.S. NONFERROUS METAL INDUSTRY

by

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ABSTRACT

Debt use as a percentage of total capitalization for the U.S. nonferrous metal industry increased substantially from the 1950s to the 1980s. The major increase in debt ratio occurred between 1961 and 1971. In one decade, the ratio of debt to total capitalization increased from 17 percent to 35 percent. Increases in capital requirements, inflation, personal and corporate taxes, federal borrowing, and business risk were important determinants of capital structure trends over the past 30 years or so. Increases in capital requirements indirectly influenced capital structure by eroding the internal funds available for future investments. As a result, firms had to call on external funds.

Changes in personal and corporate tax rates show some evidence of stimulating increased use of debt. A decline in personal tax rates in the 1960s had a positive effect on an increase in debt ratios. Another determinant of capital structure trends, inflation, encouraged greater use of the debt by raising the value of tax payments. Government borrowing inversely affected the corporate debt ratio. During the period of World War II in which government debt

was high relative to total debt in the economy, corporate debt was low. Risks and debt ratios are inversely related, and low business and financial risk in the 1960s encouraged much of the increase in debt ratios in this period.

Taken together, the factors listed above present an explanation for the changes in capital structure in the nonferrous metal industry over the past three decades.

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To Elen Ewart, a word of appereciation for her help with my English.

Chapter 1

INTRODUCTION

The capital structure of the U.S. nonferrous metal industry has changed over the last thirty years or so. There are perhaps three different eras that describe these changes. Prior to the 1960s, investments generally were financed internally or through stock offerings. Long-term debt was low. During the 1960s and early 1970s debt financing became more important. Project financing became an important way for mining companies to maintain their borrowing capacities. Since the middle 1970s, firms have maintained high debt as a percentage of total capitalization, but debt ratios have not increased substantially.

This thesis traces the dramatic changes in the capital structure of the U.S. nonferrous metal companies over the last three decades and assesses the causes of these changes.

The term nonferrous minerals refers mainly to aluminum, copper, gold, lead, molybdenum, silver, and zinc. The nonferrous metal industry mines, smelts, and refines the nonferrous minerals listed above. Seven large companies involved in the study are major producers of these

nonferrous minerals: Alcoa, Asarco, Amax, Phelps Dodge, Newmont, Kaiser Aluminum, and Reynolds. These companies are chosen because they are major producers of nonferrous minerals and metals, and have stayed in the business for three decades. Alcoa mines, refines, smelts and processes aluminum into aluminum products. Amax is engaged in exploration, mining, and other treatment of minerals and metals, as well as the production of coal, petroleum, and natural gas. Its principal products are molybdenum, coal, iron ore, copper, lead, zinc, petroleum and natural gas, potash, phosphate, nickel, tungsten, silver, and magnesium. Asarco, one of the world's leading producer of nonferrous metals, produces copper, silver, lead, and zinc. Kaiser is an important of producer of aluminum in the United States; it mines and processes bauxite, and fabricates aluminum and aluminum alloy into various products. Newmont produces gold, energy, and copper. Phelps Dodge mines about 20 percent of the copper produced in the U.S., and is a leading producer of copper rod, electric wire, and cable. Reynolds is a major world wide vertically integrated producer of primary and reclaimed aluminum and fabricated aluminum.

The capital structure to be analyzed consists of debt and equity. Debt is defined as a long-term liability (more

than one year). Long-term debt refers to notes payable, sinking fund debentures, bank loans, eurodollar bonds, convertible subordinated debentures, tax-exempt bonds (air pollution control bonds, etc.), industrial revenue bonds, and other kinds of long-term liabilities. Stockholders equity is the sum of common stocks, preferred stock, capital in excess of par value, and retained earnings. Total capitalization refers to the sum of long-term debt and stockholders equity.

Chapter 2 presents a brief overview of trends in capital structure. The measurement, description, and comparison of trends with other industries will be explained. Chapter 3 deals with the theory of optimal capital structure and develops possible causes for changes in capital structure described in Chapter 2 in light of theory.

Chapters 4 through 8 examine the possible causes of these capital structure changes. Chapter 4 focuses on the indirect effects of the capital-requirements increase on capital structure patterns. The effects of changes in inflation and interest rates are discussed in chapter 5. Chapter 6 examines the relationship between tax rates and corporate debt ratio. Another factor in determining corporate capital structure, federal government borrowing,

is presented in chapter 7. Risk as a determinant of debt is discussed in chapter 8. The last chapter, chapter 9, summarizes the first eight chapters and offers some final thoughts about changes in capital structure.

Chapter 2

TRENDS IN CAPITAL STRUCTURE

2.1. Methodological Issues and Overview of Corporate Financing Trends, 1950s-1980s

A variety of problems arise in measuring secular trends in corporate financing. The comparison of accounting numbers between periods is influenced by changes in accounting policy and fluctuations in economic conditions, particularly in the rate of inflation. Market value numbers may be a solution to this problem, although estimation error may exist. Furthermore, it is not clear to what extent market values reflect either the actual financing decision of the corporation or exogenous factors.

As discussed by Taggart (1985), four different types of data have been used in previous studies of corporate financing: book value, market value, replacement cost, and flow of funds. Each measure has its problems and advantages.

1. Book Value Balance Sheet Data. Book value refers the historical balance sheet numbers that are presented in financial reports. If the composition of the liability side of the corporate balance sheet is examined, trends in corporate financing can be observed. The use of a liberalized depreciation allowance since the 1960s

increased corporate cash flow but reduced measured profits and retained earnings. Thus, accelerated depreciation allowances tend to stimulate increased use of debt. The book-value debt ratios were overstated during inflationary times--the 1960s and 1970s--because standard accounting data do not reflect a decrease in the real value of data.

On the other hand, lease obligations, unfunded pension liabilities, and project financing are not reported in the balance sheet, so reported debt ratios may also be understated.

2. Market-Value Balance-Sheet Data. Holland and Myers (as cited in Friedman, 1986) suggest that the market value of a firm's debt and equity can be calculated by taking dividend and interest payments reported by the company and capitalizing them at current market yields. Inflation-induced valuation changes are reflected in the market-value ratio. Thus, market-value data provide a more accurate measure of debt ratio changes. The problems in these calculations are estimation errors, and separation of actual corporate financing decisions from changes in market valuation.

3. Replacement-Cost Data. Corporate leverage can be measured by dividing the market value of debt by the

replacement value of total assets (Taggart, 1985). Like market values, replacement values are subject to substantial estimation error. However, the overstatement in the book-value debt ratio during inflationary periods is reduced by using replacement cost data.

4. Flow of Funds Data. A fourth method for measuring corporate financing patterns is the use of flows of funds over periods of time, rather than stocks of funds at particular dates. This method does not account for inflation effects (Taggart, 1986).

Book-value data are used in this study, even though they are theoretically inferior to the other measures, because they exhibit trends over time similar to those of the other measures and because they are simpler to estimate.

As previously stated, the capital structure of the U.S. mining industry has changed over the last 30 years or so. The capital structure of the nonferrous metal industry follows a similar pattern. The 30-year period itself can be divided into three shorter periods. During the first period, the 1950s, mining companies generally had high profits and low debt. The second period, from the early-1960s to the early-1970s, was one of rising inflation and

dramatically higher debt. The third period, from the early-1970s to the 1980s, saw modest growth in sales and declining metal prices. Debt levels remained high. The trends in debt ratio of these periods for the U.S. nonferrous mining industry as a whole are shown in Figure 2.1.

2.2. Prior to the 1960s

Before 1960, domestic and overseas markets generally were growing, and companies were expanding capacities and earnings. Although there were downturns in the industry, it was not a permanent problem. Much of the expansion of the industry was financed internally or through stock offerings. Retained earnings composed the main portion of the funds for new investments, and the debt level was very low. Aluminum companies were the exception, however, as they had very high debt with respect to other nonferrous mining companies. Figure 2.1 presents long-term debt as a fraction of total capitalization for the U.S. nonferrous mining industry. As shown in graph, the use of debt ranged from 16 percent to 21 percent, averaging 19 percent, with no upward or downward trend.

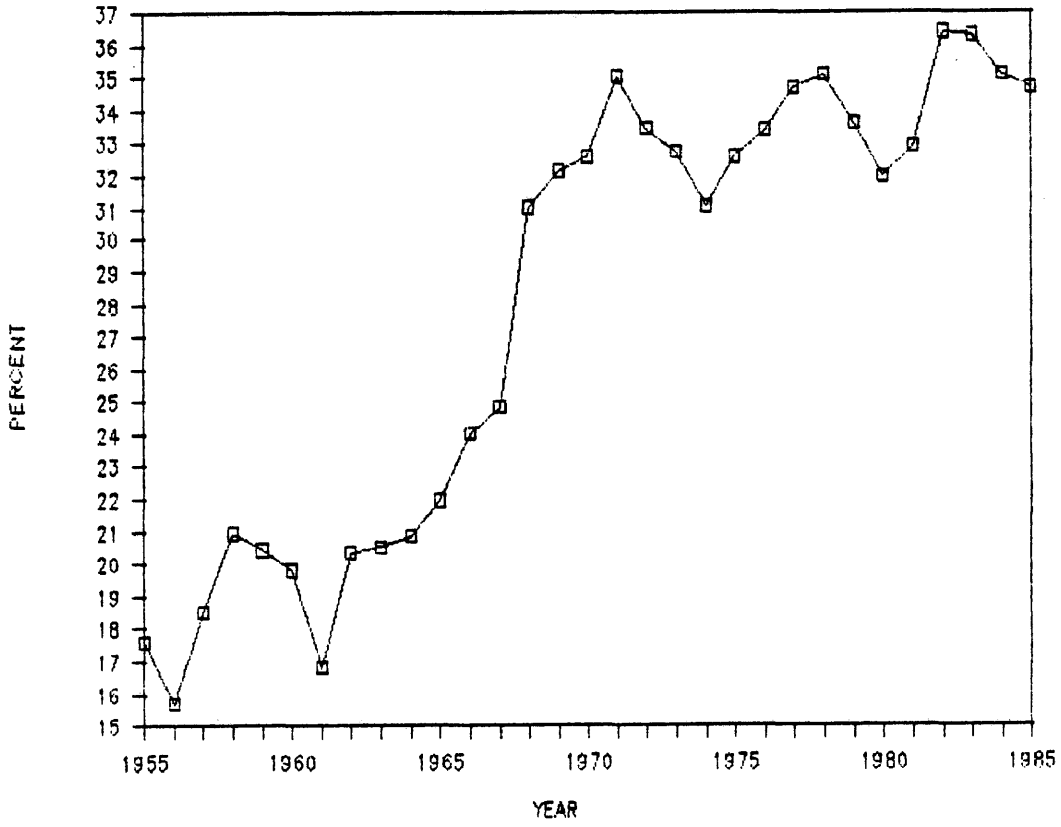

Figure 2.1

Long-term Debt as a Percentage of Total Capitalization for the Nonferrous Mining Industry, 1955-1985.

Note: Book-value balance-sheet data are used.

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining and Trade Corporations, 1955-1985.

2.3. Early 1960s to the Early 1970s

Until the mid-1960s, the nonferrous mining companies continued to grow and increase their profits. They financed investments primarily through retained earnings and equity offerings. Little debt can be seen in the balance sheets. After the mid-1960s, debt increased significantly, because the rate of capital expenditure accelerated. In addition to the expansion of business, and diversification into new areas, companies have faced new requirement such as environmental and safety controls and increase in operation costs due to inflation.

Another important source of funds, project financing, became the basis by which companies were able to maintain their borrowing capacities. Since debt used in project financing has off-balance sheet treatment, the debt ratio of the company is understated. Although "project financing" generally deals with all methods of financing projects, an exact definition (Navitt, 1983) is

> a financing of a particular economic unit in which a lender is satisfied to look initially to the cash flows and earnings of the economic unit as the source of funds from which a loan will be repaid and to the assets of the economic units as collateral for the loan.

When the aggregate data are analyzed for the 1960-1971 period, a rapid increase in the use of debt can be seen.

The year 1962 was the beginning of higher debt use with debt representing 20 percent of total capitalization. Debt then continued to increase up to 35 percent. Figure 2.1 shows these changes for nonferrous mining companies.

When the same period is analyzed for individual companies, the results in Table 2.1 are obtained. The nonaluminum companies had almost similar capital formation trends. Phelps Dodge, Asarco, Newmont, and Amax increased debt starting in 1966, 1964, 1968, and 1957 respectively, and continued to do so. Figure 2.2 represents the debt ratio pattern for Amax. Asarco, Newmont, and Phelps Dodge mining companies had similar trends: their debt ratios are shown in Appendix A.

The aluminum companies had much higher debt than the other companies. Debt ratios increased slowly. Kaiser Aluminum is the exception because of a declining debt ratio. This company had a higher debt ratio than other aluminum companies at the beginning of the period. The debt ratios of Reynolds, Alcoa, and Kaiser were 46 percent, 33 percent, and 58 percent, respectively, in 1960. The capital structure pattern of Reynolds, as representative of the aluminum industry, is shown in Figure 2.2 The figures for other companies are presented in Appendix A.

Table 2.1

Long-term Debt as a Percentage of Total Capitalization, 1960-1971

COMPANIES	1960	61	62	63	64	65	66	67	68	69	70	71
PHELPS D.	-	-	-	-	-	-	6	6	6	14	14	19
AMAX	6	6	4	20	19	23	25	27	29	27	31	39
ASARCO	-	-	-	-	11	10	9	3	5	4	3	5
REYNOLDS	48	46	46	46	43	46	47	51	51	50	53	56
NEWMONT	-	-	-	-	-	-	-	-	4	12	22	31
ALCOA	35	33	31	32	37	35	40	39	38	39	42	43
KAISER	56	58	57	56	59	53	54	48	51	46	46	50
NONFERROUS	20	17	20	21	21	22	24	25	31	32	33	35

Note: Ratios are derived from company annual reports
Dash " - " implies essentially no debt

Source: Company Annual Reports, 1955-1985

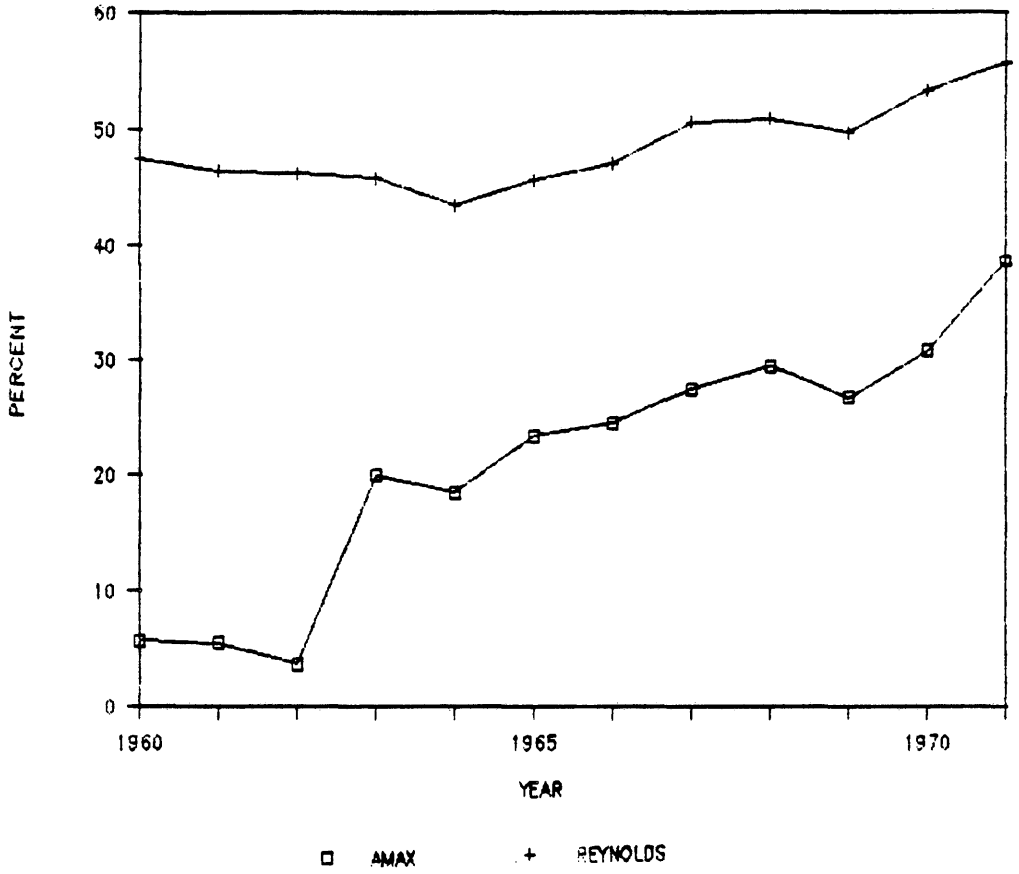

Figure 2.2

Long-term Debt as a Percentage of Total Capitalization, 1960-1971

Source: Company Annual Reports, 1960-1971

2.4. Early 1970s to the 1980s

The early 1970s to the 1980s was not a good time for most mining and metal companies. Inflation was high, environmental controls were restrictive, and energy was costly.

The increased use of debt stopped in 1971 and then almost remained fairly stable through 1985. Some fluctuation can be seen seen, but at the aggregate level, trends in capital structure remained stable. Figure 2.1 presents these changes for all of the nonferrous mining industry.

Companies searched for more debt to finance investments, and their long-term debt increased (although not as significantly as in the 1960s). Table 2.2 presents the debt ratio for the period for seven companies operating primarily in the nonferrous mining and metal industry.

Aluminum companies, as a group, exhibited similar trends. After 1980, the debt ratio increased until 1985. Debt ratios for Alcoa are shown in Figure 2.3. Debt ratios for Reynolds and Kaiser Aluminum companies are shown Appendix B. Data for the same period for nonaluminum companies, Asarco, Amax, and Newmont, are similar with debt ratios decreasing until 1980 then increasing thereafter. The debt ratio trend of Phelps Dodge stayed

Table 2.2

Long-term Debt as a Percentage of Total Capitalization, 1972-1985

COMPANIES	72	73	74	75	76	77	78	79	80	81	82	83	84	85
PHELPS D.	20	26	27	37	39	39	43	39	38	35	41	38	42	34
AMAX	39	34	29	28	29	29	25	26	31	34	40	44	43	62
ASARCO	7	11	12	30	32	33	27	20	18	28	33	32	44	40
REYNOLDS	56	55	54	49	56	47	46	42	39	39	38	43	46	51
NEWMONT	34	29	26	30	33	27	26	18	10	7	9	8	8	11
ALCOA	40	39	38	45	41	39	35	39	26	31	36	34	33	33
KAISER	50	57	51	48	47	44	43	34	31	36	40	44	49	52
NONFERROUS	33	33	31	33	33	35	35	34	32	33	36	36	35	35

Source: Company Annual Reports, 1972-1985

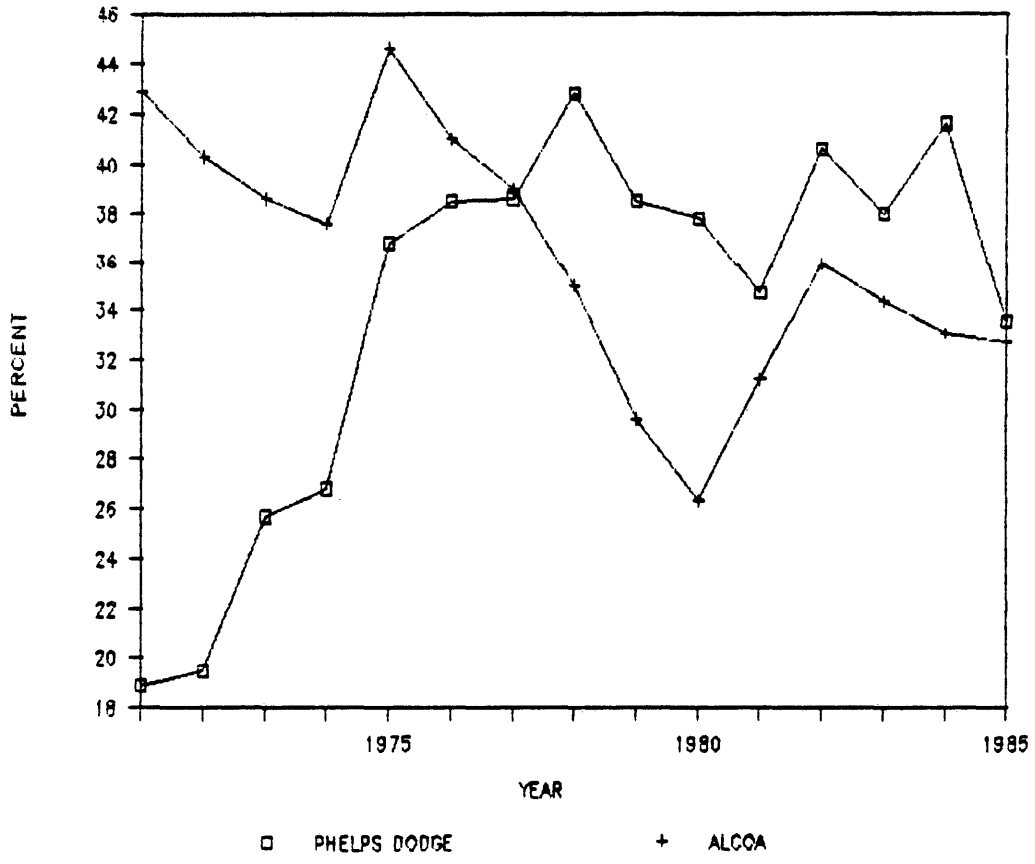

Figure 2.3

Long-term Debt as a Percentage of Total Capitalization, 1971-1985

Source: Company Annual Reports, 1971-1985

stable as presented in Figure 2.3. Ratios for other nonaluminum companies are presented in Appendix B.

2.5. Comparison with Other Industries

As shown in Figure 2.4, there are common patterns among the industries. The use of debt financing has increased considerably since the mid 1950s. For all U.S. corporations, the debt ratio was 25 percent at the beginning of 1955 and ended up at 32 percent in 1982. The manufacturing industry has had a lower debt ratio than other industries. In 1955, its debt ratio was 16 percent and increased to 27 percent at the end of the 1982. The nonferrous mining industry shows similar patterns, but relative changes from 1955 to 1982 were much greater. The debt to total capitalization ratio for the nonferrous group was 17 percent in 1955, and ended up at 36 percent by the end of 1982. This ratio is a little higher than the overall industry average. The ratio of debt in 1955 was close to that of the manufacturing industry, but in 1982, the same ratio was much higher than that of manufacturing companies.

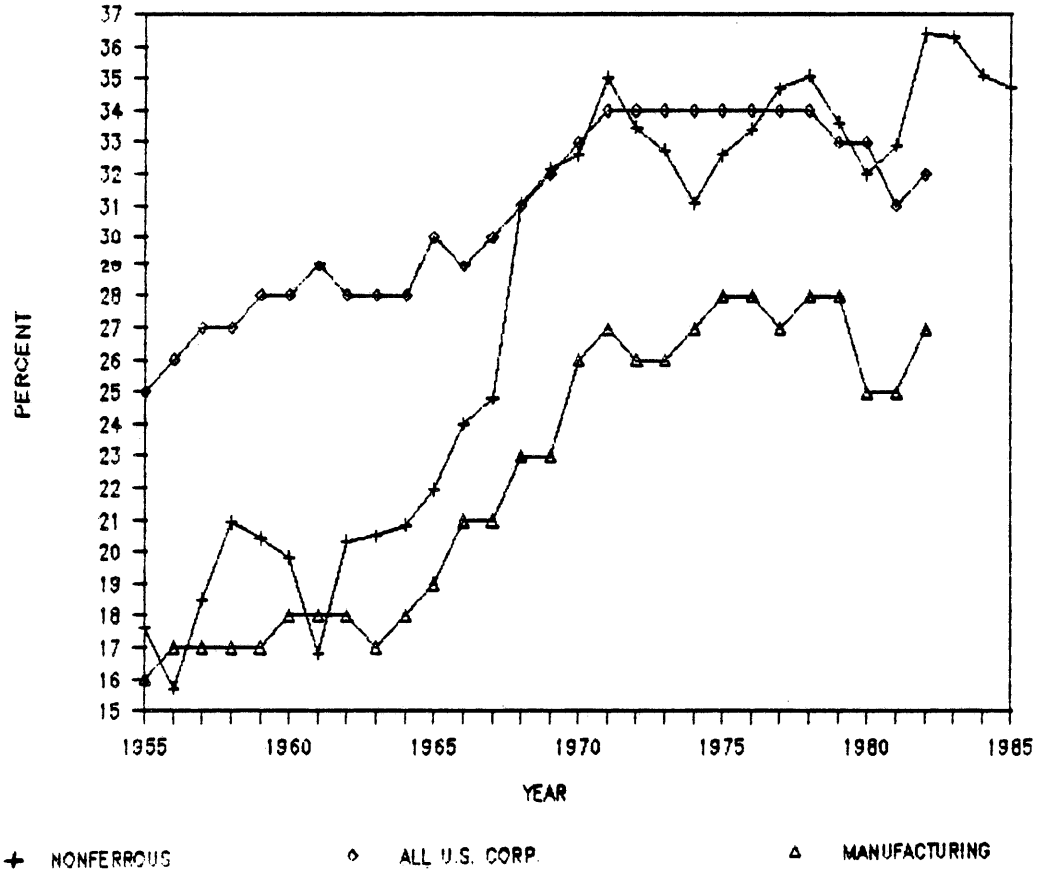

Figure 2.4

Comparison of Debt Ratios

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations.

Chapter 3

COST OF CAPITAL AND OPTIMUM CAPITAL STRUCTURE

No one knows if there is a certain formula for optimal capital structure, but there are some useful facts and insights that help us to recognize some of costs and benefits of debt and equity financing. One also can determine with reasonable confidence which kind of firm should borrow relatively more, and which kind less. Almost all airlines, real estate development companies, utilities, steel, aluminum, chemicals, and mining companies rely heavily on debt. On the other hand, it is easy to find advertising and drug companies that are financed largely with equity. Growth companies like Digital Equipment, Hewlett-Packard, and Polaroid generally do not use much debt, although they are capital intensive and expanding fast.

There are many theories about the choice of capital structure, but only the traditional view and Modigliani and Miller's famous propositions will be summarized.

1. Traditional View. Traditionalists claim that a moderate amount of borrowing may increase the expected equity return, r_E, at a relatively slow rate due to expected low risk . Then, r_E increases more rapidly because additional

borrowing increases expected risk. The weighted average cost of capital, r_A, declines at moderate debt levels, then rises sharply as firms borrow more as shown in Figure 3.1. The optimal capital structure is the one that minimizes r_A, according to the traditional view. The solid lines in Figure 3.1 show the traditional view. The symbol r_D is the expected return on debt. Costs of debt are lower than equity because of the tax deductibility of debt. Costs of debt rise steadily with an increase in leverage, but rates of increase accelerates with higher debt levels, showing the increased likelihood of bankruptcy and its related costs.

The traditional idea holds that actual markets are imperfect, which may allow firms that borrow to provide a valuable service for investors.

2. Modigliani and Miller's Propositions. Modigliani and Miller made the following assumptions:

a. Capital markets are perfect.

b. All firms are in the same business risk class.

c. Firms are identical.

d. The debt of corporations and individuals is riskless.

e. All cash flows are perpetuities.

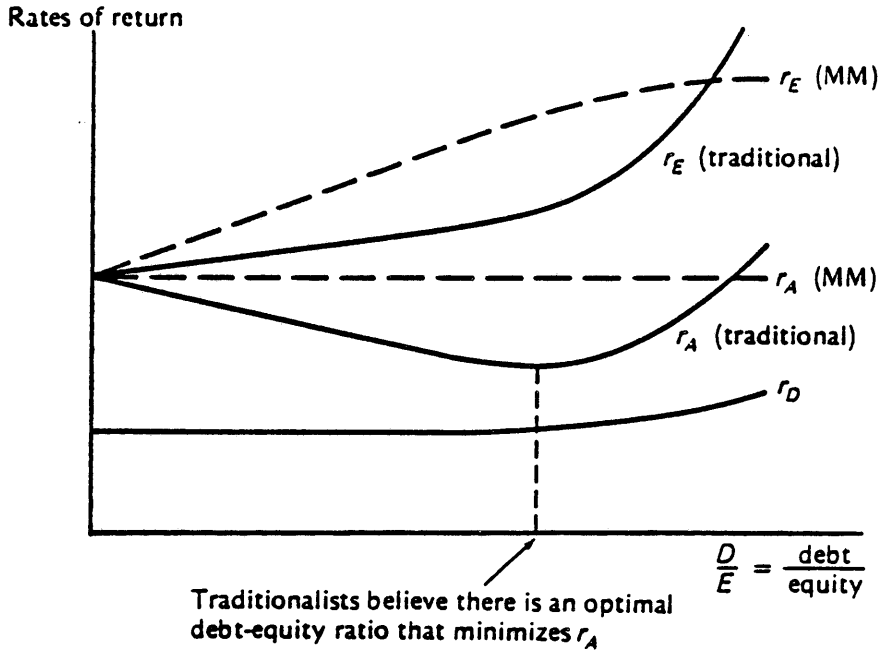

Figure 3.1

Traditional View of Capital Structure

Source: Brealey, R. and Myers, S., 1984, Principles of Corporate Finance, New York, McGraw Hill Co. pp. 355-376

Proposition I. Under the assumption of no corporate income taxes, no combination of securities is better than another. The firm's value is independent of capital structure.

The firm can increase the expected stream of earnings per share by simply borrowing more. But share prices will not increase because higher expected earnings will be offset by a higher cost of equity capital.

The expected return on assets is equal to the expected operating income divided by the total market value of the firm's securities (Brealey and Myers, 1984).
Expected return on assets:

$$r_A = \frac{\text{Expected operating income}}{\text{Market value of all securities}}$$

If the firm's debt and all its equity are held by an investor, this investor is entitled to the firm's operating income. Therefore, the expected return on assets would be equal to the expected return on the portfolio. The expected return on the portfolio is equal to the weighted average of the expected return of the individual holdings (Brealey and Myers, 1984).

The expected return on the firms asset, r_A, is not affected by the borrowing decision.

Proposition II. The expected return on equity, r_E, increases with the debt-equity ratio so long as debt is risk free. If the firm borrows more, however, then the risk of default increases and debt holders demand a higher return on the debt. When this occurs, the rate of increase in r_E slows. The reason is that some of the firm's business risk is shifted to holders of risky debt. Figure 3.2. shows the general implication of proposition II. When borrowing increases more, more of that risk is transferred to bondholders.

Modigliani and Miller's propositions are applicable only in the perfect capital market. It is believed that capital markets are generally well-functioning, but they are not 100 percent 100 percent of the time. Therefore, Modigliani and Miller's proposition must be wrong sometimes in some places (Brealey and Myers, 1984). It is the financial managers' responsibility to figure out where and when they are wrong.

As is noticed, some of the things that can explain the trends of capital structure are left out of these theories. Taxes and perception of risk are ignored. It is assumed that bankruptcy was cheap, quick, and painless. It is not. The possible interactions of investment and financing decision are also ignored.

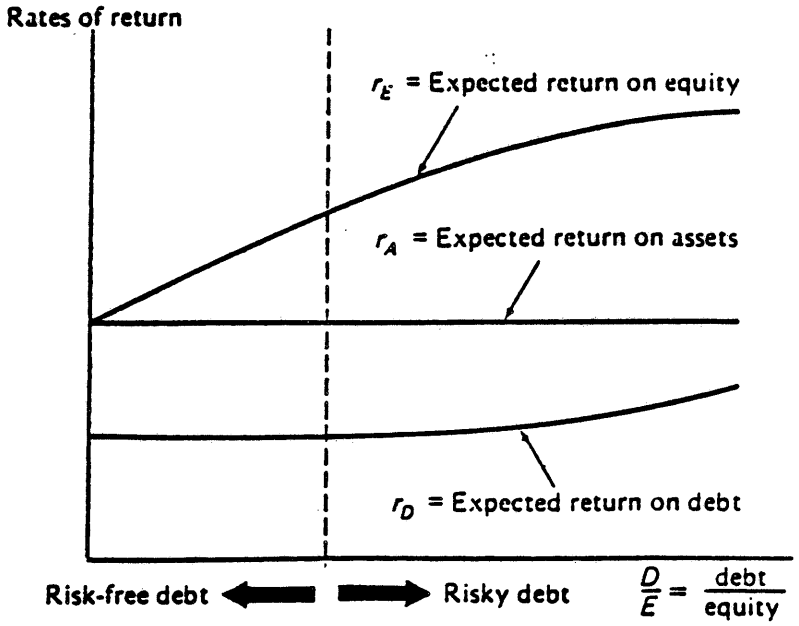

Figure 3.2

Modigliani and Miller's Proposition II

Source: Brealey, R. and Myers, S., 1984, Principles of Corporate Finance, New York, McGraw Hill Co., pp. 355-376

Now the possible determinants of capital structure will be assessed individually to explain the capital structure trends described in Chapter 2. Business financing observers (such as Taggart, 1985) emphasize that the primary determinants of changes in capital structure are the level of corporate and personal taxes, inflation, and perception of business and financial risk. The possible influence of federal borrowing on capital structure will also be analyzed. In addition to these factors, the influence of an increase in capital requirements, which decreases the firm's internal funds will be assessed. The decrease in internal fund, increases the need for external financing. All of the factors listed above help explain why firms choose debt financing over equity or equity financing over debt.

The following chapters assess the relative importance of the possible causes of changes in capital structure in the U.S. nonferrous mining and metal industry.

Chapter 4

INCREASE IN CAPITAL REQUIREMENTS

Capital requirements have increased from two points: first, companies have grown and diversified into new fields. Second, the capital required to produce a unit of metal or mineral has increased compared to metal prices. Increases in capital requirements erode the internally generated funds, and as a result, firms must look for external funds.

Projects that required tens of millions of dollars of capital three decades ago today require hundreds of millions of dollars. The reason for the increases in capital requirements will be analyzed in this chapter. Table 4.1 shows that two comparable projects had different costs. The first project, the Silver Bell mine, required $900 per short ton of copper capacity in 1953. The average copper price in that year was $580 per a short ton, so the investment was 1.55 times the price of copper that year. The second project, the Copper Flat mine, cost $5,150 per ton of capacity in 1982. The price of copper in that year averaged $1460 a ton, so the investment was 3.53 times the price of copper that year. A similar example can be given for silver mines. Table 4.2 shows that the Galena mine in

Table 4.1

Capital Costs for Two Copper Mines

Mine	Location	Date of Start-up	Initial Capacity 000 stpy Cu Content	Cost of Facilities U.S $ million	U.S $ per stpy Capacity
Siver Bell	Arizona	1953	20	18	900
Copper Flat	New Mexico	1982	20	108	5,120

Table 4.2

Capital Costs for Two Silver Mines

Mine	Location	Date of Start-up	Annual Capacity 000 oz Ag	Cost of Facilities U.S. $ mil.	Cost per oz of Capacity
Galena	Idaho	1955	4,000	3	0.9
Coeur	Idaho	1976	2,500	23	9.2

Source: C. Tinsley, and others. 1985. Finance for Mineral Industry. New York: AIME Inc, pp. 17-22

Idaho, required $0.90 per ounce of capacity in 1955. Another project, the Coeur mine in Idaho, cost $9.20 per ounce of capacity in 1976.

These examples suggest that capital requirements have increased significantly over the last several decades. The following sections examine several possible causes of increasing capital requirements: inflation, environmental and safety controls, land policies, declining ore grades, remote areas, sophisticated equipment, and expansion existing businesses and diversification into new fields.

4.1. Inflation

The mining industry is capital intensive. Inflation in recent years has increased the capital requirements of industry. Under inflationary conditions, depreciation and depletion allowances no longer generate sufficient cash to replace the old equipment in the present operation. If the only funds available are the depreciation allowance on the original machine, a used shovel can not be replaced with a new one. To illustrate this, an hypothetical example will be given. Assume that a company bought a shovel for $100,000 in 1972. This shovel was depreciated by the straight-line method over 8 years. The equipment cost will

be escalated using the metal mining deflator to compare with the depreciation allowance generated (Table 4.3). As seen in Table 4.3, at the end of the shovel's life the total tax savings generated was $100,000, whereas the equipment cost rose to $343,200. To replace this shovel, the company had to find another $243,200. This clearly indicates that the capital requirement in the 1970s increased enormously because of higher inflation.

A comparison of the consumer price index and the metal mining index is presented in Figure 4.1. Note that the metal mining index reached its highest point in 1980. Beginning in 1972, the metal mining index accelerated for 8 years, then started declining in 1980. From Figure 4.1 a hundred miners' dollars in 1972 would require $343 in 1980. Almost a 17 percent compounded growth rate over that eight-year period can be seen. This rate rose faster than the increase in the general price level.

4.2. Environmental and Safety Controls

Capital requirements for environmental and safety controls have increased enormously. Strict air and water pollution regulations required companies to have control equipment that was costly to purchase and operate. This equipment did not add effective capacity.

Table 4.3

Cost of Shovel and Tax Savings

Year	Tax Saving from Depreciation ($)	Cost of Shovel ($)
1972	0	100,000
1973	12,500	147,800
1974	25,000	170,800
1975	37,500	163,400
1976	50,000	186,700
1977	62,500	184,000
1978	75,000	190,000
1979	87,500	277,700
1980	100,000	343,200

Note: Cost escalated using metal mining deflator.

Source: Manufacturers Hanover Trust Co.

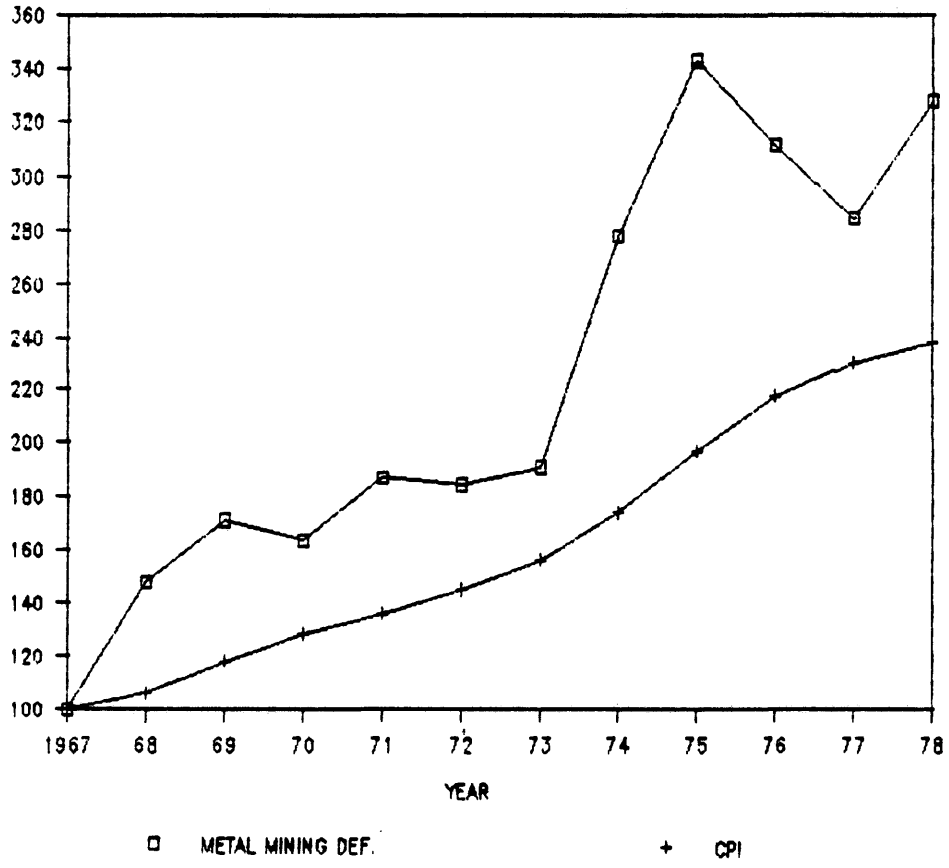

Figure 4.1

Comparison of CPI and Metal Mining Deflator

Note: 1972 = 100

Source: Baiz, F. Christian, 1985, "Capital Formation and Project Finance Prospects: A new agenda for Metals Mining," Mining Engineering, August., pp. 1044-1046

Tighter air and water pollution controls were started in the late sixties. Federal and state governments approved new legislation, and created administrative agencies to deal with the problem.

The survey made in December, 1978, by the Wall Street Journal indicates that four leading copper companies spent more than $1 billion in conforming to pollution control regulations. Kennecott spent $411 million, Asarco $239 million, Phelps Dodge $330 million, and Inspiration $123 million.

The ratio of pollution control expenditures to total capital spending displays interesting information for the period 1968-1981 by expenditures for all business, manufacturing and nonferrous metals (Figure 4.1). Capital requirements for pollution controls increased from the late sixties to the mid-seventies, but have declined after that. As was shown in Figure 4.2, the proportion of capital expenditures spent by nonferrous metals is considerably higher than that for all industries.

4.3. Land Use

Much of the land with the best potential for significant nonferrous mineral deposits in the United States is owned by the federal government. This implies

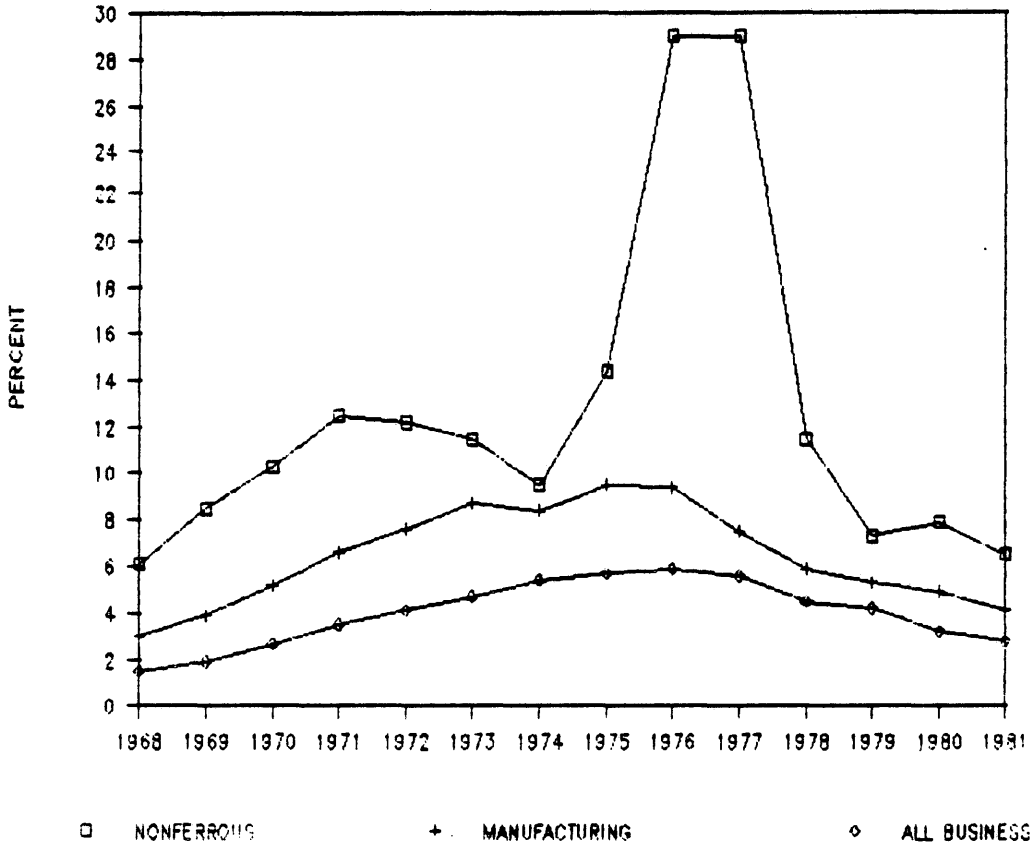

Figure 4.2

Pollution Control Expenditures as a Percentage of Capital Spending

Note: Solid waste is included starting in 1975.

Source: McGraw Hill Annual Surveys.

that the future availability of mineral resources in the country is influenced by land policies. There are two major problems with federal land policies. The first is the extent of closed or withdrawn federal lands from mineral exploration and development. In 1975, the U.S. Department of Interior (DOI, 1976) and the Office of Technology Assessment (OTA, 1979) studied the availability of hardrock mineral exploration on federal lands. According to OTA's study, lands closed to exploration are about 30 to 40 percent of federal onshore lands, the highly restricted lands are 5 to 15 percent, and the moderately, slightly, or nonrestricted lands are from 40 to 60 percent.

The second major problem encountered by industry is the slowness of decision making and response to the permission for access to public land for exploration and development. These delays add to the completion time of projects and costs.

These two major problems lead to a situation where much of the most favorable public land is undeveloped and inaccessible. As this happens, the opportunity costs of leaving deposits undeveloped and inaccessible will increase as long as the factors affecting the increase in capital requirements are present.

4.4. Decline in Grade of Ore

Since higher grades of ores tend to be found and depleted first, ore grades tend to decline over time. Copper exemplifies this situation. The average copper content of ore grade mined in the United States declined from about 0.85 percent in 1957 to 0.55 in 1972 (Sousa, 1981). The open-pit mining methods have made possible the mining of the large-scale lower grade deposits types economical. Capital costs per unit of output increase as grades decline.

4.5. Remote Areas

The location of mines in more remote areas increases the capital requirement for transport, housing, water, power, and other facilities.

An interesting cost estimation study that indicates how remote areas increase the capital requirements was done by Gordon Driver of Noranda (1972). It indicates that new construction in a remote areas such as northern Canada may have capital costs as much as 75 percent above those for mines in a more developed area.

4.6. Modern or Sophisticated Equipment

Almost every day expensive and sophisticated equipment

enters the market. This equipment in general reduces the unit cost of metal produced, but raises capital costs per unit of metal. According to a report on mine modernization published by Mining Engineering magazine in October, 1985, modernization of equipment for 53 percent of updated operations required more than $1,500,000 for a single project.

4.7 Expansion in Existing Business and Diversification into New Fields

Expanding of existing business and diversifying into new areas require high capital. Nonferrous mining is cyclical. During the high growth of demand in the 1950s and 1960s, industry expanded and diversified into new businesses between 1950 and the early-1970s, Aluminum consumption grew 10 percent a year. Copper, lead, zinc, and nickel consumption grew at a rate of 5-6 percent a year. Some companies have integrated vertically in to new businesses. Some others have diversified businesses such as oil.

The increased capital requirements for the last three decades has eroded available internal funds for future investments. As a result, firms had had to call on external funds. The following sections will explain the choice of debt or equity financing in the use of external funds.

Chapter 5

CORPORATE AND PERSONAL TAXES

Chapter 3 concluded that financial leverage has no impact on the firm's value, assuming a perfect capital market without corporate taxes. Nevertheless, firms and investors are subject to income taxes.

When the personal and corporate tax rates are taken into account, two models, Miller (1977) and DeAngelo and Masulis (1980), explain how leverage affects the firm's value. The following two sections present these models. After discussing the models, the following sections link the theories with the financing trends observed in Chapter 2.

5.1. The Miller Model

Prior to analyzing Miller's theory, the following definitions must be understood: Tc is the corporate tax rate, Tps is the personal tax rate on common stock and Tpb is the personal tax rate on debt income. When the personal and corporate income taxes are taken into account, the gain from leverage is G_L,

$$G_L = \left(1 - \frac{(1-Tc)(1-Tps)}{1-Tpb}\right) B_L,$$

where B_L is the market value of the leveraged firm's debt.

Miller used this expression to analyze the aggregate supply and demand for corporate debt. In Figure 5.1, $r_s = r_o/(1-Tc)$, the pretax rate of return on bonds supplied by the corporation. The horizontal line in Figure 5.1 represents the aggregate supply of corporate bonds. It is assumed all corporations have the same tax rate. The demand for corporate bonds begins at the intercept point, r_o. This point is the rate of return on debt for tax-free institutions (for example, municipal bonds). Not all the investors desire a return of r_o, however, as some would like to have their return approach $r_o/(1-Tpb)$. The demand curve for corporate bonds at the same point begins to rise due to the progressive personal income tax. As is illustrated in Figure 5.1, the equilibrium point is located where the demand and supply curve intercept.

$$\text{Supply} = \text{Demand}$$

$$\frac{r_o}{1-Tc} = \frac{r_o}{1-Tpb}.$$

If the bonds are offered for more than the equilibrium quantity of bonds, B^*, then the interest rates will be driven above their supply price and the firm will find

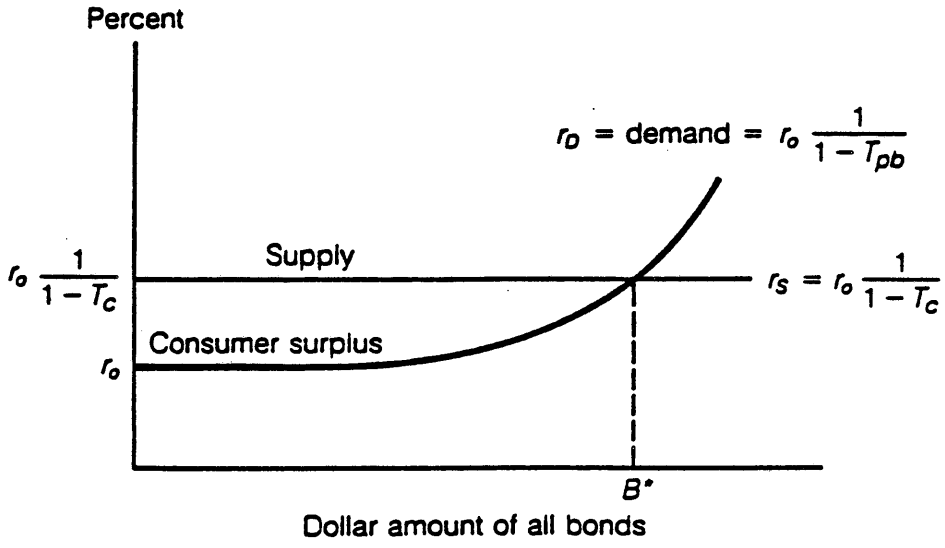

Figure 5.1

Aggregate Supply and Demand for Corporate Bonds
(before tax rates)

Source: Weston, Fred J., and Copeland, T. E. 1986. Managerial Finance, Toronto: The Dryden Press.

leverage unprofitable. If the bonds are initially supplied below B^*, the interest rates will be lower. Firms will increase the amount of leverage, and this will continue until the equilibrium quantity, B^*, is reached. Thus, at equilibrium, any gain from leverage is zero. The firm's choice of financial leverage will not affect the value of each firm so long as all firms have the same effective tax rate.

5.2. DeAngelo and Masulis Model: The Effect of Multiple Tax Shields

DeAngelo and Masulis have developed a model that takes into account the role of corporate tax shields in addition to interest payments on debt. The corporate tax shield includes depreciation and depletion allowances and investment tax credits. Not all firms pay the same effective tax because of different tax shields. The DeAngelo and Masulis model indicates that a level of debt selected by the firm is negatively related to the level of other tax shield substitutes such as investment tax credit, depreciation, or depletion. The model also points out that as firms borrow more, the probability of having sufficient earnings to utilize fully all available interest tax shield will decrease. Hence, the expected value of the interest tax shield will decline. The supply of corporate debt has a

downward sloping curve as shown in Figure 5.2.

Under these conditions, one can say that there should be an optimal level of debt for the firm. Thus, an optimal capital structure can be obtained under existence of multiple forms of tax shields and bankruptcy costs. The marginal expected advantage of interest tax shields will be related to the marginal cost of bankruptcy to yield an optimal level of financial leverage.

5.3. The Interpretation of Capital Structure Trends

This section attempts to link the theories described in the preceding sections with the financing trends observed in Chapter 2. The trends in corporate and personal tax rates will be compared with the capital structure trends. This attempt must be considered introductory, as neither the available theory nor the available data are sufficient to provide conclusive results.

As was indicated in the preceding section, tax considerations have a moderate importance in determining capital structure. Table 5.1 presents personal tax rates for those investors with the highest and lowest marginal tax rate. While low-tax-bracket investors maintain shares in highly leveraged firms, high-tax-bracket investors hold shares in low-leveraged firms. Low-tax-bracket investors

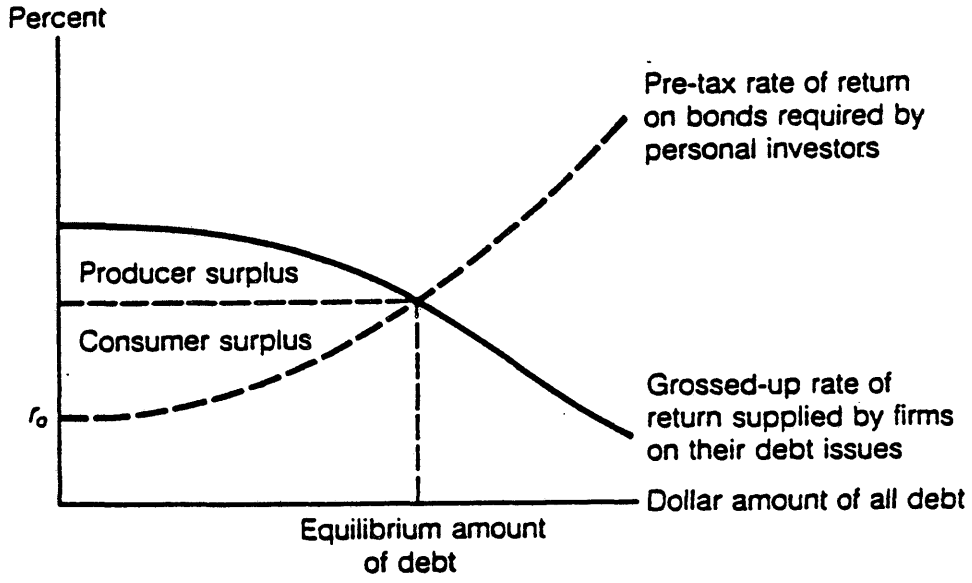

Figure 5.2

Possible Declining Benefits of Interest Tax Shields

Source: Weston, Fred J., and Copeland, T. E. 1986. Managerial Finance, Toronto: The Dryden Press.

Table 5.1

Corporate and Personal Tax Rates and Debt Incentive Tax Ratios

Year	Lowest Value of Tp	Highest Value of Tp	Tc	d_L	d_H
1955-63	0.200	0.910	0.520	0.400	-4.330
1964	0.160	0.770	0.500	0.410	-1.170
1965-67	0.140	0.700	0.480	0.400	-0.730
1968	0.140	0.753	0.480	0.400	-1.100
1969	0.140	0.770	0.480	0.400	-1.260
1970	0.140	0.718	0.480	0.400	-0.840
1971-76	0.140	0.700	0.480	0.400	-0.730
1977-78	0.000	0.700	0.480	0.520	-0.730
1978-84	0.000	0.700	0.460	0.540	-0.800
1985	0.000	0.500	0.460	0.540	-0.080

Source: Internal Revenue Service

maximize the tax advantage debt by borrowing through corporations, while high-tax-bracket investors prefer to borrow on their own account.

Grier and Stribel (1980) have developed a formula that indicates a very rough measure of the strength of these preferences. This ratio is called "the net debt incentive tax ratio."

$$\text{Net Debt Incentive Tax Ratio, d, } = 1 - \frac{1-T_c}{1-T_p} ,$$

where T_p is the personal tax rate on ordinary income and T_c is the corporate tax rate. The net debt incentive tax ratio gets larger when the ratio of (1-Tc)/(1-Tp) becomes smaller. The ratio, (1-Tc)/(1-Tp), is affected by personal and corporate tax rates. When personal tax rate gets smaller and/or corporate tax rate becomes larger, the ratio, (1-Tc)/(1-Tp), gets smaller. Table 5.1 gives a time series for d_H, the debt incentive tax ratio for investors in the highest tax bracket, and d_L, the ratio for investors in the lowest tax bracket. These ratios are the measurement of the value of marginal return streams to investors in these tax brackets (Taggart, 1985).

If it is assumed that wealth distribution does not shift extremely over time, changes in d will give, at least, a rough idea of the strength of demand for corporate

leverage by low- and high-tax-bracket investors.

The demand for corporate bonds should increase if d values tend to increase over time for both low-and high-tax-bracket investors. Furthermore, bankruptcy and agency costs easily offset any tax advantage to corporate debt during times when d values are small, even for low-tax-bracket investors (Taggart, 1985).

Figure 5.3 presents the variations of long-term debt over the past 30 years for the U.S. nonferrous mining industry. Figures 5.4 and 5.5 both represent the net incentive tax ratios for investors in the highest and lowest tax brackets. Figure 5.4 shows that the the net debt incentive tax ratios became less negative for investors in the high tax bracket, with the and biggest increase in the net tax advantage to corporate debt occurring between 1963 and 1965. In these years, the highest value of personal tax rate dropped from 91 percent to 77 percent. It is interesting to see that the increase in the debt ratios also started during these years. Oddly, Figure 5.5 does not show a similar trend with debt ratio.

It can be concluded that there is some evidence of a close correspondence between movements in tax rates and corporate debt ratios.

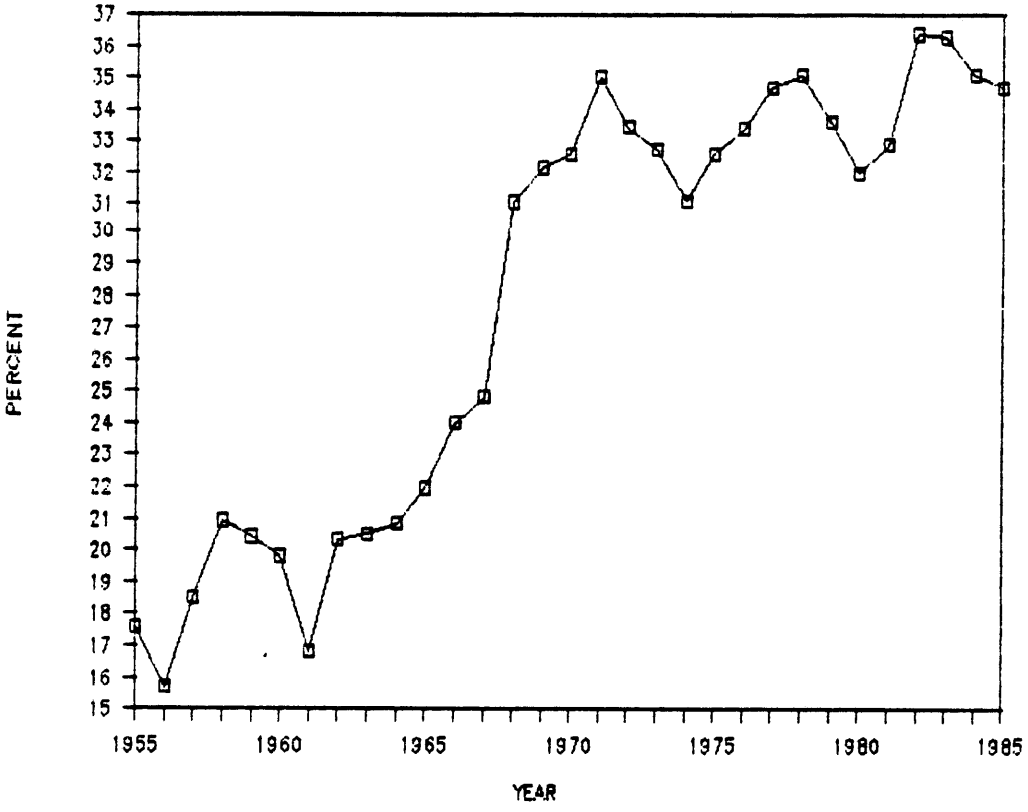

Figure 5.3

Long-term Debt as a Percentage of Total Capitalization for the Nonferrous Mining Industry, 1955-1985

Note: Book value balance sheet data are used

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, 1955-1985

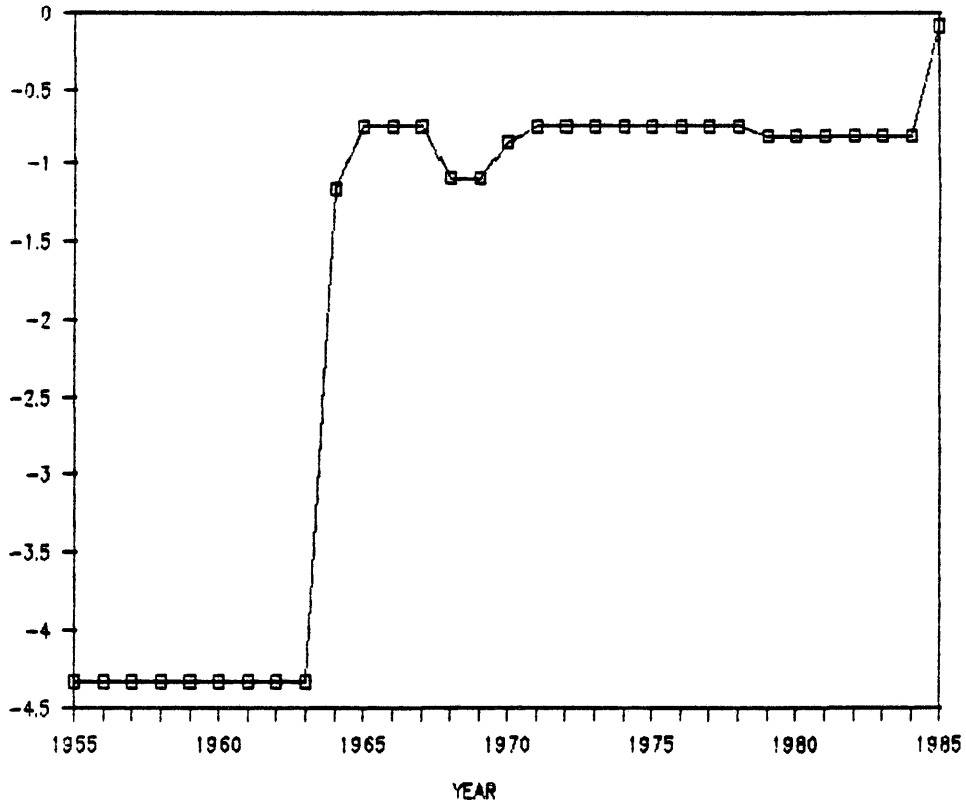

Figure 5.4

Net Incentive Tax Ratios for the Highest Personal Tax Rate

Source: Internal Revenue Service

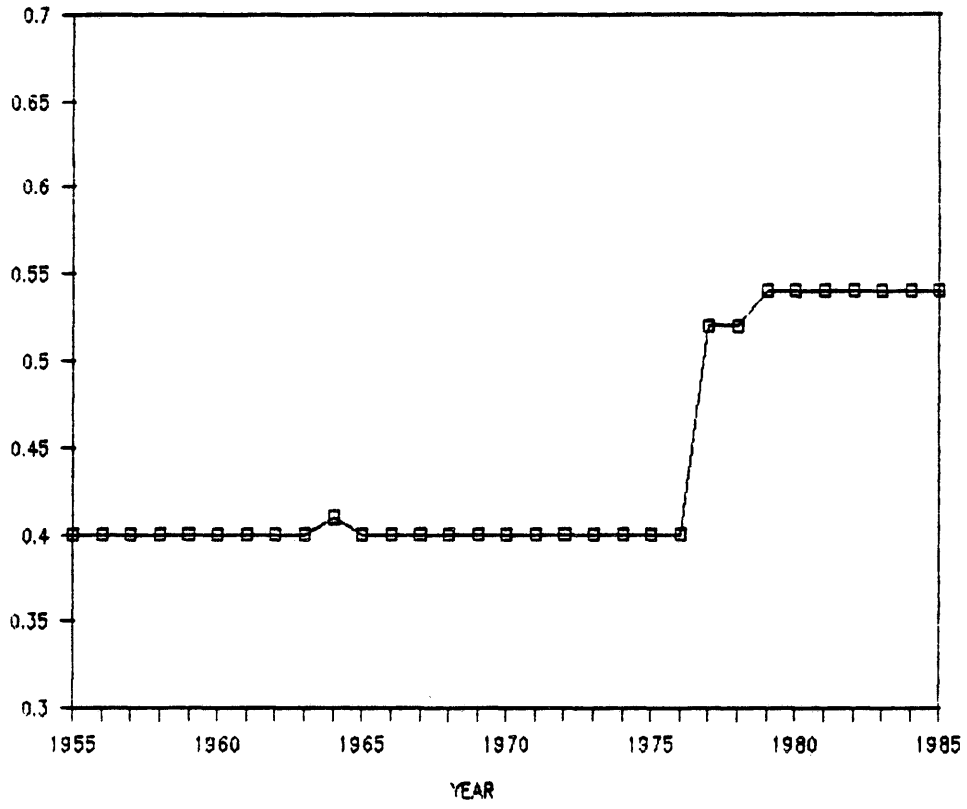

Figure 5.5

Net Incentive Tax Ratios for the Lowest Personal Tax Rate

Source: Internal Revenue Service

Chapter 6

THE EFFECTS OF INFLATION

6.1. Theories and Implications

The theory in this chapter relies heavily on Taggart (1985). Inflation is another important determinant of corporate financing trends. The notion of "debt is repaid in cheaper dollars" is not accepted by most financial economists as a cause of higher debt ratios because, lenders merely will raise interest rates in response to increases in expected inflation. Rather, the argument here is that inflation encourages greater use of debt by raising the value of the tax deduction on interest payments. In other words, there is some interaction between inflation and tax factors. Inflation increases the real tax rate on corporate income because the historical cost, rather than the replacement the cost, of plant and inventories is considered in computing taxable income. Inflation also increases the real tax rate on capital gains that are nominal, not real.

Miller (1977) has suggested a model called the tax saving-bankruptcy cost model. In this model, first, the effect of inflation will be analyzed without agency costs and, second, with agency costs. Agency costs, here, refer

to the bankruptcy costs or, more generally, all sorts of agency costs (legal, accounting, filing, and other administrative costs).

In the tax saving-bankruptcy cost model (Miller model), all interest rates increase with a rise in expected inflation. The increased premium in interest rates by inflation is taxed at the personal level. This taxation removes the benefits of higher interest rates. The effects of inflation on tax-exempt and taxable bonds can be given as an example. An increase in expected inflation of Δi causes an increase in the rate of tax-exempt bonds by Δi because investors demand a higher return on their investment. The situation is different for investors who have taxable bonds. Investors will require nominal rates that must increase enough to maintain the real after-tax yields. that is, if the personal tax is Tpm for the marginal investors, then the taxable bond rate must increase by roughly $\Delta i/(1-Tpm)$. In the Miller Model, if no agency cost is taken into account, an increase in expected inflation moves the supply curve upward as shown in Figure 6.1. The increase in the supply curve will be $\Delta r_o/(1-Tc)$ or $\Delta i/(1-Tc)$ (Tc is the corporate tax rate). The demand curve also shifts upward. However, the amount of increase in the demand curve is different for investors in different tax brackets. There are two different cases. First, the demand

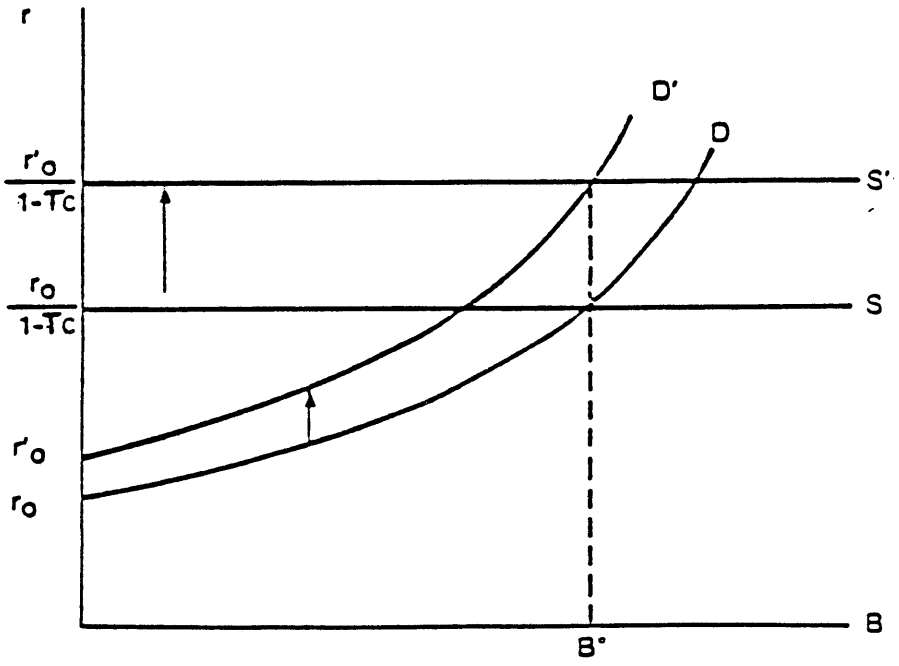

Figure 6.1

Effect of an Increase in Expected Inflation
in Miller Model Without Agency Costs

Source: Friedman, Benjamin M., 1985, Corporate Capital Structure in the U.S., Chicago: National Bureau of Economic Research, pp. 13-60

curve will shift upward by $\Delta r_o = \Delta i$ for tax-exempt investors who demand taxable bonds. Second, the demand curve will shift upward by $\Delta i/(1-Tpk)$ for investor personal tax rate Tpk. When it is stated in a different way, in the initial equilibrium, B^*, the personal tax rate, Tpm, is equal to the corporate tax bracket, Tc. At B^*, then an increase in expected inflation shifts the demand curve upward by $\Delta i/(1-Tc)$ which is the same amount of increase in the supply curve. As a result, there will be no change in the equilibrium amount of debt, B^*.

When the statement above is expressed in arithmetic form, the following equations are obtained. A change in expected inflation will change the corporate equilibrium debt. This can be expressed as

$$\frac{\partial B^*}{\partial i} = \frac{-(1-Tc)\partial(r/r_o)/\partial i}{-(1-Tc)\partial(r/r_o)/\partial B}$$

where

r: Certainty-equivalent yields on corporate debt

r: Tax-empt bond yields

B: The aggregate amount of debt

The expression above is negative since an increase in interest rate, i, increase r relative to r_o.

Expressing the numerator in a different way

$$-(1-Tc)\partial(r/r_o)/\partial i = -(1-Tc)\left[\frac{r_o\frac{\partial r}{\partial i} - r\frac{\partial ro}{\partial i}}{r_o^2}\right]$$

Letting $\Delta i=\Delta r_o$ and $\Delta r=\Delta i/(1-Tpm)$, then the numerator reduces to zero, and the difference between tax-exempt and taxable bonds for the marginal investors disappears.

As is indicated in the preceding chapter, bankruptcy costs have an important effect on corporate debt levels. Thus, when Miller's model is combined with the agency cost model, the result above is changed. (Figure 6.2). The supply curve is downward sloping because as borrowing increases, the threat of bankruptcy and financial risks increases, and this decreases the supply of debt. The interception point of the demand and supply curves give an equilibrium point of B*a. The supply curve shifts up by $\Delta i/(1-Tc)$ when the expected inflation increases. The demand curve, however, shifts up by $\Delta i/(1-Tpm)<\Delta i/(1-Tc)$. The new intersection point occurs to the right of B*a. Therefore, when agency costs are present, an increase in expected inflation encourages debt over equity financing and an increase in equilibrium corporate leverage. The intersection of inflation with agency costs and the tax system can cause these results.

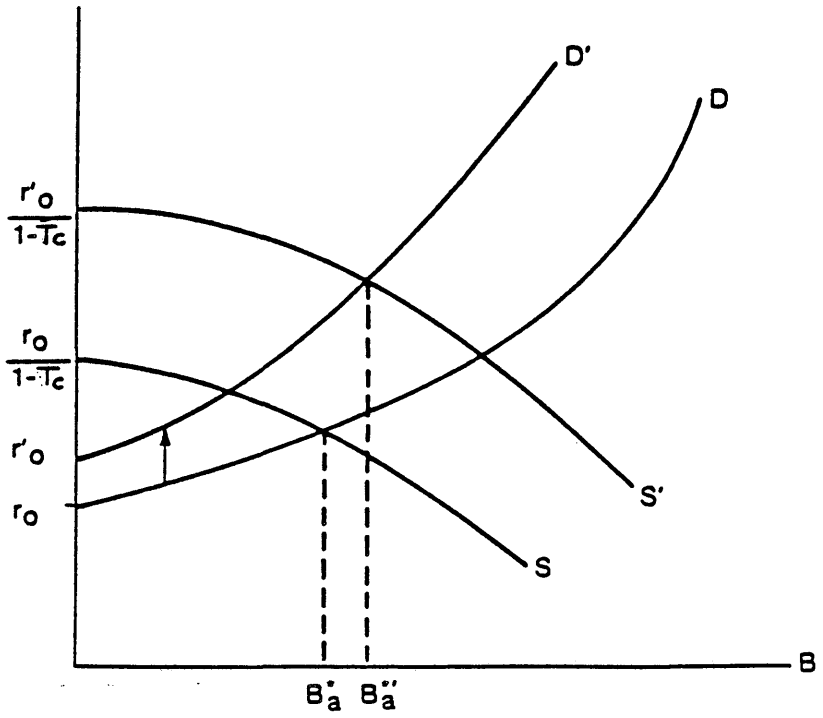

Figure 6.2

Effect of an Increase in Expected Inflation in Miller Model with Agency Costs

Source: Friedman, M. Benjamin, 1985, Corporate Capital Structure in the U.S., Chicago: National Bureau of Economic Research, pp. 13-60.

6.2. Interpretation of Capital Structure Trends by Inflation

As discussed in section 6.1, the real tax advantage of debt is favorable under inflationary conditions. Thus, the interaction between taxes and inflation may be an explanation of corporate capital structure trends.

In Figure 6.3, annual inflation rates, as measured by percentage changes in the GNP deflator, are graphed. The increase in inflation started in 1961-63 then continued until 1975. In 1976, inflation dropped 4 percent and then increased to the level of 1975 in 1981. Inflation dropped as low as 3.5 percent in 1985. Although Figure 6.4 was presented several times in the preceding chapters, it is represented here to use in comparison of debt with inflation rates. It is not difficult to see the similarities between the periods of increase in debt and inflation. Both inflation and debt started to increase in the beginning of the 1960s and continued to increase rapidly. The increase in debt ratio remain virtually stable after the 1970s. Nevertheless, inflation continued to increase until 1981. Perhaps, debt ratios stabilized because of the pressures of agency and bankruptcy costs.

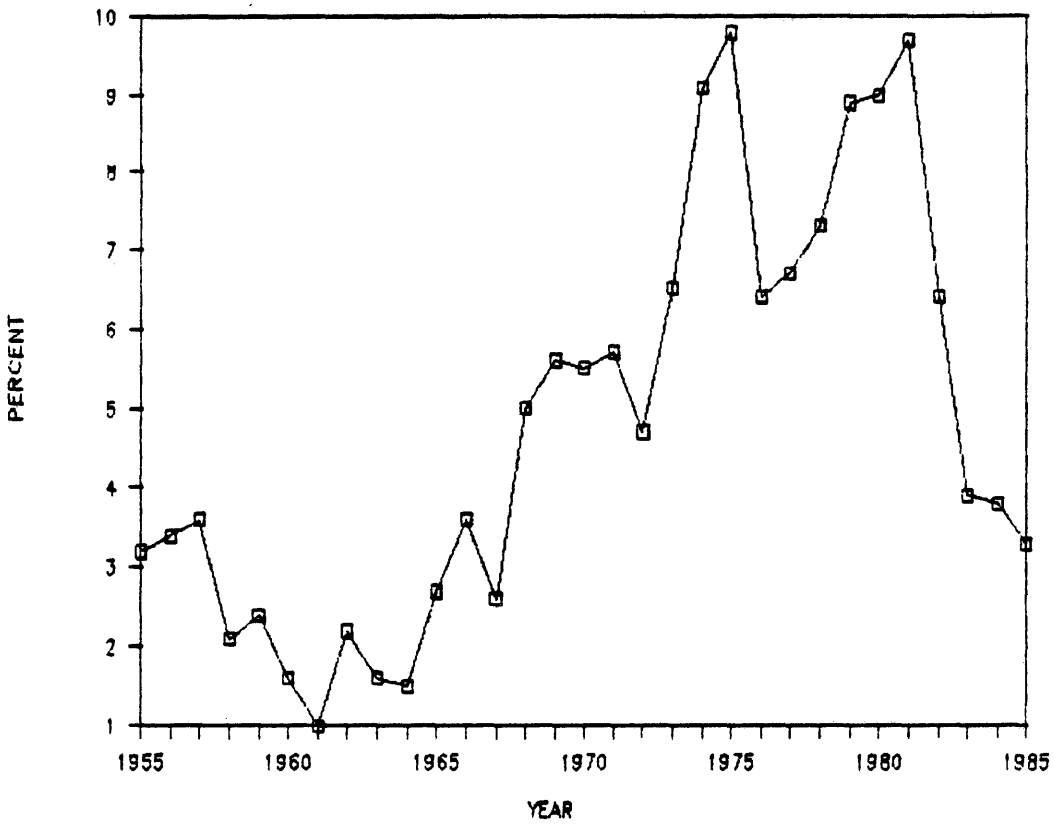

Figure 6.3

Yearly Changes in Implicit GNP Deflator

Note: 1982 = 100

Source: Department of Commerce, Bureau of Economic Analysis

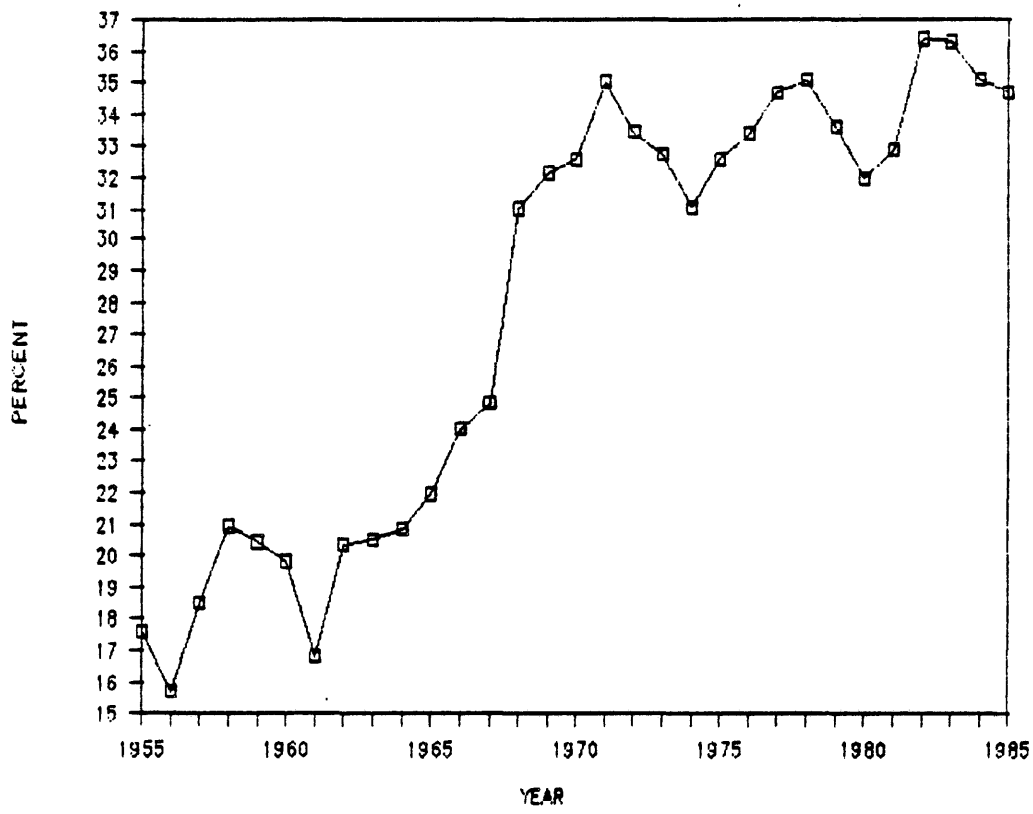

Figure 6.4

Long-term Debt as a Percentage of Total Capitalization for the Nonferrous Mining Industry, 1955-1985

Note: Book value balance sheet data are used

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, 1955-1985

Hence, although the debt ratios have increased because of the interaction between tax and inflation in recent years, this factor is not the only determinant of the capital structure trends.

Chapter 7

GOVERNMENT BORROWING

7.1. Miller Theory and Implications

Government borrowing is another factor that affects corporate capital structure trends. Indications are that an exogenous increase in government debt will reduce the supply of corporate debt.

Two different types of government borrowing, tax-exempt and taxable bonds, will be taken into account. When the government increases the supply of tax-exempt bonds, B_o, the following changes will be seen in corporate debt (Taggart, 1985):

$$\frac{\partial B^*}{\partial G} = \frac{-\left[1-Tc\right]\partial\left[\frac{r}{r_o}\right]/\partial G}{-\left[1-Tc\right]\partial\left[\frac{r}{r_o}\right]/\partial B} \qquad (1)$$

where B is the aggregate amount of corporate debt, r is the certainty-equivalent yield on corporate debt, and Tc is the corporate tax rate.

When the supply of tax-exempt bonds, B_o, increases, the

tax-exempt bond yield, r_o, will increase relative to r. This makes the expression (1) positive. In Miller's model, from a personal tax point of view, tax-exempt bonds are substitutes for equity. Thus, any increase in the supply of tax-exempt bonds shifts the demand curve down for corporate debt. Nevertheless an increase in the supply of taxable bonds has the opposite effect on the equilibrium amount of bond, B^*. An increase in federal government bonds, G, causes the following change in corporate debt:

$$\frac{\partial B^*}{\partial B_o} = \frac{-\left[1-Tc\right]\partial\left[\frac{r}{r_o}\right]/\partial B_o}{-\left[1-Tc\right]\partial\left[\frac{r}{r_o}\right]/\partial B} \qquad (2)$$

The expression (2) above will be negative because an increase in G increases r relative to r_o. From a personal tax point of view, taxable bonds are substitutes for corporate debt, and an increase in taxable government debt always reduces the supply of corporate debt (McDonald, 1983). As a graphical expression, the demand curve shifts upward due to an increase in government debt, and this reduces the equilibrium amount of debt.

7.2. Evidence of Government Borrowing

As indicated previously, government borrowing has an important effect on corporate capital structure trends. An indication of such a relationship is presented in Figure 7.1. The inverse relationship can be seen from this graph. Although it is not shown in this figure, in the years of World War II, federal government borrowing reached its maximum point. In the 1960s and 1970s, government borrowing declined enormously, whereas nonferrous mining industry's debt ratio increased substantially. In the last decade, government borrowing tends to increase as shown in Figure 7.1.

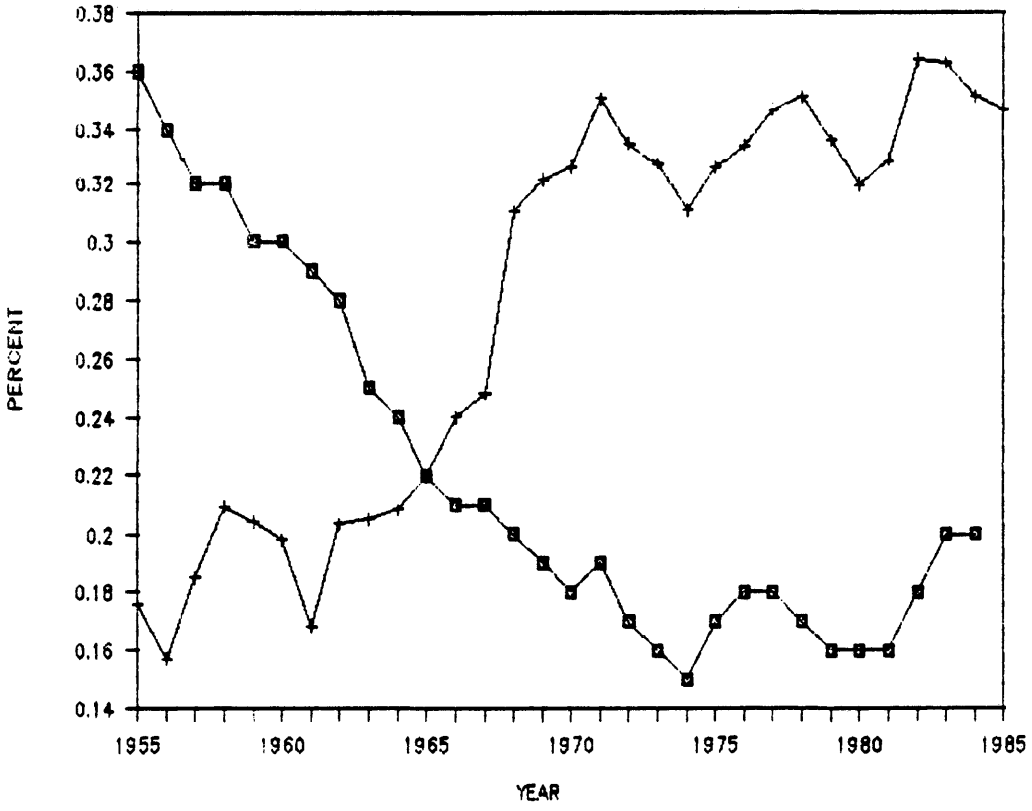

Figure 7.1

The Relation of Government and Corporate Debt Ratio

Note: Nonferrous Mining Industry Debt Ratio = Debt/ Total Capitalization
Government Debt Ratio = Government Debt/Total Nonfinancial Sectors Debt

Source: Federal Reserve Flow of Funds Accounts

CHAPTER 8

RISKS

8.1. Definition and Description of Risk

Risk is defined as the chance that some unfavorable event will occur (Brigham, 1985). The word risk also describes the possibility that realized return will be less than expected return (Archer, 1983). Two types of risk have an important influence on capital structure: business risk and financial risk. Business risk is the uncertainty in projections of future operating income (EBIT: earning before interest and tax payments). Business risk may be the most important determinant of a firm's capital structure. Fluctuations in EBIT are caused by many factors--booms and recessions in the national economy, labor strikes, price controls, and so on. Business risk varies from industry to industry. Further, business risk changes over time. Cyclical industries such as aluminum and tend to copper have a high business risk.

A number of factors affect business risk. These factors are variability in demand, sales price, input price, and operating leverage. The more stable the demand for a firm's products, the less business risk occurs (other things held constant). A highly volatile sales price of a

firm's products increases the business risk for that firm. Uncertainty about the input price creates high business risk. If a firm's fixed costs are a large percentage of total costs, then the firm is said to have a high degree of operating leverage. A small decline in sales can cause a large decrease in EBIT. As a result, the higher a firm's fixed costs, the greater the business risk. Capital intensive firms and industries, therefore have high business risk.

Financial risk refers to the additional risk that is incurred by financial leverage. Financial risk is reflected in the variability of the net income stream. This additional risk is placed on the firm's stockholders. Financial and business risk have an important effect on a firm's cost of equity and debt. This relation is shown in Figure 8.1. The more debt used, the riskier the debt and the higher the interest rate. Also, the use of more debt increases the riskiness of firm's stock and the required rate of return on equity, Ke. A firm chooses an optimal capital structure in which its value is maximized and its capital cost is minimized.

8.2. Data on Business and Financial Risk

As indicated in the preceding section, business and

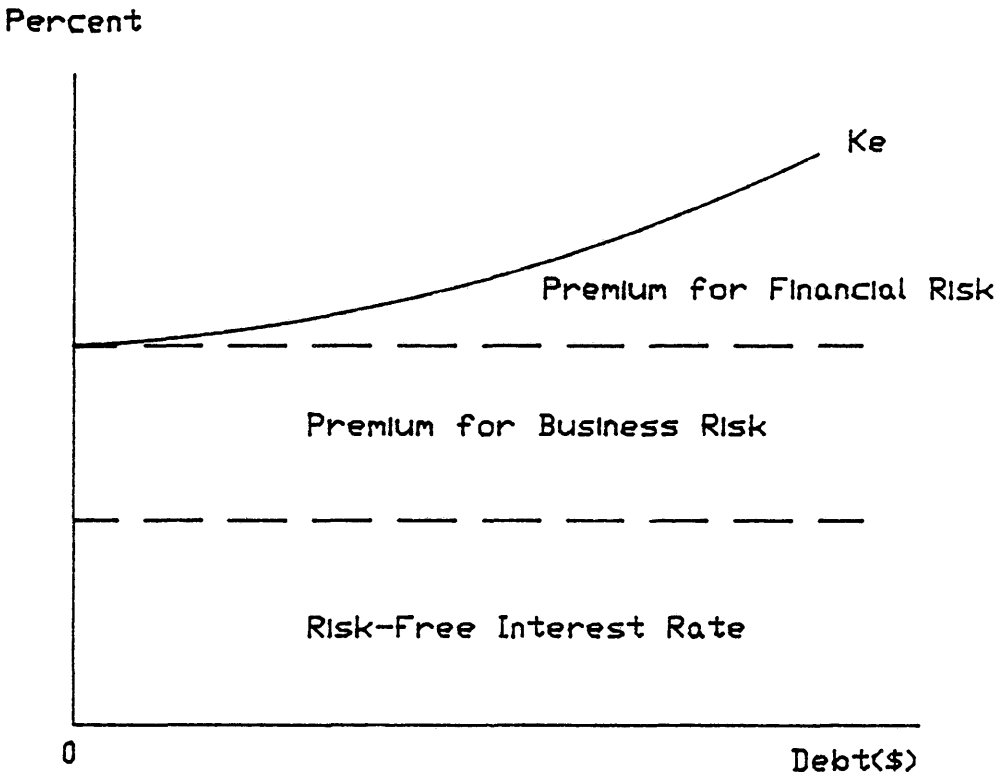

Figure 8.1

Effect of Business and Financial Risk on Cost of Equity

Source: Brigham, Eugene F. 1985. financial Management: Theory and Practice, New York: The Dryden Press.

financial risk have an important effect on capital structure. As business risk increases, a firm's operating earnings may fall short of paying its debt interest and principal, and financial risk increases. Therefore, there is an inverse relationship between risks--financial and business risk-- and corporate debt ratio. There are difficulties in measuring business and financial risk. But the coefficient of variation for a given period gives a proxy measure of risk. The coefficient of variation is defined as

Coefficient of variation of A:

$$CV(A) = \frac{\text{Standard Deviation of A}}{\text{Mean of A}}$$

Since the coefficient of variation is a standardized risk measure, it can be used to compare the relative riskiness of time periods of different lengths. The quarterly operating earnings (EBIT) of nonferrous mining and metal industry are grouped in five-year periods. The standard deviation and mean of each group is calculated and used to obtain the coefficient of variation. As the ratio gets smaller, the degree of business risk gets smaller. These coefficients of variation are graphed in Figure 8.2 to show how business risk changed over time. The coefficient of

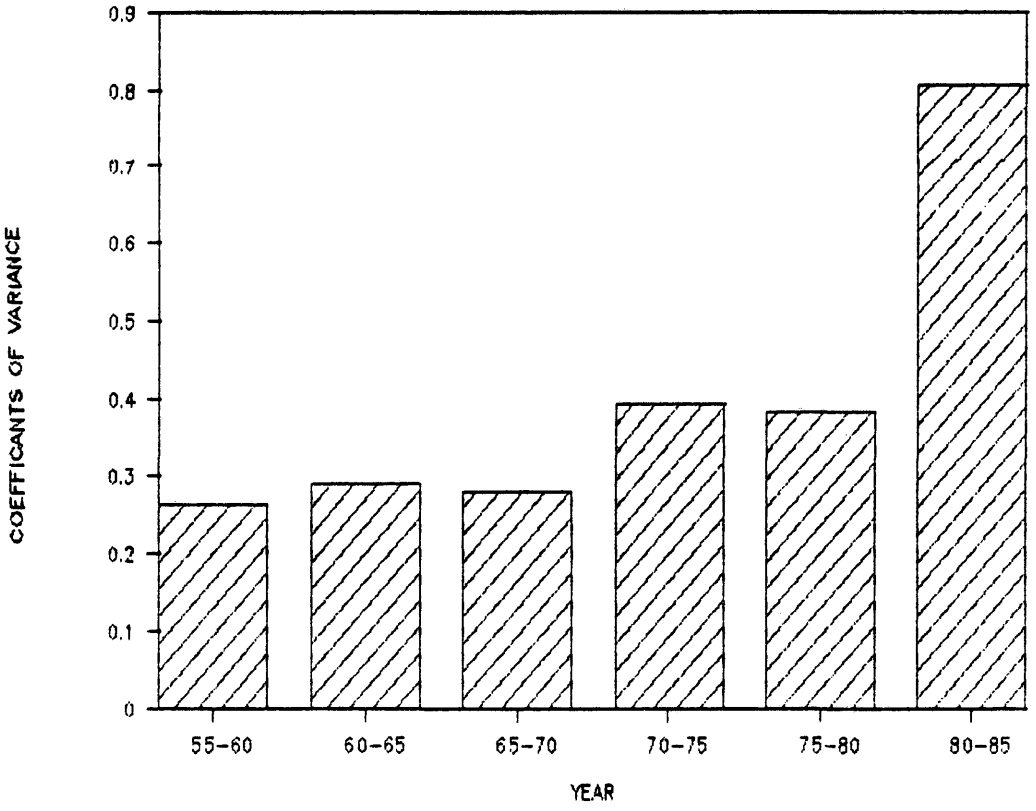

Figure 8.2

Changes in Business Risk, 1950s-1980s

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporation. 1955-1985

variation of EBIT was smaller prior to the 1970s. That is, business risk was lower in the 1960s than in the 1970s 1980s. The lower business risk during the 1960s encouraged companies to use debt financing in new investments. After the early 1970s, business risk increased and as a result the increase in debt ratio stopped (Figure 8.3).

During the 1970s and the 1980s, business risk and financial risk increased sharply due to

a. Slower rate of sales growth.
b. Sharply increasing production costs.
c. High inflation.
d. High cost of capital.
e. Static productivity.
f. Steep rises in energy costs.
g. Increased capital requirements for environmental control.
h. The depressed mineral prices after the recession of 1982.

All these factors have eroded operating income. Furthermore, higher use of debt increased financial risk substantially.

As described earlier, financial risk is the additional risk induced by the use of financial leverage

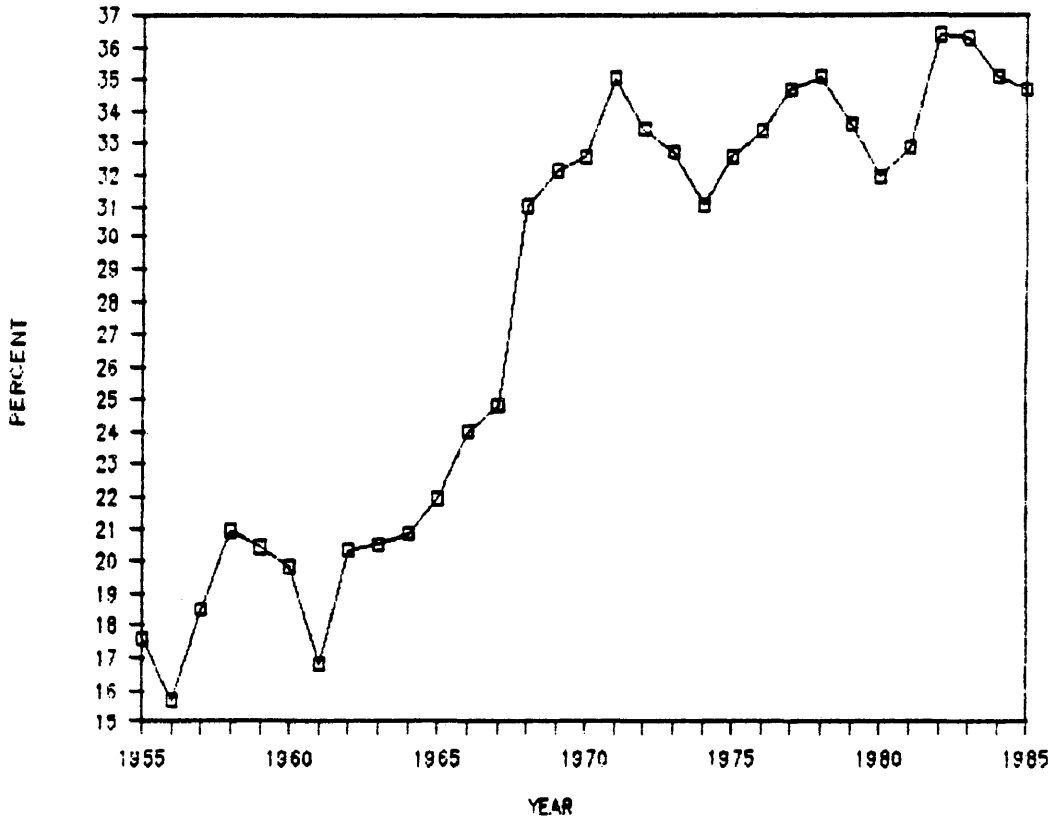

Figure 8.3

Long-term Debt as a Percentage of Total Capitalization for the Nonferrous Mining Industry, 1955-1985

Note: Book value balance-sheet data are used

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, 1955-1985

and is reflected in the variability of the net income stream. Financial risk is also measured as a ratio of the standard deviation of net income to net income in a given year, as shown in Figure 8.4. The lower the ratio, the smaller the financial risk. The financial risk ratio and the business risk ratio follow similar patterns. As a result, what it is said for business risk, can be said for financial risk. That is, financial risk has increased substantially in the last decade.

Low business and financial risk during the early 1960s and 1970s resulted in low cost of debt and equity financing, but because the cost of debt was lower than the cost of equity, firms have used more debt financing. Therefore, the proportion of debt to total capitalization increased in that period.

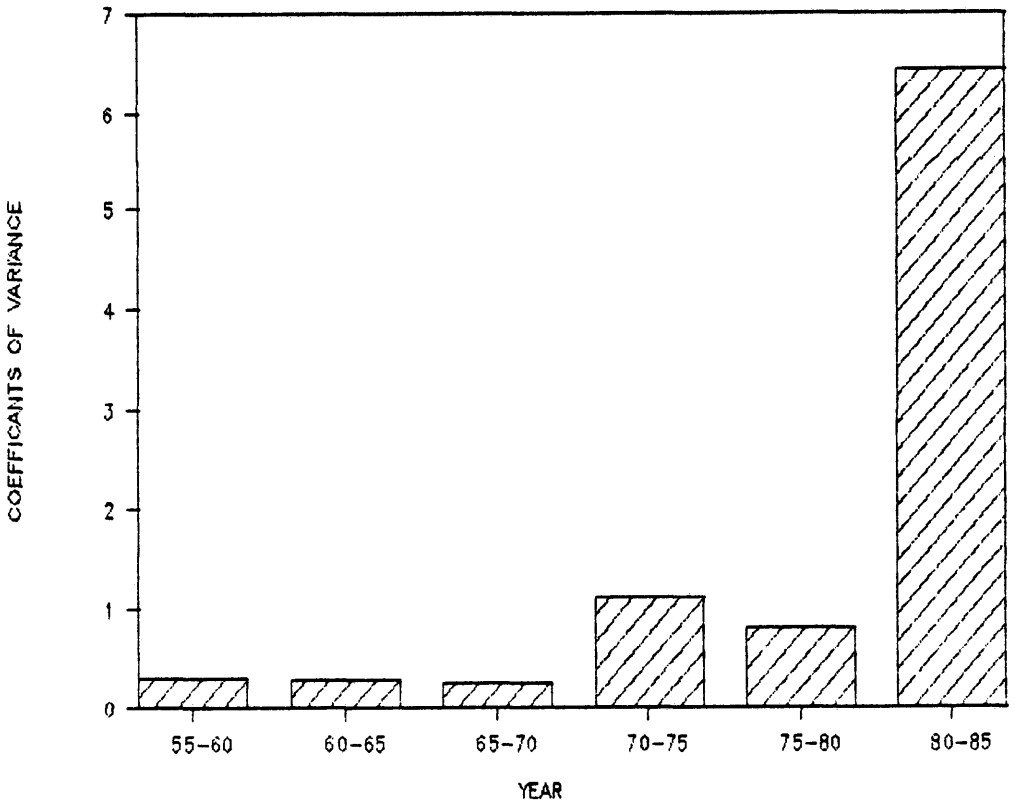

Figure 8.4

Changes in Financial Risk, 1950s-1980s

Note: 1961=100
Since the coefficient of variance of 1980-1985 period is negative, it is taken as absolute

Source: Federal Trade Commission, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporation, 1955-1985

Chapter 9

CONCLUSIONS

The capital structure of the U.S. nonferrous metal industry has changed over the last 30 years or so. This change was quite striking between 1961 and 1971. In one decade, the ratio of debt to total capitalization increased from 17 percent to 35 percent. This move toward greater debt is even more striking when one considers that other sources of debt, project financing, unfunded pension plans, and so on, are not reflected in the balance sheet.

Capital requirements for firms have increased enormously over the last thirty years. Different factors have affected capital requirements differently at different times. For example, high growth in demand during the 1960s required companies to expand their capacities. The expansion in capacities resulted in additional capital requirements. Inflation was very high during the 1970s. Input costs increased at a faster rate than the price of the commodities. Depreciation and depletion allowances were eroded by inflation. Environmental and safety controls required high-cost pollution control equipment. These resulted in increased capital requirements per pound of metal. The restriction on land use caused an increase in

the opportunity cost by leaving the lands inaccessible and undeveloped. Ore grade declined for most minerals. As ore grades decline, capital costs per unit of output increased. Remote mine locations and the use of sophisticated equipment also added to capital requirements. As a result, corporate cash flows and profits declined. Companies had to call on external funds for investment funds.

If a company chooses external financing, it has, in general, two choices. The first choice is debt, and the second is equity. The factors affecting the firm's choices were assessed in this study, and the following results were obtained.

Aggregate changes in capital structure can be explained by tax-law changes, inflation, government borrowing, and risks.

Personal and corporate income taxes have an important effect on capital structure. Changes in the personal and corporate tax rate change the incentive for debt use. A decline in personal tax rate decreases expected return on debt and shifts the demand curve for bonds by lenders to the right. In the new equilibrium, the amount of corporate debt is higher. The major increase in debt ratio for the U.S. nonferrous mining industry occurred between 1961 and 1971. In that period, the personal tax rate dropped

substantially. The personal tax rate for the highest tax bracket investors dropped from 91 percent to 70 percent. The same rate for the lowest tax bracket investors also dropped from 20 percent to 14 percent. Although corporate tax rates declined from 52 percent to 48 percent, this decline does not explain the changes in capital structure.

Another important determinant of capital structure was inflation. Inflation encourages greater use of debt by raising the value of the tax deduction on interest payments. Theoretically, the expected inflation shifts both the supply and demand curve of bonds upward by different amounts. The new equilibrium point of debt will be greater after these shifts. Therefore, when agency costs are present, an increase in expected inflation encourages debt over equity financing and an increase in corporate leverage. During the period from 1960 to 1975, the percentage changes in the implicit GNP deflator increased from 1 percent to 10, as the debt ratio moved from 17 percent to 35 percent.

Government borrowing as a fraction of all nonfinancial sector debt declined enormously after World War II. It was found that there is an inverse relations between government borrowing and the corporate debt ratio. During the ten-year period in which the nonferrous mining industry's debt ratio

increased, government debt declined substantially.

The last factor, risk, has an important effect on capital structure. Two types of risks, business and financial risk, are taken into account in this study. Business risk is the uncertainty in projections of operating income. Financial risk refers to the additional risk that is incurred by financial leverage. Financial risk is reflected in the variability of the net income stream. Low business risk and financial risk during the early 1960s and 1970s resulted in low cost of debt and equity financing. Since the cost of debt was lower than the cost of equity, firms used more debt financing in the 1960s.

The factors presented above are not all of the factors affecting capital structure, only the most important. Taken together, these factors go a long way toward explaining changes in the capital structure of the U.S. nonferrous metal industry between 1955 and 1985.

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Appendix A

DEBT RATIOS FOR COMPANIES, 1960-1971

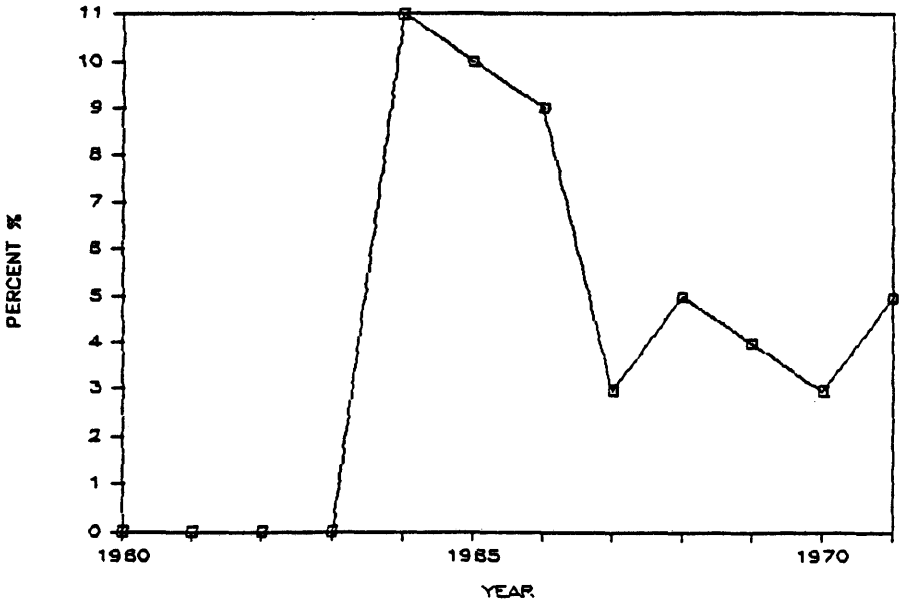

Figure A.1: Debt Ratio of Asarco, 1960-1971

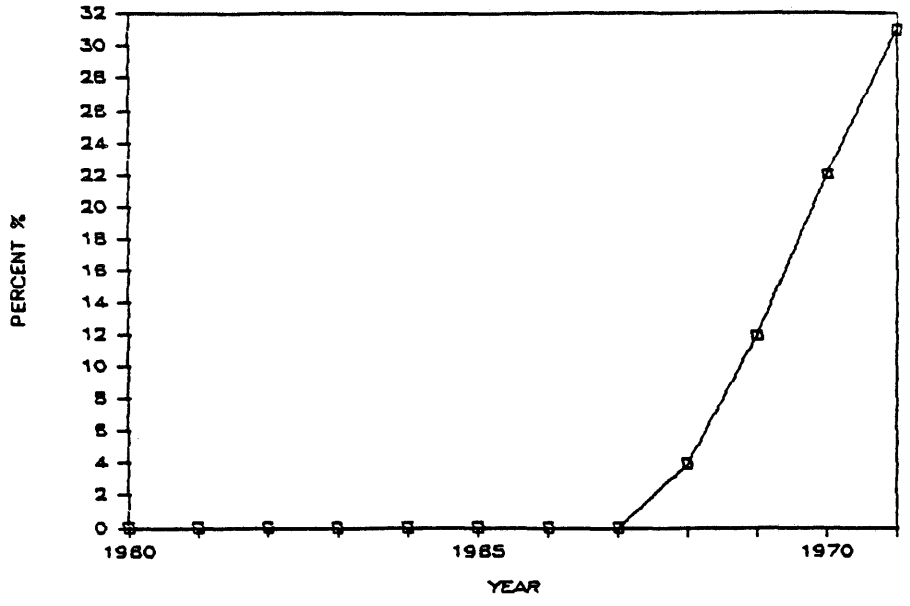

Figure A.2: Debt Ratio of Newmont, 1960-1971

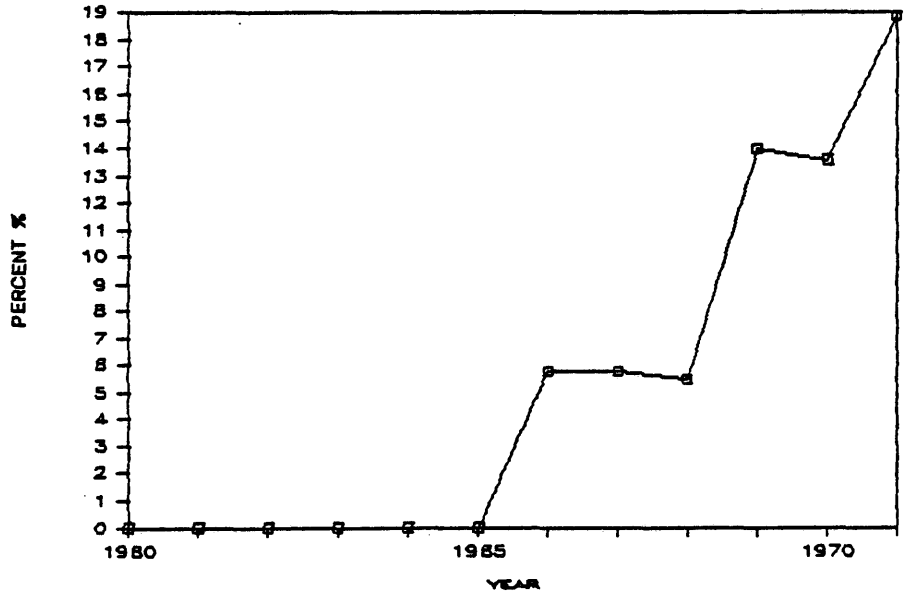

Figure A.3: Debt Ratio of Phelps Dodge, 1960-1971

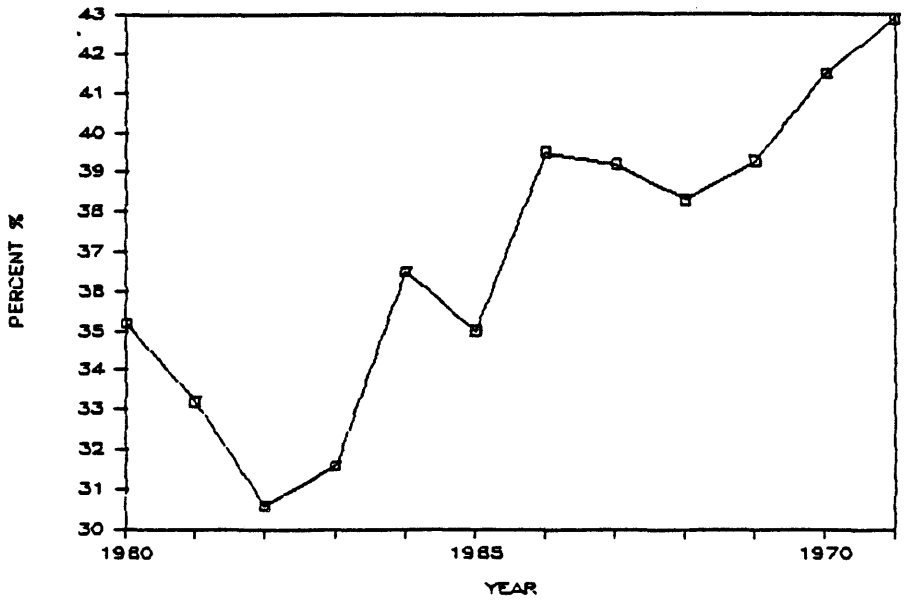

Figure A.4: Debt Ratio of Alcoa, 1960-1971

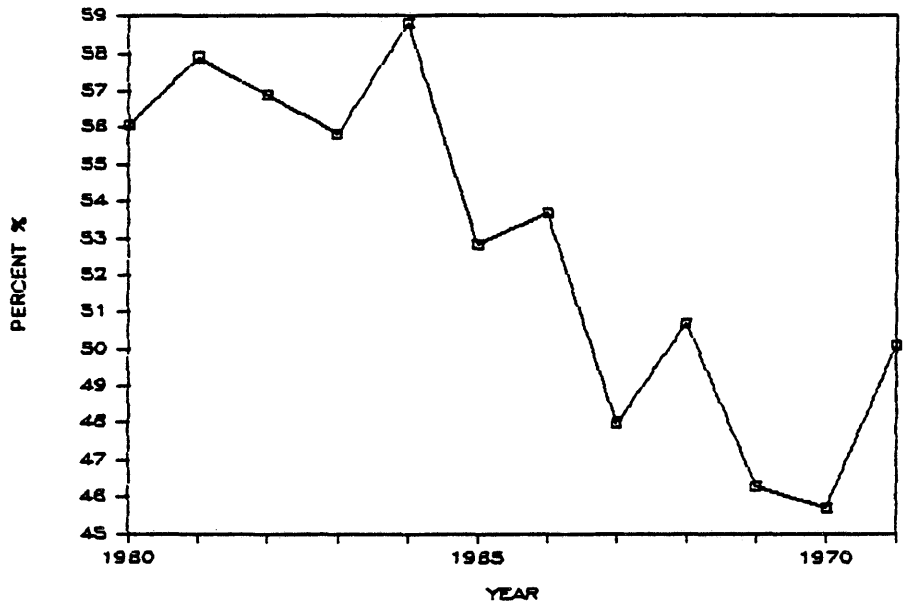

Figure A.5: Debt Ratio of Kaiser, 1960-1971

Appendix B

DEBT RATIOS FOR COMPANIES, 1971-1985

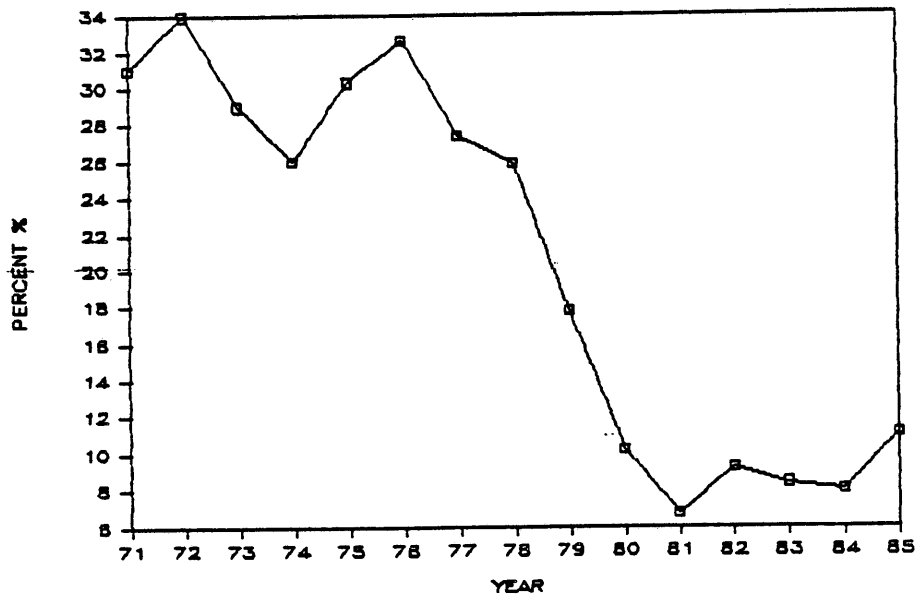

Figure B.1: Debt Ratio of Newmont, 1971-1985

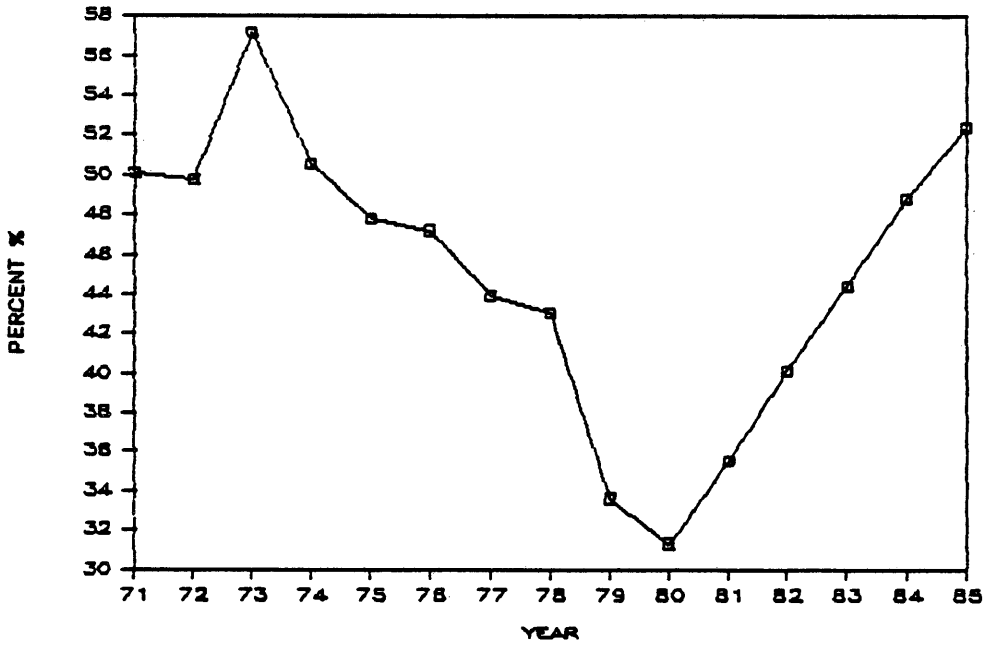

Figure B.2: Debt Ratio of Kaiser, 1971-1985

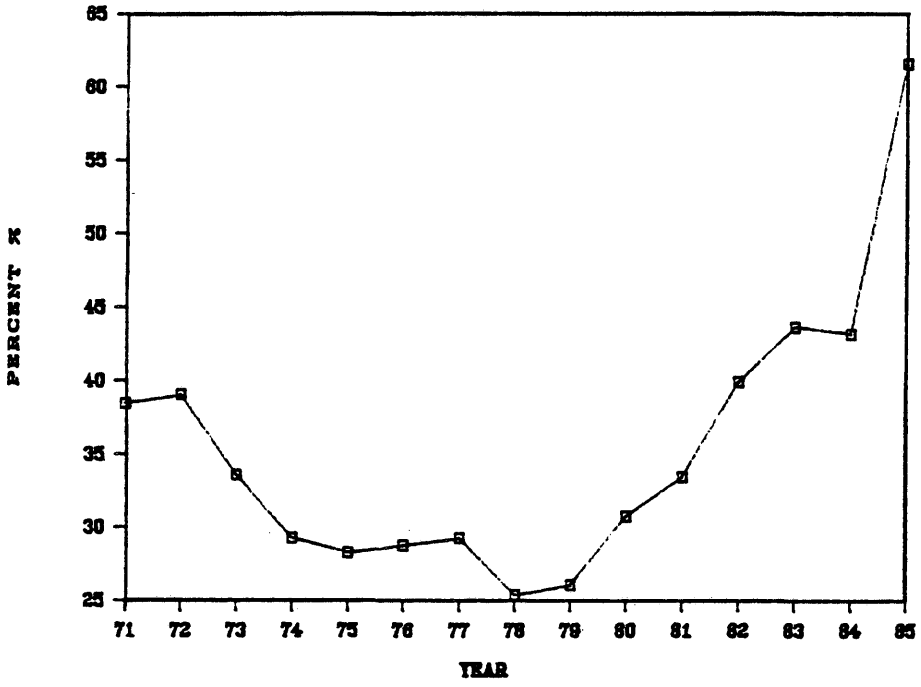

Figure B.3: Debt Ratio of Amax, 1971-1985

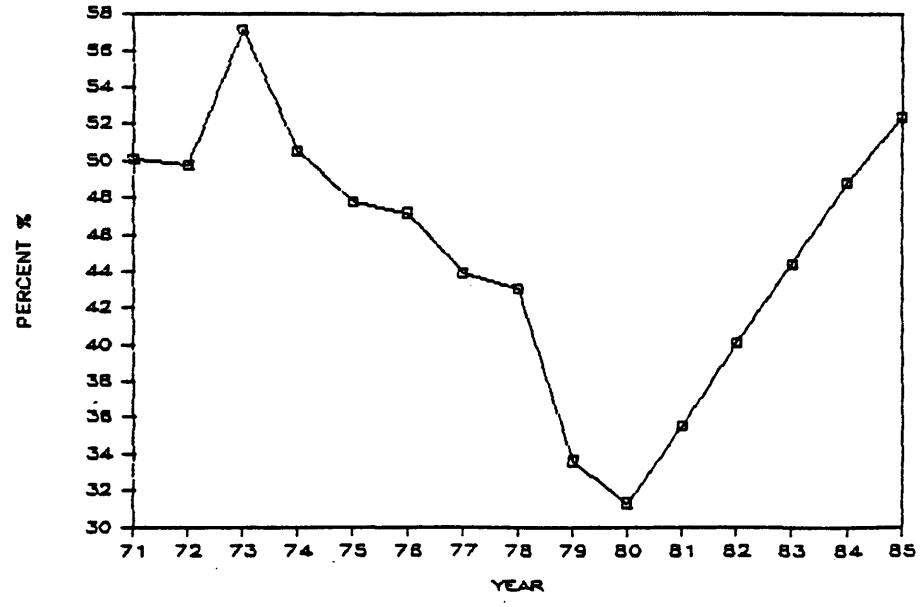

Figure B.4: Debt Ratio of Asarco, 1971-1985

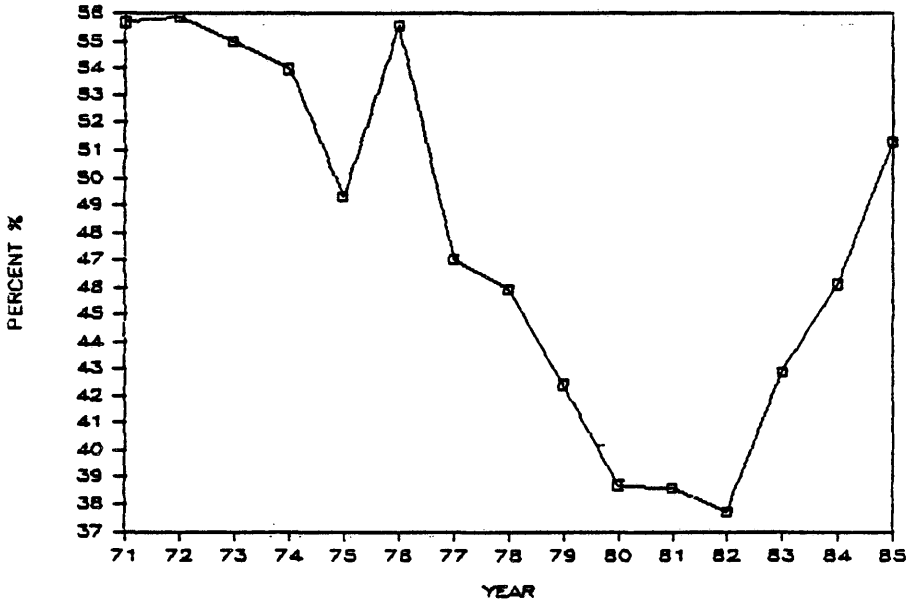

Figure B.5: Debt Ratio of Reynolds, 1971-1985