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DISCUSSION PAPER NO. 324

Taxation and the Financial Policy of Firms: Theory and Empirical Applications to Canada

by

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RÉSUMÉ

La présente étude traite de l'incidence de l'impôt des sociétés sur le financement par emprunt (ou effet de levier) des entreprises. Les auteurs examinent quatre modèles théoriques. Ceux-ci indiquent qu'une réduction du financement par emprunt peut avoir plusieurs causes : (i) une diminution du taux de l'impôt sur les sociétés (parce que l'intérêt sur la dette est déductible aux fins de cet impôt); (ii) des amortissements accélérés (des "avantages fiscaux" plus importants) et une limitation de la déductibilité des pertes fiscales encourues sur d'autres revenus ("compensation de pertes"); (iii) une augmentation de l'instabilité du revenu d'exploitation; (iv) un accroissement des risques de gestion (qui dépend de la corrélation entre le revenu d'un gestionnaire qui est assuré par la rentabilité de la compagnie et ses autres sources de revenu); (v) une augmentation des coûts prévus de faillite; (vi) un taux d'inflation plus élevé (parce que l'intérêt nominal sur les obligations est déductible, aux fins de l'impôt, à un taux plus élevé que le taux d'impôt sur les intérêts que touchent les investisseurs).

Les modèles sont appliqués à des données chronologiques et transversales, tirées du dossier COMPUSTAT et d'une bande

magnétique de l'Université Laval, pour la période 1970-1982. Les sociétés sont des entreprises canadiennes inscrites à la Bourse de Toronto. Dans l'évaluation des taux de l'impôt sur les sociétés, il est tenu compte des variations interindustrielles et interprovinciales, ainsi que des fluctuations dans le temps.

La principale constatation découlant de cette analyse empirique est que la taxation des sociétés influe beaucoup sur l'effet de levier de la dette, tellement qu'une augmentation d'un point du taux de l'impôt sur les sociétés fait monter le ratio d'endettement de 0,75 point. D'autres facteurs influent aussi sur ce ratio. Ainsi, une augmentation de l'instabilité du revenu d'exploitation contribue à la réduction du ratio d'endettement. Quant à l'instabilité des risques de gestion, elle y contribue dans une mesure à peu près égale. Avec les données disponibles, il n'est pas facile de mesurer les "avantages fiscaux", la "compensation des pertes" ainsi que les coûts prévus d'une faillite. Par conséquent, il est difficile de tirer des conclusions très nettes de l'impact de ces variables.

Les auteurs s'efforcent aussi d'étudier des modèles dans lesquels la rémunération du capital, avant impôt, et la croissance de l'actif immobilisé sont des facteurs déterminants de l'effet de levier. Or, pour expliquer ce dernier, chacune de ces variables se révèle significative, de sorte que l'incidence d'une augmentation du taux de l'impôt des sociétés sur l'effet de levier s'en trouve réduite.

Les auteurs déduisent de leur analyse que l'impôt sur les sociétés influe sur l'effet de levier, mais ils ne concluent pas qu'il faudrait adopter des mesures incitatives ponctuelles en vue de favoriser le financement par actions. Ils soutiennent qu'il faudrait procéder à une juste intégration de la fiscalité des entreprises avec celle des particuliers. Ils examinent cette question dans un régime d'impôt à la consommation et un régime d'impôt sur le revenu total, et ce, dans le contexte d'une économie fermée et d'une économie ouverte.

ABSTRACT

This study examines the impact of the corporate tax on debt financing (or leverage) of corporations. Four theoretical models are examined. These suggest that a reduction in debt financing is caused by (i) a reduction of the corporate tax rate (because debt interest is deductible for corporate tax purposes); (ii) faster write-offs (greater 'tax shield') and limitation on the deductibility of tax losses from other income ('loss offset'); (iii) an increase in the volatility of operating income; (iv) an increase in managerial risk (which depends upon the correlation between a manager's income derived from company profitability and the manager's other income); (v) an increase in expected bankruptcy costs; (vi) a higher inflation rate (because the nominal interest on bonds is deductible for tax purposes at a value higher than the rate at which interest income is taxed in the hands of investors).

The models are applied to Canadian time-series-cross-section data from the COMPUSTAT file and the Laval tape, for the period 1970-82. The companies are Canadian-controlled companies traded on the Toronto Stock Exchange. The measurement of corporate tax rates takes into account between-industry and between-province variation, as well as variation over time.

The principal finding of the empirical work is that corporate taxation significantly affects leverage, to the extent that an additional point increase in the corporate tax rate causes an additional 0.75 point increase in the debt-asset ratio. Other factors also influence the debt-asset ratio. For example, an increase in the volatility of operating income and in a proximate measure of managerial risk each reduce the debt-asset ratio. With the data available, it is difficult to measure 'tax shield', 'loss offset' and expected bankruptcy costs. Consequently, firm conclusions in respect of

these variables are difficult to draw.

Some attempt is made to consider models in which the gross-of-tax return to capital and growth in fixed assets are determinants of leverage. Each of these variables is found to be significant in explaining leverage, whereupon the effect of an increase in the corporate tax rate on leverage is reduced.

While it is concluded that corporate taxation influences leverage, it is not concluded that special ad hoc incentives should be adopted to encourage equity financing. It is argued that there should be proper integration of corporate and personal taxation; this is explored in the context of consumption and comprehensive income taxation, in closed and open economies.

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FOREWORD

This paper is one of the outputs from Council's three year study of the taxation of capital income -- or of the income derived from savings and investment. The study program had important dimensions in both time and space. The effects of capital taxation on both present and future output and standards of living were scrutinized. Taxes levied by all levels of Canadian government were studied as were the international implications of the taxation of capital income. Another important emphasis in the study program was on the interrelationship among specific measures of capital taxation. Here, general equilibrium and other techniques were used to examine the various measures as an interrelated system. Separate studies were also undertaken of specific measures of capital taxation including the personal and corporate income taxes, sales and transaction taxes, property taxes, and resource taxes.

An important characteristic of the income tax is its differential treatment of income from debt- and equity-financed capital. The latter is taxed both in the hands of corporations and again when distributed to shareholders.

Dividend tax credits and partial exclusion of capital gains from taxable income provide relief from this double taxation. Even so, it is possible that taxation discourages equity finance and is responsible for part of the debt burden of Canadian business. The present study is one of two commissioned to investigate the difficult empirical relationship between taxes and indebtedness.

When this paper was written, Mr. Bartholdy was a graduate student at Queen's University and is now on the faculty of the School of Business at St. Mary's University. Professors Fisher and Mintz are on the faculty of Queen's University. Professor Fisher has published extensively in the field of econometrics and Professor Mintz in the fields of business finance and taxation.

Judith Maxwell
Chairman

CHAPTER 1

TAX POLICY IN CANADA

1.1 Introduction

The recession of the 1980's and subsequent bankruptcies that arose from it forced many companies to re-examine the methods they had been using to finance capital investment. Efforts were made to limit the possibility of bankruptcy by reducing leverage, that is the ratio of debt to eqûity.[1] Firms that tended to rely on debt as a source of finance were viewed by financial markets as more likely to run into financial difficulty. In the period 1982-83 many companies witnessed a sharp increase in their debt-equity ratios.[2] This was due partly to the difficulty of issuing equity when stock market values were falling, and partly to a decline in the profits available for reinvestment. This experience raised the concern of policy makers that leverage had generally become too high. To reduce leverage, certain tax measures were adopted in the May 1983 Budget[3], to encourage equity financing.

These developments raise two important issues. First, does leverage in fact matter when firms make investment decisions? Much of the early literature in financial economics suggests that the source of financing is irrelevant to the firm. This proposition, which was originally argued by Modigliani and Miller (1958), was developed in a simple model based _inter alia_ on the assumption that corporate and household debt are perfect substitutes, in the following sense. If a corporation issues one dollar more of debt while reducing equity by one dollar, then shareholders will reduce their equity investment in the firm by one dollar and either purchase one more dollar of corporate debt or reduce personal borrowings by one dollar. If the cost of issuing debt _via_ the firm is equal either to the household's rate of return on bonds or to the cost of borrowing funds, then the corporation's financial decision is irrelevant to the shareholders, since they can offset corporate leverage with personal leverage. This is essentially the 'home-made leverage' theorem put forward by Modigliani and Miller in 1958 and it has been central to much of the debate concerning financial leverage and business' investment decisions since that time.

The Modigliani-Miller proposition gave birth to a vast literature aimed at establishing the relevance of financial policy to investment decisions, on the one hand, and of denying its relevance, on the other. Much of this literature concentrated on whether the assumption that corporate and personal debt are perfect substitutes may be sustained after allowing for (i) bankruptcy costs, (ii) transaction costs, (iii) taxation, (iv) lack of information to outside investors for assessing the quality of firms, and (v) 'agency' costs arising from non-pecuniary rewards which induce managers to pursue objectives other than profit maximization. In Chapter 2, various models in which the tax system interacts with bankruptcy costs and 'agency' costs are introduced. In some models, the leverage decision affects the value of a firm since corporate and personal debt are no longer perfect substitutes. Corporate and personal taxation influence leverage and this effect can be derived explicitly in these models. It still remains an important issue whether leverage affects the value of a firm and its investment decisions. In one of the models discussed in Chapter 2 leverage is irrelevant, even in the presence of taxes.

The second issue raised as a consequence of developments in the 1980's is the impact of tax policy on a firm's leverage decision. Does the current tax system encourage or discourage debt financing? In a model which allows taxes and financial policy to affect the value of a firm, corporate and personal tax rates and allowances influence leverage in different ways. Some of the tax provisions that are important in influencing corporate financing are the deductibility of interest payments from corporate taxable income, the payment of dividend tax credits and the preferential treatment of capital gains. Some tax provisions, such as interest deductibility, encourage debt financing; others, such as the low taxation of equity income, encourage equity financing; and so on.

The general aim of this study is to determine the extent to which taxation influences financial policy, taking account of the fact that Canada is a capital importing country, with an economy which is small relative to the rest of the world. As will be demonstrated, this requires that the potential importance of foreign savings and foreign tax systems on the costs faced by Canadian businesses in seeking capital from abroad be recognized in empirical work.

Another question to be addressed is whether the law should be amended to weaken or strengthen its influence on financing. The analysis of this issue depends in part on the first two issues discussed above: (i) Does leverage matter to the firm? And if so: (ii) What effect does taxation have on leverage? The theory developed in Chapter 2 suggests that leverage could be relevant and the empirical work of Chapter 3 makes an attempt to measure the impact of various Canadian tax provisions on leverage. Even if taxation influences leverage and leverage matters to the firm, it must still be asked what economic cost is borne by society, consequent upon tax policy influencing the financial decisions of firms. The answer to this question depends on the conclusions to the first two issues.

The theory outlined in Chapter 2 suggests that bankruptcy and 'agency' costs are resource costs associated with leverage. Additional debt financing increases the likelihood of a firm declaring bankruptcy, so that it is either wound up or dissolved to be reorganized. This process incurs direct costs, associated with trustee, legal and accounting fees. Other indirect costs, arising for example from the loss in sales, may be incurred as well. Debt financing can also affect the salaries paid to managers, and thus the incentive for managers to work for the benefit of the firm's owners. In particular, if debt financing makes the salary paid to a manager more risky, but otherwise induces the manager to work harder, then shareholders are forced to compensate a manager for the reduced value of income corresponding to the risk. Thus taxes influence leverage and hence 'agency' costs.

These bankruptcy and 'agency' costs would be experienced by firms, even if there were no taxes. Taxation, however, can influence the level of bankruptcy and 'agency' costs. If the tax system encourages too much or too little leverage, then additional resource costs will be incurred compared with a situation when taxation does not affect leverage. Alterations to the tax law, to reduce its bias toward certain sources of finance, are discussed in Chapter 4. One benchmark for reform is to remove the bias. This would be appropriate to the extent that businesses and households generally participate in well-functioning capital markets. Another benchmark for tax reform is to use the tax system to offset imperfections in capital markets arising, for example, from government regulation of financial intermediaries or from the costs of obtaining information. Such imperfections may lead to too little or too much leverage. Tax policy can be used to offset some of these imperfections.

The discussion is organised as follows. Chapter 2 is devoted to analysing various models which determine how financial policy affects the valuation of firms, and how corporate and personal taxation influence leverage. Chapter 3 discusses an empirical appraisal of the theory of Chapter 2, in particular, it provides some estimates of the effects of various provisions in the tax law on leverage. Chapter 4 discusses reform of the law with respect to its impact on debt and equity decisions. The present position of Canadian tax law and how it affects the financing of Canadian businesses are discussed in the remainder of this chapter. As a result of this discussion, certain limitations on the theoretical and empirical results of Chapters 2 and 3 emerge and these are outlined at the end of this chapter.

1.2 Tax Policy in Canada in Relation to Financial Policy

Canadian businesses use three sources of finance, all of which can be treated differently under the present tax law. These sources of finance include (i) debt (bonds, bank loans, accounts payable and other short- and long-term liabilities), (ii) retained earnings (undistributed profits) and (iii) new equity issues. From the perspective of taxation, it is these three sources of financing that are most relevant. Sources (ii) and (iii) are forms of equity financing. The distinction between short- and long-term debt is not as important, since interest paid on all forms of debt, except for capitalized interest, is deductible from corporate taxable income.

Debt and equity issued by Canadian businesses are owned, from a tax point of view, by several types of investors. One type is the Canadian household which owns equity and debt directly from purchasing shares and bonds offered in stock and bond markets. Another investor is the financial intermediary or corporation which owns financial assets. A financial intermediary may be owned by both Canadian and foreign households. Canadian households own non-financial businesses indirectly by lending funds to a financial intermediary which, in turn, invests these funds in businesses. The final type of investor is the (corporate or household) foreigner who pays both Canadian taxes and the taxes of his resident country, depending on internat- ional tax arrangements.

In the discussion below, Canadian corporate and personal tax law, as these affect the three different types of investors, are reviewed. Direct ownership by Canadian households of non-financial capital is discussed first. Then the tax law relating to financial intermediaries and foreign ownership of Canadian capital, either of a direct or an indirect form through corporations and intermediaries, is reviewed. This distinction permits consideration in detail of the impact of taxation on the financing of businesses.

1.2.1 Household Capital Income

Households receive three forms of investment income for income tax purposes: interest, dividends and capital gains. The total tax paid on these forms of income depends on the use of various provisions of corporate and personal income tax, because both of these taxes reduce the return earned on bonds and equities. The corporate and personal tax bases are first described, followed by the interaction between the two types of tax and how these affect the amount of equity and bonds issued by a Canadian corporation to a Canadian household.

The Corporate Tax System

The corporate tax is, in principle, levied on income accruing to the shareowners of the corporation. There are two main forms of taxable income: active business income and passive (financial) income. The discussion of passive income is deferred until the section on financial intermediation. Active business income is equal to revenues earned on the sale of goods and services less labour and capital costs. Capital costs include capital cost allowances, depletion allowances, the cost of inventories, and the interest expense incurred on borrowed funds.

The deductibility of interest expenses from corporate taxable income is the most important feature of the corporate tax affecting financial policy. This deduction implies that the owner of equity, not debt, pays corporate tax on the income he receives. The deduction of borrowing costs can also be generous to equity owners of the business, during times of rising prices. Part of the interest deducted from the corporate tax base is a payment to the lender to maintain the purchasing power or real value of the debt's principal. Allowing this portion of interest expenses to be deducted from the corporate tax base is tantamount to allowing the business to deduct a part of the capital value of the debt. As shown in Chapter 2, the deductibility of interest, without adjusting for inflation, can encourage debt financing, although this depends on various provisions of the corporate and personal tax law in relation to capital income.

The valuation of capital cost allowances for tax purposes differs from the 'economic depreciation' of capital, since the former is set by fiat while economic depreciation arises from physical wear and tear and revaluation of capital. In some cases, capital cost allowances are substantially more than economic depreciation. For example, manufacturing machinery, pollution control equipment and energy conservation assets are written off at a rate of 50% on a straight line basis, subject to a half-year convention rule. Heavy constructon equipment is written off at a rate of 50% on a diminishing balance basis, also subject to the half-year convention rule. These four assets comprise 17% of total capital investment and 30% of the machinery investment of non-resource industries (based on the years 1979-81. For other classes, especially structures in non-resource industries, capital cost allowance (CCA) rates used for tax purposes are closer to economic depreciation rates. However, in times of rising prices the CCA rates used for tax purposes can be inadequate. A CCA rate is based on the original purchasing price of capital, not its replacement cost. Inflation consequently erodes the value of the CCA.

The valuation of inventories is based on the first-in-first-out (FIFO) principle, where the cost is the lower of the replacement cost and the original cost of acquiring the inventory. In times of constant prices, the valuation of inventories is not difficult, since the price at which a commodity is introduced into the inventory stock is the same as the price when it is taken out. In times of rising prices, FIFO valuation is inadequate since, in general, the cost of replacing the inventory is more than the original cost of the inventory.

Resource firms are also given special deductions, many of these being more generous than the true economic cost of holding the assets. These deductions include: (i) a CCA allowance for new mine assets equal to the mining profit of the firm until the asset is written off (subject to a minimum rate of 30%); (ii) a fast write-off of machinery and structures under Class 10 (30%) or Class 12 (100%); and (iii) earned depletion for resource firms (phased out for oil and gas since 1981) equal to 1/3 of exploration, development, processing and new mine asset expenditures. In addition, exploration and development intangible expenditures are allowable as expenses, even though the creation of the asset (such as a mine shaft or drilling knowledge) may have long-lasting value in creating more depletable reserves.

When the value of deductions is generous relative to the cost of holding the asset, then this difference is referred to as a 'tax shield'. When a business is paying taxes in a year, it can take full advantage of all tax shields. However, when a business is not paying taxes in a year, it may not be able to take full advantage of its tax shield, because the deduction is postponed to the future, without being carried forward at a rate of interest. As will be shown in Chapter 2, the availability of tax shields will influence financing decisions. In particular, a business which issues more debt relative to equity will create a greater potential of incurring corporate taxable losses. When losses are created, the business will either: (i) carry back losses up to 3 years (one year prior to 1983) and receive a tax refund; or (ii) carry forward the losses to be applied against future taxable income (before 1983, losses had to be used up within 5 years, and after 1983 within 7 years).[4] When losses or deductions are carried forward, the value of deductions is worth less to the business, since the deduction is not indexed at a rate of interest. Debt financing can reduce the present value of the tax shields by postponing the date for their use; thus firms may choose to rely more on equity financing.

Another important corporate tax provision that influences the financing decision of firms is the depletion allowance. Prior to 1974, 'automatic' depletion was granted to resource firms and this allowance was equal to one quarter of the net profit of the resource firm. Ontario retains 'automatic' depletion in its corporate tax law, although the rate is 1/3 of net profit. Thus the deductibility of debt interest reduces not only the corporate tax base but also the depletion allowance base. Since 1974, resource firms were allowed earned rather than 'automatic' depletion, based on exploration, development, new mine and processing asset expenditures. However, the amount claimed in any year is subject to a limit of 25% of the net income of the business, the excess being carried forward indefinitely. Thus, financing by debt can lengthen the time until earned depletion is completely claimed. Even if the firm is paying taxes, it may choose to finance capital with less debt, so as to take quicker advantage of earned depletion.

Once corporate taxable income is computed, a tax rate is applied to determine corporate taxes payable gross of any tax credits. Any qualifying losses from previous years can reduce corporate taxable income. If tax losses are incurred, these may be carried backward or forward, subject to the limitations described above. The current federal tax rate varies across sectors and sizes of firms. On large nonmanufacturing firms it is 36%, on large manufacturing 30%, on small non-manufacturing 15% and on small manufacturing 10%. The 1986 Federal Budget will reduce these tax rates by 3 percentage points for large manufacturing and 2 percentage points for small firms by 1989. In addition, some provincial governments apply a tax on the federal base. The exceptions are Quebec, Ontario and Alberta which have their own corporate tax law; however these are similar to the federal base. Provincial governments have a lower tax rate on small businesses and some give special rates for manufacturing and resource firms.

Once calculated, federal corporate taxes payable are reduced by the investment tax credit and foreign tax credit. The investment tax credit is equal to 7% of investment expenditures made on depreciable assets in resource, manufacturing, agriculture, fishing and forestry activities. A higher tax credit is available for investments in specially designated areas and slower growth regions of Canada. A rate of 20% and 30% is available for expenditures on research and development (R&D), except for small businesses which are allowed 35% on the first $2 million of R&D expenditure. If the investment tax credit cannot be claimed in a year, it can then be carried back or forward as with taxable losses. By 1989, the investment tax credit will be abolished except for a 20% rate in the Maritimes, 40% in specially designated areas, 60% in Cape Breton, and the 20% to 35% rate for R&D. The foreign tax credit is equal to foreign corporate taxes paid on profits earned by branches and foreign affiliates abroad that are included in the taxable income of the Canadian corporation. Dividends received from foreign affiliates operating in treaty countries are exempt from Canadian tax but foreign taxes may not be credited against Canadian corporate taxes.

The variety of provincial and federal corporate tax rates in Canada renders a special advantage to the study of business finance. Many studies conducted in the United States, for example, are hampered by a lack of variation in corporate tax rates across industries and time.

Personal Taxes on Capital Income

The federal personal tax is levied on the receipt of three forms of capital income: interest, dividends and capital gains. The taxation of interest is generally straightforward. Most interest income earned on bonds, deposits and mortgages is included in taxable income. The interest expenses incurred in borrowing money to finance investments is deductible from taxable personal income.

The taxation of dividends is more complicated. Canadian tax law integrates corporate and personal taxes by allowing a dividend tax credit to be paid to the investor to offset corporate taxes paid prior to the distribution of profits. The dividend tax credit is available to Canadian residents and for dividends received from a Canadian corporation. No dividend tax credit is paid for dividends received from foreign corporations, although a foreign tax credit is given for foreign withholding taxes.

The personal tax on dividends eligible for the tax credit is calculated in the following manner. Dividends received are first grossed-up by a factor of 150% (to be reduced to 133-1/3% in 1987), whereupon the federal dividend tax credit is equal to 22-2/3% of this amount (to be reduced to 16-2/3% in 1987). The Federal personal tax liability on dividends is equal to the marginal tax rate (the highest possible rate is 34%) multiplied by 1-1/2 times dividends received, less the dividend tax credit. The provincial tax is levied as a surcharge on federal taxes payable (for example, Ontario's rate is 48% of net federal taxes). For an individual in the top income category in Ontario, the effective personal tax on $1 of dividend income received in 1986 is equal to $\{1.5(.34-.227)(1+.48)\}=\$.25$. Investors with lower income pay a lower effective personal tax on dividends. For an individual with less than $17,000 in taxable income, the effective personal tax rate can be negative. This is not to say that the dividend tax credit is too generous. The main purpose of credit is to avoid double taxation of dividend income, such that the effective corporate and personal tax rate remains positive.

In principle, the combined federal and provincial dividend tax credit should be equal to corporate taxes paid prior to distribution. For public corporations, the dividend tax credit is less than the corporate tax paid, especially for non-manufacturing businesses. For private corporations claiming the small business tax deduction, the dividend tax credit is too generous. The November 1981 Budget reduced, at the federal level, the incentive for small companies to pay out income as dividend, by adding a 12-1/2% tax on distributed profit (this tax is being eliminated in 1987 with the reduction in the dividend tax credit). However, the provinces have substantially reduced corporate tax rates on small business (averaging 3% across the provinces in 1984). Thus the dividend tax credit remains generous for small businesses, taking into account both federal and provincial taxes.

Capital gain income is taxed as income realized in the hands of the investor. When an investor sells shares, the taxable capital gain is calculated as one-half of the difference between the price when shares are sold and the cost when purchased. Beginning 1986, the first $500,000 of net capital gains earned during an individual's lifetime will be exempt from tax. However, allowable losses arising from investments in Canadian-controlled private corporations (CCPC's) may be written off other income and this amount reduces the lifetime exemption of net capital gains. No allowance is made for inflation which erodes the purchasing power of wealth. However, the effective capital gains tax is reduced substantially by the lifetime exemption and deferral of taxes by postponing the sale of assets. However, except for CCPC's, losses can be written off only against future taxable capital gains, rather than other current income. This reduces the degree to which the government shares in the riskiness of investments with the investor.

The above description of personal taxes levied on capital income ignores several opportunities under which investors can shelter their savings from tax. One tax instrument is the Registered Pension Plan (RPP) and the Registered Retirement Saving Plan (RRSP). The current law allows an individual who belongs to a pension plan to deduct up to $3,500 in contributions to a RRSP and RPP or $5,500 in contributions to a RRSP if the individual has no pension plan. Withdrawals from these plans are fully taxable. If the personal tax rate is constant over the lifetime of the individual, then the present value of taxes owing on these plans is equal to zero.

There are several other methods by which savings can be sheltered from tax. An individual who owns a qualifying life insurance plan can earn interest free of tax. In addition, a $1,000 investment income deduction is allowed for eligible interest, taxable dividends and capital gains. For most lower- and middle-income individuals, capital income is untaxed. High income individuals can reduce tax liabilities by sheltering bonds and mortgages in a RRSP or in other tax sheltering devices. They can also borrow capital to invest in equities. The equity income is taxed at a lower rate than the tax saved on the deductibility of borrowing interest costs.

Under the current personal tax law, Canadian households face lower effective personal tax rates on dividends and capital gains compared with other sources of income. This arises from the dividend tax credit and the preferential treatment of capital gains. Interest income, unless fully sheltered, is taxed at a higher rate. Lower income individuals are likely to shelter all of their capital income. High income individuals tend to face positive effective tax rates on their marginal savings. This will be an important consideration in the theoretical and empirical discussion of Chapters 2 and 3.

1.2.2 Corporate Investment Income

In principle, investment or passive income flowing through corporations and financial institutions should be fully integrated into the overall tax system. For this purpose, the tax law distinguishes between public and private resident corporations.

Public Corporations

Treatment of the investment income of public corporations is similar to that under the personal tax law, except for inter-corporate dividends. In general, interest and one-half of capital gain income are taxable in the hands of a public corporation, while inter-corporate dividends are not taxed. Since profit net of interest is taxable in the hands of the corporation generating it, the tax-free flow of inter-corporate dividends paid from taxed profits avoids double taxation. Similarly, interest, which is deductible from the taxable income of a debt-issuing corporation, is taxable in the hands of the lending corporation. The lending corporation may either deduct its own financing costs from taxable income or pay out dividends that are subject to the dividend tax credit. The taxation of the income from capital gain on shares held by a public corporation, however, is different, since while the profit generated by a non-financial corporation is taxable, the capital gain on shares held by the financial or parent corporation reflects profits that have already been taxed. This suggests that reinvestment of profits by non-financial corporations is the least preferred method of finance, from the point of view of a financial intermediary.

There are several important exceptions to the above rules. First, several measures developed in the later 1970's were intended to reduce after-tax financing of corporations arising from tax incentives provided to resource and manufacturing businesses since 1972. After-tax financing arose when a corporation paying no tax could make more effective use of interest write-offs, by transferring the deduction to a corporation paying taxes, so as to reduce the cost of credit. This was accomplished by a non-taxpaying corporation issuing income debentures or term preferred shares to a lending institution. The dividends, or debenture income, would not be taxable in the hands of the lending institution but the lender could deduct the financing costs from other sources of income. Thus a financial intermediary could reduce the effective interest rate charged on a financial 'loan' made to a non-financial company. The debt-equity ratio of the issuing corporation would fall, depending upon the extent to which the non-tax paying corporation issued term preferred shares rather than income debentures. As a consequence of after-tax financing, the average corporate tax rates on banks fell from 50% to less than 10% during the period 1979-80.

After 1978, the tax law was amended several times to circumscribe after-tax financing. Only in one instance was after-tax financing encouraged. This was a special concession, given in 1980, to allow small businesses to issue bonds, the interest of which would not be taxed in the hands of the chartered banks. The budget of November 1978 no longer allowed the income on term preferred shares of more than 10 year duration and on income debentures to flow to a lending corporation free of tax.[5] Subsequent tax amendments imposed further restrictions. The law now allows the lender to receive non-taxable income earned on Small Business Development Bonds and term preferred shares of within five years duration, but only when issued by financially distressed companies.

There are a number of other provisions in the tax law that affect investment income earned by public corporations. These provisions apply especially to financial institutions. Such corporations are permitted to deduct a reserve equal to 1-1/2% of the first $2 billion, and 1% of the excess, of qualifying securities. The total deduction is limited to the previous year's deduction plus 1/3 of the maximum amount. When the deduction is more than the real value of doubtful debts, the difference is equivalent to an interest-free loan. The deduction can have lasting value, if loan volume grows.

Certain financial institutions are also given special tax concessions. Two important cases are pension funds and insurance companies. Pension plans are explicitly exempt from tax, since these plans are intended for retirement. Moreover, no dividend tax credit is paid to the pension plan. Thus the pension holder can be better off owning equity assets outside the pension plan rather than within it. This suggests then the tax system induces pension plans to prefer debt rather than equity issued by other corporations.

Insurance companies are taxed on income defined as net revenues generated on financial assets less a reserve deduction for income owing to policy owners. A policy reserve deduction is permitted on dividend income received by an insurance company. An incentive for an insurance company to purchase equity would arise, if the tax rate of the equity-issuing corporation were less than that faced by the insurance company. Federal regulations restrict the amount of equity that may be owned by an insurance company.

Private Corporations

The tax system makes a serious attempt to integrate taxes on all forms of investment income of a private corporation with the incomes of its owners. The integration of investment income is achieved by a special refundable tax (Part IV) of 25% on dividend income earned by a corporation, a 46% tax on interest, rent and dividends from foreign sources, and 50% of income from capital gain. A tax credit is paid out on the distribution of dividends equal to $1 for $4 of dividends paid. This refund offsets taxes payable on dividends received by the corporation and reduces the effective tax rate on other investment income to 33%. The distribution of this investment income as dividends is subject to the dividend tax credit. As for net capital gains earned by a corporation and paid out as dividends to shareowners, the tax credit of 25% is approximately equal to the initial tax on capital gain income which is 1/2 of 46%, namely 23%.

The refund on Part IV taxes to a private corporation is limited by the amount of tax already paid by it and not yet fully credited. This is the "refundable dividend tax on hand" and it limits the ability of firms to apply the tax credit against non-qualifying income. The purpose of these integration measures is to reduce the incentive for individuals to defer personal taxes on investment income, by leaving such income in an investment company.

The tax law, as applied to private corporations, does not favour the holding of any portfolio investment, bond or equity, by a private investment corporation. Individuals who own private holding companies would be indifferent to owning debt or equity issued by the non-financial corporation, if such assets were held as part of the holding company's portfolio rather than part of the individual's portfolio. Public corporations, however, are not indifferent to the financial policy undertaken by another public corporation that an intermediary owns. For the tax reasons cited above, the public corporation prefers debt rather than equity financing when the issuing corporation may be paying no tax and can transfer its interest deductions to a financial institution. A public corporation also prefers the profits of another corporaton not to be retained for investment, if capital gain taxes are paid on the value of shares owned by the intermediary.

1.2.3 Foreign Investors

Canadian businesses may be financed by corporations or individuals of a different nationality. A distinction is made between Canadian-controlled and foreign-controlled companies. Canadian-controlled private corporations may claim the small business tax credit while foreign-controlled companies (if more than 50% of equity is foreign-controlled) are subject to the general rate of corporate taxes. Many foreign-controlled companies, often private companies, are subsidiaries operated by multinational companies. Consequently, special tax planning issues may be involved with the financing of their subsidiaries. The implications of taxing foreign investment in Canada, by distinguishing between Canadian-controlled and foreign-controlled firms, are discussed below. It is quite difficult to decide when a business is controlled by foreigners since the tax law recognizes three levels of control, 10%, 25% and 50%; this will be illustrated below.

Canadian-controlled Companies

When Canadian-controlled private or public corporations are in part owned by foreign investors, certain international tax conventions become important in assessing the tax liabilities of the foreign investors. Canada has double taxation agreements with most industrialized or newly-developed countries. Attention will be paid to the taxation of investment coming from these countries. Indeed, much of the foreign investment in Canada originates from the United States and Europe.

When a Canadian-controlled corporation pays out interest or dividends, a Canadian withholding tax is assessed on such income. Exceptions to this rule are interest on long-term corporate bonds paid to "arm's length parties" and interest paid by Canadian financial intermediaries that are members of the Canadian Payments Association. Capital gain income attributable to foreigners is also exempt from withholding taxes except for capital gains arising from the sale of private corporations and Canadian real estate. This reflects the difficulty of taxing capital gains on shares listed on both Canadian and foreign stock exchanges.

The general rate of the withholding tax is 25% although it is usually lowered to 15% by treaty. The total effective Canadian tax on dividends paid to foreigners is the corporate tax plus the withholding tax. Interest income, which is deductible from Canadian corporate tax, is only taxed at the withholding tax rate when applicable. For example, if the corporate tax rate is 40% and the withholding tax rate is 15%, then total Canadian taxes paid are 49% on dividend income and, at most, 15% on interest income.

Once a foreign individual or corporation receives income from Canada, the foreigner is able, under most tax systems, to credit some or all of the Canadian taxes against the tax liabilities owing on such income in the foreign country. The extent to which a foreign investor can credit Canadian corporate tax on business profits depends on the amount of ownership the foreigner has in a Canadian business. Current U.S. law requires a minimum of 10% ownership in order that a U.S. company may claim tax credit for corporate taxes paid in another country. Discussion of the crediting of Canadian corporate income taxes is deferred until the next section.

The ability of a foreign investor to gain credit for Canadian withholding tax depends on the rates of taxation in Canada and abroad and the type of foreign tax credit permitted under the foreign country's tax law. Some countries, notably the United States, permit taxpayers to use a global tax credit: the U.S. taxpayer aggregates all income from all countries and credits foreign taxes paid against U.S. tax liabilities payable on world-wide income. If the foreign tax paid is less than the U.S. tax liability on a foreign income, then an excess foreign tax credit will arise which is the difference between the U.S. and foreign taxes payable. These excess tax credits can be used to offset insufficient tax credits arising from elsewhere. Other countries, such as the United Kingdom, permit taxpayers to calculate tax credits per country. This limits an investor trading in international markets from offsetting excess foreign tax credits generated by low taxation in one foreign country against high taxes in another.

Foreign investors are usually in a position to credit Canadian withholding taxes against personal or corporate resident tax liabilities. There have been important exceptions to this, however. When the foreign investor is a financial intermediary investing in Canadian assets, especially bonds, it may be difficult for the financial intermediary to gain credit for Canadian withholding taxes. This will occur when the financial intermediary is debt financed. The intermediary is paying little tax to his own government, whereupon Canadian withholding taxes may not be credited. It was for this reason that the Canadian withholding tax on long-term bonds was suspended in 1976.

A similar inability to gain credit from Canadian withholding taxes arises when a foreigner is able to shelter his saving from taxation in his own country. An important example of the latter is pension funds of other countries which cannot use a tax credit for foreign withholding taxes since they are exempt from taxation.

When only Canadian withholding taxes are credited by a foreign investor against taxes of the country of residence, then the foreigner might prefer a Canadian corporation to be debt financed. The effective tax on interest income received from a Canadian corporation will be the personal or corporate tax payable by the foreigner on interest income.[6] An equity asset will be taxed, however, at the Canadian corporate tax rate plus any tax liabilities on either dividends or capital gains in the country of residence. If the combined Canadian and resident-country tax on equity income is more than that on interest income, the foreign investor will prefer a Canadian corporation to be debt financed. This question is dealt with in Chapter 2.

Foreign-controlled Corporations

Tax considerations for foreign-controlled corporations in Canada are the same as discussed above, except that Canadian corporate income taxes (both federal and provincial) are credited against the taxes of the resident country. Canadian law recognizes foreign control when it is more than 50% of voting equity, although corporate taxes are credited in the U.S., if U.S. ownership of a Canadian firm is more than 10%. There are two additional factors that are important in influencing foreign-controlled corporate financing in Canada. The first is the impact of the foreign tax credit in countries such as the United States which applies only to income patriated to the foreign parent. The second is the impact of the 'thin capitalization' rule which applies to foreign-controlled corporations operating in Canada, foreign control being defined as more than 25% ownership.

With respect to the operation of the foreign tax credit, Canadian corporate taxes are credited on dividends received by a parent from a subsidiary and on profits earned by a branch in Canada. A few countries, however, include retained profits of subsidiaries in the tax base for the calculation of tax credit. A U.S. tax credit, for example, is given for tax liabilities paid on patriated income. As shown by Hartman (1982), this can give an important advantage to a foreign subsidiary, namely, to finance investment with retained earnings. This arises in Canada if the effective corporate tax rate on investment (having allowed for accelerated depreciation and investment tax credits) is less than the U.S. effective corporate tax rate on patriated income. With this situation, the U.S. subsidiary is able to defer U.S. taxes by reinvesting profits. The value of the deferral is greater when the difference between Canadian and U.S. tax rates increases. Thus retained earnings is a favourable source of finance for foreign subsidiaries operating in Canada, compared with new equity issues and debt.

There are other important international tax issues that influence the financing decisions of foreign corporations operating in Canada. For example, there are circumstances under which debt finance may be a favoured source. A U.S. parent corporation paying low taxes in the U.S. would prefer to reduce Canadian (and worldwide) tax liabilities as much as possible, which may be done by increasing debt financing of a subsidiary operating in Canada. In this way, the parent corporation pays only Canadian withholding taxes rather than corporate plus withholding taxes (which could be more than the tax liability in the U.S.). Canada limits this possibility by applying a 'thin capitalization' rule: interest paid on debt owing to a related non-resident is not deductible to the extent that debt exceeds three times shareholders' equity. To be a related non-resident it is necessary to own at least 25% of issued equity shares.

There are other advantages resulting from debt financing by a foreign-owned subsidiary some of which arise only as a consequence of sophisticated tax planning. Because these issues become extremely difficult to quantify precisely, foreign-controlled subsidiaries have been excluded from the empirical work presented in Chapter 3. This is no small drawback, since tax effects on financing are likely to be important in an international setting.

1.3 Goals and Limitations

There are three specific aims of the research reported in Chapters 2 and 3. These are:

(i) to determine whether corporate and personal taxation can influence leverage (measured as the debt-asset ratio) of Canadian-controlled public corporations;

(ii) to estimate the impact of various provisions in the corporate and personal tax law on leverage, bearing in mind the openness of the Canadian capital market to international credit markets; and

(iii) to discuss whether tax policy should be used as a means of inducing firms to rely more or less on debt financing.

The scope of the work reported below is limited in several ways. First, only equity and debt financing are dealt with. Thus the distinction between retained earnings and new equity issues is ignored. Taxes can influence the composition of equity financing undertaken by businesses, a topic that has been the subject of recent work on dividend policy and taxation. Poterba and Summers (1984) provide an excellent discussion of the issues associated with dividend policy and taxation. The present work may be viewed as complementary to studies of dividend policy. The personal tax on equity, as defined in Chapter 2, may be viewed either as the tax rate on capital gains, the dividend tax rate or a weighted average of personal tax rates on equity income. As Poterba and Summers demonstrate, the appropriate tax on equity income depends on the role of dividends in conveying information about a firm and the degree to which markets can eliminate differences in after-tax returns on various assets through arbitrage.

A second limitation of this study is that it concentrates only on Canadian-controlled public corporations and excludes foreign-controlled public companies and private corporations. As indicated earlier, the taxation of foreign-owned corporations is a fairly complicated issue and the effects of taxation on financing depend upon the prevailing Canadian and foreign tax law. It is too complicated a task, within the scope of the present study, to sort out all of the international tax systems as these affect the financing of foreign-controlled subsidiaries in Canada. The absence of Canadian-controlled private corporations in the study is simply a consequence of data limitations. Use has been made of the Compustat file of over 300 public companies listed on the Toronto Stock Exchange. To include private corporations would require another source of data, including information on ownership.

Thirdly, the financing behaviour of Canadian financial institutions is not examined. While the tax system has important consequences for the composition of assets and liabilities of these institutions, a more detailed study would be needed to separate tax from regulatory effects. For example, banks tend to be more levered as a result of the Canada Deposit Insurance, since this does not charge experience-related premiums when insuring the deposits of qualified institutions. Moreover, many financial intermediaries are restricted by legislation to maintain a certain amount of equity assets as part of the institution's portfolio. The impact of taxation on financial intermediary behaviour is an important, but difficult, subject that goes beyond the scope of the present study.

Given the limitations, it should be emphasized that Canadian-controlled public corporations account for a substantial amount of investment in Canada and dominate most sectors of the economy. In consequence, the results of the present study are likely to provide some useful pointers to the general effects of taxation on the financing of businesses in Canada.

Footnotes

1. Debt refers to the liabilities of a corporation reflecting a prior claim of lenders to the assets of a firm that becomes bankrupt. Debt can be short- or long-term and secured debt has the first claim on assets compared with unsecured debt. Equity refers to the value of shares in the firm including the implicit value of retained earnings.
2. See the Department of Finance (1984).
3. These measures include a refundable tax credit for non-tax paying companies that flow through to the purchasers of new equity.
4. These limits may be avoided by not declaring the entitlement to the capital cost allowance of the firm for the year. Exploration and development expenditures, as well as earned depletion, may be carried forward indefinitely and certain exploration and development deductions can benefit the equity owners.
5. Another mechanism of after-tax financing includes the limited partnership in which partners may deduct losses of projects from another source of taxable income.
6. Capital gains or losses arising from currency revaluation affect the investment income of foreign investors. This source of income is taxed at a lower rate than dividend and interest income in the hands of the investor.

CHAPTER 2

TAXATION AND FINANCIAL POLICY: THEORY

2.1 Introduction

The impact of taxation on the financial policy of firms has been the subject of a voluminous literature during the post war period. Much of the literature has concentrated on an important controversy that began with the analysis of Modigliani and Miller (1958). The common perception prior to the appearance of this work was that financial policy (such as the amount of debt issued relative to equity) mattered to the firm, since the value of the firm would be affected by the method of financing capital acquisition. However, Modigliani and Miller showed that financial policy may be irrelevant, in the sense that the value of the firm is independent of its leverage. This argument rested on the so-called 'homemade leverage theorem': if a firm borrows more debt and less equity, households respond by reducing equity assets in favour of bonds or borrowing less funds to finance their equity portfolios. So long as the corporate and personal lending and borrowing interest rates are identical when adjusted for risk, then the value of the firm is unaffected by its financial policy.

As is well known in the literature, the Modigliani-Miller hypothesis is based on some strong assumptions: (i) the categorization of firms into well-defined risk classes; (ii) the absence of bankruptcy costs; (iii) the absence of transaction costs; (iv) equal information about firms must be available to all investors; and (v) there is no taxation. Each of these assumptions has spawned new research designed to extend or nullify the Modigliani-Miller hypothesis in a more realistic economic environment. Models have been developed to include such features as incomplete markets for risk bearing [Auerbach-King (1981), bankruptcy [Stiglitz (1972), Scott (1976) and Stapleton (1975)], advantages from information to inside investors [Leland-Pyle (1977), Ross (1977), Bhattacharya (1979) and Myers and Majluf (1985)], and managerial incentive or agency problems [Jensen-Mecking 1976), Grossman-Hart (1980) and and Fama (1980)].

Another area of research of special interest to this chapter is the effect of taxation on the financial policy of firms. As discussed in Chapter 1, Canada like most Western tax systems, allows borrowing costs to be deducted from corporate taxable income and levies different taxes on dividends, capital gains and interest income accruing to individuals. It is certainly possible that sources of equity income can be taxed at a rate higher (lower) than debt income, if the combined corporate and personal tax on dividend and/or capital gain income is more (less) than the tax on interest income. As shown by Stigitz (1973), firms could be all-debt or all-equity financed, depending on the tax rates faced by the marginal investor in the economy. Aggregating across income classes, so long as the tax on equity is more than that on debt, firms should be all debt financed in a Modigliani-Miller economy. Of course, such a result is simply not observed in reality. For this and other reasons, several studies since 1972 have looked at alternative financial models incorporating more realistic features of capital markets.

This chapter aims to compare several financial models that permit study of the impact of taxation on the financial policy of firms, in particular the impact of taxation on debt-asset ratios. Each model will be analyzed separately so that the exact relations between financial policy and taxation may be developed. In Section 2.2, four models are considered: (i) a certainty model with investors in different income classes following Miller (1977);

(ii) a model without bankruptcy incorporating uncertainty and an asymmetric treatment of taxable profits and losses under the tax system [DeAngelo-Masulis (1980)]; (iii) a model with taxation and uncertainty such that the debt-asset ratio infuences the manager of the firm to work harder; and (iv) a model with bankruptcy costs and full loss offsetting in the tax system.[1] In each of these models, an equilibrium debt-asset ratio may be derived, at least for the aggregate of all firms. This depends on the tax rates faced by firms and their investors as well as other exogenous factors, like interest rates, uncertainty, the level of demand and so on. Comparative static results are obtained where possible, so that the models are empirically distinguishable.

The latter models described above have been recently termed "static tradeoff" models [see Myers (1984)]. The property of these models is that firms issue debt until its marginal benefit (such as reduced corporate and personal tax liabilities) is equal to its marginal cost (such as increased agency and bankruptcy costs).

Another type of model recently explored in the literature is one with asymmetric information. In these models, the type of security issued to finance investment indicates to outside investors the quality of the firm. However, a cost is involved with issuing certain securities. Myers and Majluf (1985) show that inside investors prefer the firm to use internal finance (retained earnings) rather than external sources of finance. Bonds are also preferred to new equity issues as a source of finance. Myers terms this the "pecking-order" hypothesis in that some forms of securities are preferred to other sources of finance.

At the end of Section 2.2, we discuss some of the implications of the "pecking-order hypothesis" in relation to the "static tradeoff" models that are presented in detail. We do not offer, however, an extensive analysis of "pecking-order" models which would take this study to far afield.

Much of the anaysis in Section 2.2 is based on a very simple economy. In Section 2.3, several complications are introduced: (i) the openness of Canadian capital markets; (ii) inflation; (iii) the separability of investment and financial policies; and (iv) the adjustment costs which are incurred when financial policy is changed. Incorporating these complications into the environment in which the models operate leads to some relatively straightforward extensions of the basic comparative static results. The analysis would have been much more burdensome, had the more realistic environment been introduced at the outset.

The ultimate goal of this chapter is to develop models which contain different aspects of behaviour which, when put together, allow a realistic empirical appraisal of the impact of taxes on the financial policy of firms. Section 2.4, which concludes the chapter, describes the various theoretical results that are of relevance to the empirical work of Chapter 3.

2.2 Financial Models

Each of the models to be developed will be formulated under four common assumptions: (i) there is no inflation; (ii) the owners of firms are risk neutral; (iii) investment and financial policy are independent (or the investment level is fixed); and (iv) firms face no transaction costs as financial policy is varied. The analysis proceeds on the basis of two, and only two, forms of finance: debt and equity. In the models that we develop in this chapter, the distinction between new equity and retained earnings is not important. In "static-tradeoff" models, the type of equity finance is determined independently of the leverage decision. However, in the "pecking-order" model which allow for inside investors to have more information than outside investors, the amount of retained earnings, and new equity issues used as sources of equity finance, depend on the debt decision of the firm.

No distinction is also made between long- and short-term debt, since there are no explicit tax consequences to be borne in mind if firms choose to switch from long- to short-term financing (or vice-versa). This is a consequence of the deductibility of interest from corporate taxable income, no matter what the source of debt finance.[2]

2.2.1 The Miller Equilibrium

Much of the early literature on the financial policy of firms and taxation presumed a single type of investor in the economy. It was forcefully argued by Miller (1977) that, given a progressive income tax, a model of financial behaviour should include many investors facing different marginal tax rates. This is followed below.

The original Miller model rests upon three important assumptions. These are:

A.1 Firms maximize their market value and individuals seek to hold those assets yielding the highest after-tax rate of return which is known with certainty.

A.2 Firms are not constrained in issuing debt or equity.

A.3 Individuals face restricted capital markets in which equity cannot be sold short and funds cannot be borrowed.

Assumption A.1 is in keeping with the literature. The Miller equilibrium has been extended to a model of uncertainty [Auerbach and King (1983)], but such an extension would add little to the analysis discussed in this chapter, at least at this point.

In regard to assumption A.2, earlier models such as Stiglitz (1973), assume that debt financing is constrained to be more than the value of capital or that firms do not simultaneously hold bond assets. If, for tax reasons, firms prefer debt to equity (or vice-versa), then the firm is limited in the amount of debt it can issue and it cannot engage in arbitrage to take advantage of differentials in the cost of finance induced by taxation. In the Miller equilibrium, no constraints are imposed on the firm in respect of issuing debt or equity.

Assumption A.3 is controversial. Individuals, unlike firms, are limited in their capacity to engage in arbitrage between after-tax interest rates arising from differing tax rates on debt and equity. If the tax rate on debt interest is less than that on the returns from equity, and before-tax returns on these assets are equal, then an investor would prefer to own as much debt as possible. The amount of debt held in a portfolio may be increased by selling equity short [i.e. selling equity which is not presenty held and buying later, when delivery is required, the gain (or loss) per share being the fall (or rise) in price in the meantime]. If the tax rate on equity is less than on debt, equity may be bought and held long (i.e. in excess of 100% of the total value of the firm's assets) and debt sold short. With no capital market constraints, an investor would hold infinite amounts of some assets and sell short infinite amount of other assets. Miller imposes assumption A.3 to segment the market, thereby limiting possible arbitrage that would arise from after-tax interest rate differentials. As will be shown below, the Miller equilibrium depends on arbitrary financial constraints faced by investors, without explicit justification of such constraints. In a hypothetical world of certainty, such capital market constraints on investors are hard to justify. However, in a more realistic environment (e.g. one with uncertainty and differing amounts of information available to investors) such constraints may be quite sensible.

The Miller equilibrium may be derived as follows. Let ρ denote the marginal return on capital, K, which is financed either by equity, E, or by debt, B. Let ρ_E denote the annual return paid on each dollar of equity, before payment of personal taxes. Equity owners receive the return on capital less the interest paid on debt and less corporate taxes. The corporate tax is levied on the return to equity; only the costs of borrowing are deductible from net revenues generated by capital. The return to equity is thus equal to the after-corporate-tax income divided by the amount of equity:

$$\rho_E = \frac{(\rho K - iB)(1-u)}{E} \qquad (2.2.1)$$

in which u = corporate tax rate and i = interest paid per dollar of issued debt. Let Θ^j denote the personal tax rate on equity held by the jth individual. This may be viewed as a combination of the effective tax rate on dividends and accrued capital gains. Interest on debt is taxable at the rate m^j for the jth individual. Let r^j_D be the after-tax return on debt, and r^j_E the after-tax return on equity, both the jth individual. Then $r^j_D = i(1-m^j)$ and $r^j_E = \rho^E(1-\Theta^j)$. An investor will prefer holding all debt, all equity or some of each according to the investor's personal tax rate; namely according as $r^j_E < r^j_D$, $r^j_E > r^j_D$ or $r^j_E = r^j_D$, respectively. It is here that assumption A.3 plays an important role in the analysis. If the after-tax return on equity is more (less) than the after-tax return on debt, then the investor will specialize in owning equity (debt). The investor cannot purchase unlimited amounts of equity or bonds, because no borrowing of debt or short selling of equity is permitted. If the after-tax returns on the two assets are equal, the investor is indifferent between debt and equity and hence is unconcerned about how much of each to hold in a portfolio.

Let γ be the debt-asset ratio: $\gamma \equiv (B/K)$. Clearly $B = \gamma K$ and $E = (1-\gamma)K$. Using equation (2.2.1), the implicit value of total equity attributable to the jth investor, V^j_E, may be written as the capitalized value of the after-tax return paid to the jth investor using as the discount rate the corresponding opportunity cost of investing funds elsewhere, r^j_E. Thus

$$V^j_E = \frac{(\rho K-\gamma ik)(1-u)(1-\Theta^j)}{r^j_E} \quad . \tag{2.2.2}$$

The value of the firm's equity is determined in the market by the marginal investor. A crucial aspect of the Miller equilibrium is that intra-marginal investors are constrained from purchasing more equity. Consequently, intra-marginal investors value the firm differently from the market equilibrium value. Similarly, debt owners are unable to purchase more debt because they cannot borrow from the stock market by selling short.

The value of the firm V is the value of its debt, B, plus the value of its equity. The value of a firm's equity is determined from (2.2.2) in the market, by the marginal investor. In this setting, it is helpful to drop the superscript j and to regard Θ, r^E and V^E as continuous variables. Thus

$$V = V_E + B = \frac{(\rho K-\gamma iK)(1-u)(1-\Theta)}{r^E} + \gamma K \quad ,$$

and capital is common to all terms on the right-hand side. Consequently, the last equation may be normalized with respect to capital, whereupon K becomes unity. Hence, in units of capital,

$$V = \frac{1}{r_E} [\rho(1-u)(1-\Theta) + \gamma\{r^E - i(1-u)(1-\Theta)\}] \quad . \qquad (2.2.3)$$

Thus the value of a firm depends on the debt-asset ratio, γ, unless $r_E = i(1-u)(1-\Theta)$; i.e. unless the after-tax opportunity cost of equity finance, r_E, is equal to the after-corporate- and after-personal-tax cost of debt finance $\{i(1-u)(1-\Theta)\}$. If $r_E > i(1-u)(1-\Theta)$, then theoretically the firm can increase its value without bound, by increasing the debt-asset ratio without bound, in view of assumption A.2 and the fact that interest (i) and tax rates (u and Θ) are given exogenously. To reach an equilibrium, firms may be thought of as continuing to issue debt, so long as investors are willing to hold it. As shown above, investor j prefers debt to equity whenever $\rho_E(1-\Theta^j) < i(1-m^j)$. Consequently, as the firm issues more and more debt, it may be taken up by investors in higher and higher tax brackets until those in the highest tax bracket are constrained by their inability to sell short. Let the tax rates of these marginal investors be at $\Theta = \Theta^*$ and $m = m^*$. The process of issuing debt, then, may continue until

$$r_E - \rho_E(1-\Theta^*) = i(1-m^*) \quad ,$$

whereupon no more investors may be found to hold more debt, since this would require $r_E < i(1-m^*)$. When $r_E = i(1-m^*)$, the value of the firm can increase no further and $r_E = i(1-u)(1-\Theta^*)$ according to (2.2.3). It follows that equilibrium is determined when $r_E = i(1-m^*) = i(1-u)(1-\Theta^*)$ implying

$$m^* = u + \Theta^*(1-u). \tag{2.2.4}$$

Thus the firm issues debt until the tax rate on equity applying to the marginal investor $[u + \Theta^*(1-u)]$ is equal to the tax rate applying to the same marginal investor on interest income (m^*). Now there is some number α for which $\Theta^*=\alpha m^*$. It then follows from equation (2.2.4) that

$$m^* = [\frac{u}{1 - \alpha(1-u)}]$$

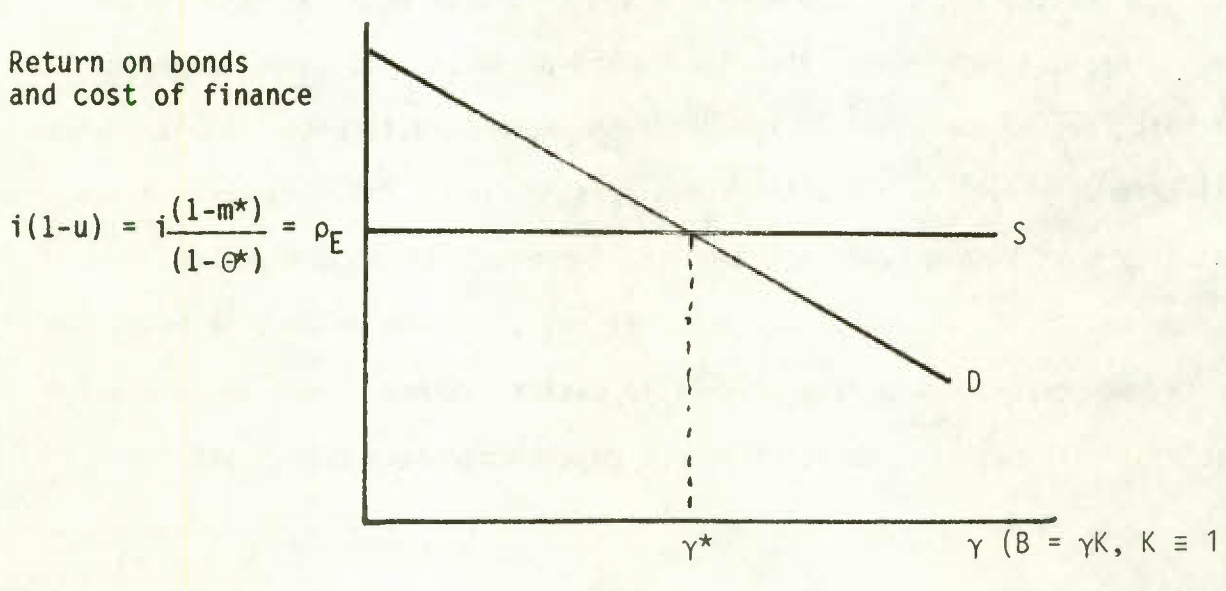
which is a relationship between the corporate tax rate and the personal tax rate on interest for the marginal investor. Investors with higher incomes than the marginal investor - who face a personal tax rate on interest greater than m^* - will own debt. Given the absence of uncertainty in the model, complete specialization of asset ownership is obtained, except for the marginal investor who may own both debt and equity. With uncertainty, complete specialization would not occur, since risk as well as tax considerations would influence the portfolio decisions of investors [see Auerbach and King (1983)].

The Miller equilibrium thus predicts the following: a firm is indifferent between issuing debt and issuing equity, since the marginal investor is indifferent between holding these two assets. Nevertheless, an aggregate debt-asset ratio will exist and may be calculated. This depends on the aggregate savings made available by investors of differing incomes and the nature of capital market constraints faced by them. In Diagram 2.2.1, the demand for bonds by households (D) and the supply of bonds by firms (S) are illustrated. The demand for bonds depends on personal tax rates. Households will demand bonds if the return on bonds is more than the opportunity cost of holding bonds, which is the after-tax return on equity. Equilibrium in capital markets implies that the jth household will own bonds if the after-tax return on equity is less than on bonds: $\rho_E(1-\Theta^j) < i(1-m^j)$ implying that $\rho_E < \{i(1-m^j)\}/(1-\Theta^j)$. If $\{i(1-m^j)/(1-\Theta^j)\}$ is viewed as the tax-adjusted return on bonds, the jth household will hold bonds if this return is more than the after-corporation-tax return on equity ρ_E. Since as income rises the personal tax on equity rises less quickly than the personal tax on debt, the tax-adjusted return on bonds will fall, the higher is income. For the marginal investor, $\rho_E = \{i(1-m^*)/(1-\Theta^*)\}$.

The supply of bonds by a firm is determined by the after-corporate-tax cost of issuing debt, $\{i(1-u)\}$. In equilibrium, the opportunity cost of issuing debt is equal to the return paid on equity, or $\rho_E = i(1-u)$. The supply of bonds is perfectly elastic with respect to the after-tax interest rate, since the interest rate is independent of the amount of bonds issued by the firm.

Diagram 2.2.1

Miller Equilibrium for the Financial Market



The aggregate debt-asset ratio, γ^*, clearly depends on the tax schedule faced by the investors of the economy. A higher corporate tax rate shifts the supply curve downward, causing the debt-asset ratio to rise. A lower statutory tax on equity (Θ) or a higher statutory tax on interest income (m) for all investors will cause the demand curve to shift leftward thereby reducing the debt-asset ratio.

Other factors can also affect the debt-asset ratio. An increase in the general level of income in the economy can cause individuals generally to shift into higher tax brackets. Given that the tax on interest (m) increases more than the tax on equity (Θ), then the demand for bonds will fall and the aggregate debt-asset ratio will fall. Or, suppose that capital market constraints are sensitive to the business cycle. Assuming that equity cannot be sold short no matter what the level of national income, and that individuals face different borrowing limits depending on the availability of credit, an increase in economic activity can raise borrowing limits, allowing individuals who prefer it to own more equity. Then the aggregate debt-asset ratio will fall due to an increase in the upper limit placed on borrowing from the market.

A change in the interest rate may also affect equilibrium. If the market interest rate rises, then the owners of bonds will move into higher tax brackets causing the level of the interest income tax to rise. Equity owners will generally realize a capital loss, arising from a fall in share values, so that they move into a lower tax bracket, thereby reducing the personal tax rate on equity, Θ, as well. The marginal investor, who holds both bonds and equity, may experience a rise or fall in capital income. Thus an interest rate rise will have an ambiguous effect on the aggregate debt-asset ratio.

Moreover, as has been argued above, it may be more difficult for individuals to borrow funds with an increase in interest rates, because capital market constraints becomes tighter thereby making fewer funds available to purchase equity. The total impact of an interest rate increase would then result in a reduction of the debt-asset ratio.

From the above discussion, the Miller financial equilibrium predicts that the aggregate debt-asset ratio depends upon the corporate tax rate and personal tax rates on equity and debt, aggregate income levels, and the level of interest rates. These variables affect the debt-asset ratio by bringing about (i) changes in the identity of the marginal investor and (ii) endogenous changes in capital market constraints.

There is one further complication with the Miller financial equilibrium. In many countries such as Canada, corporate tax rates vary across industries and different sizes of firms. The corporate tax on Canadian manufacturing industries, for example, is less than that on non-manufacturing firms (c.f. Chapter 1). Small firms also face lower tax rates. What happens to a Miller equilibrium when there are different corporate tax rates from firm to firm?

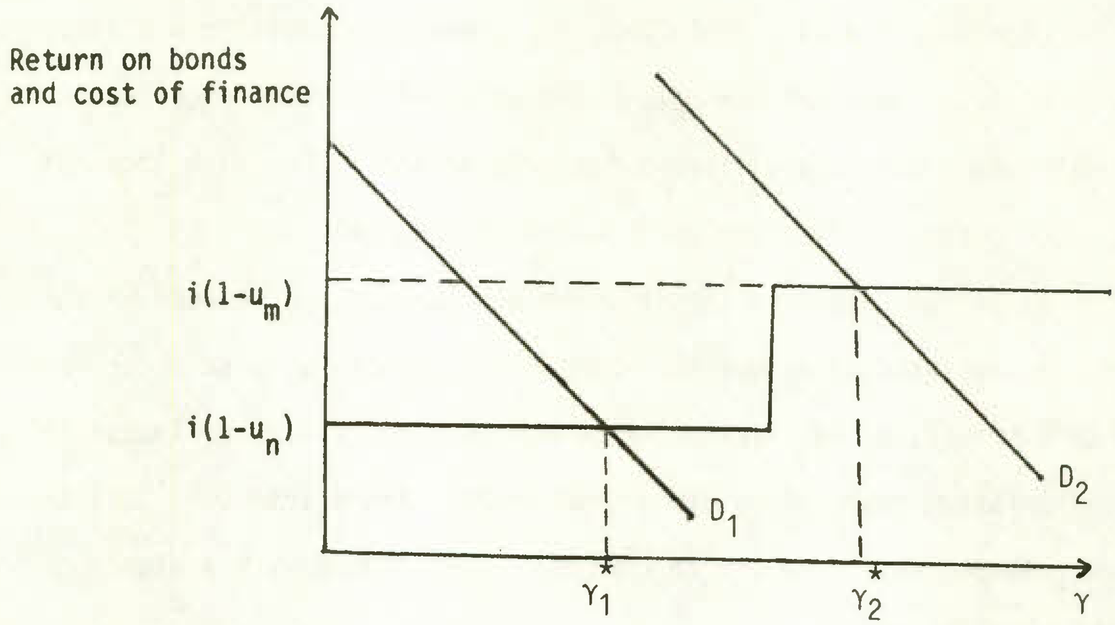
Consider the Miller model with two types of firms: low-tax rate (manufacturing) and high-tax rate (non-manufacturing) firms. Suppose both types of firms issue equity. Since a non-manufacturing firm faces a high corporate tax rate, it benefits more from issuing bonds compared with the low tax rate manufacturing firm. Moreover, the manufacturing firm can offer an after-tax return to equity higher than that offered by the high tax rate non-manufacturing firm. Investors who prefer equity would be attracted to own the manufacturing firm's equity. For a given level of capital stock, the manufacturing firm could issue equity until it could no longer sell it, because individuals prefer debt or the manufacturing firm requires no more finance.[4] Depending on the aggregate level of savings from households of different income classes, the manufacturing firm will be all equity financed or partly equity and partly debt financed. If the manufacturing firm is only equity financed, then the non-manufacturing firm will issue debt until a marginal investor is indifferent to holding debt or equity. Thus, in equilibrium, the manufacturing firm would be all equity financed and the non-manufacturing firm would be partly equity financed, or the manufacturing firm would be partly financed and the non-manufacturing would be all debt financed. The after-tax return on equity and debt for the manufacturing firm would be more than for the non-manufacturing firm. Thus, if capital moves between the sectors, the marginal before-tax return to capital (ρ) in manufacturing would be less than that for non-manufacturing and after-tax rates of return on all assets would be equalized.

Diagram 2.2.2 illustrates the two possible equilibria in a Miller model with differential corporate tax rates, u_n for non-manufacturing firms and u_m for manufacturing firms, $u_n > u_m$. The supply curve of debt is discontinuous, jumping upward at the point where the non-manufacturing firms would cease issuing bonds to finance capital acquisition. The two demand curves, D_1 and D_2 are for low savings (D_1) and high amounts of savings (D_2) available to bond markets. For the demand curve D_1, the non-manufacturing firms are both debt and equity financed, while manufacturing businesses are only equity financed. For the demand curve D_2, non-manufacturing firms are debt-financed only while manufacturing businesses are both debt and equity financed.

In a Miller equilibrium with differential corporate tax rates, low-tax rate firms are expected to be more equity financed than high-tax rate firms. Changes in the tax rates would affect the financial policy of one set of firms but not that of the other which are not wholly owned by the marginal investor.

Diagram 2.2.2

Miller Equilibrium with Differential Tax Rates



2.2.2 Imperfect Loss Offsetting

The argument that corporate taxation favours debt financing, and that firms can thereby be encouraged to become fully levered, has been made for taxation systems that treat profits and losses symmetrically. For example, a system in which the government provides a refundable tax credit representing its share of a taxable loss incurred by a firm would be symmetrical. However, tax systems rarely provide for a symmetric treatment of profits and losses. De Angelo and Masulis (1980) [and recently, Mayer (1986) and Auerbach (1986)] point out that taxable losses would be incurred by a firm financed solely by debt, because the firm cannot then take advantage of certain available 'tax shields', like accelerated depreciation allowances. When a firm becomes non-taxable due to its debt policy, it may be at a disadvantage, insofar as the personal tax on interest income is more than that on equity income. This is pointed out by Mintz (1983) who also suggests that imperfect loss offsetting on the personal side may induce firms to choose less debt financing.

A simple, risk neutral model, leading to an optimum financial policy determined solely by taxation, is developed below. This concentrates on the treatment of corporate taxable losses and, for simplicity, full loss offsetting is assumed on the personal tax side. The marginal investor faces a tax rate on equity and a possibly different tax rate on debt. The firm does not go bankrupt and offers a risk-free bond to finance capital.

Let $\rho(s)$ be the return to capital, net of depreciation, earned by the firm in the future state of nature s. Which state of nature is to occur is not known to investors or the firm prior to making a portfolio or financial decision. The future state of nature s lies in the closed interval $[0,s]$ and it is assumed that a higher return to capital is associated with a higher value of the state of nature.

Equity owners of the firm earn a return on their investment in each period. This is equal to the return to capital less debt financing costs and corporate taxes. As before, the rate of interest paid on debt financing is equal to i and the debt-asset ratio is γ. With constant returns to scale, the value of the firm is independent of its size so the value of capital is set equal to unity.

Corporate taxable income is equal to the return to capital less the interest costs of debt finance and any special allowances for capital investment, over and above the true cost of using capital; examples of this are the investment tax credit and accelerated depreciation allowances.[5] Let $\chi(s)$ be the value of these allowances in state s. The value of allowances could depend upon the state of nature if, for example, capital good prices vary across the state of nature. Corporate taxable income in state s, CT(s), can thus be defined as

$$CT(s) = \rho(s) - \gamma i - \chi(s). \tag{2.2.5}$$

If corporate taxable income is positive, the firm pays corporate taxes at the rate u. If corporate taxable losses are incurred, then the government pays to the firm a refundable tax credit or permits losses to be carried back or forward against other tax liabilities at the rate βu, $0 \leqq \beta \leqq 1$. The state of nature when corporate taxable income is zero in value is $s = s_c$. Note that s_c falls with a higher return to capital and rises with a higher debt-asset ratio, interest rate or value of the tax shield. Thus s_c is given by

$$s_c = s_c[\rho(s), \chi(s), i; \gamma]$$

in which $\frac{\partial s_c}{\partial \gamma} > 0$, $\frac{\partial s_c}{\partial \rho(s)} < 0$, $\frac{\partial s_c}{\partial \chi(s)} > 0$ and $\frac{\partial s_c}{\partial i} > 0$.

One can view β as a refundability parameter indicating the extent to which there is loss offsetting under the corporate tax: if $\beta=1$, the tax provides a full loss offset. Note that β is independent of both the state of nature and the size of corporate taxable losses. It is conceivable that β could vary with the size of losses, but to avoid unnecessary complication it is treated as a constant.

The return to equity in each state of nature is equal to

$$\rho_E(s) = \frac{\rho(s) - \gamma i - u(s)\ CT(s)}{E}$$

$$= \frac{\{\rho(s) - \gamma i \beta\{1 - u(s)\} + u(s)\ \chi(s)}{(1 - \gamma)}$$

where use is made of (2.2.5) and $E = (1-\gamma)$, the value of equity. The corporate tax rate explicitly depends on the state of nature:

$$u(s) = \begin{cases} u & \text{for} \quad s_c \leqq s \leqq \bar{s} \, ; \\ \beta u & \text{for} \quad 0 \leqq s < s_c \, . \end{cases}$$

Under the personal income tax, the return to equity is taxed at the rate Θ; this is viewed as a combination of dividend and capital gains taxes. It is further assumed that all realized capital losses on shares sold can be fully written off against other personal income. There is thus full refundability for the personal income tax on equity. As in Section 2.2.1, it is assumed the personal tax rate on interest income is m. Investors can own both debt and equity issued by the firm. For the risk neutral investor, the opportunity cost of investing in the equity of the firm is thus $r = i(1-m)$.

The total value of the firm is equal to the discounted value of the return to equity plus the value of bonds:

$$V = (1-\Theta)\left[\frac{\int_0^{s} p_s[(1-u(s))(\rho(s)-\gamma i)+u(s)\ \chi(s)]ds}{r}\right] + \gamma \qquad (2.2.7)$$

where p_s is the probability that the state s will occur.

The firm chooses its debt-asset ratio so as to maximize its market value. The first-order condition for an interest maximum $(0 < \gamma < 1)$ yields, after some manipulation,[6]

$$\Theta + (1-\Theta)u[\hat{p}_c + \beta(1 - \hat{p}_c)] = m \qquad (2.2.8)$$

in which $\int_{s_c}^{\bar{s}} p_s ds = \hat{p}_c$ and $\int_0^{s_c} p_s ds = (1-\hat{p}_c)$, $\hat{p}_c$ being interpreted as the probability of corporate taxable income being non-negative.

The equilibrium condition in (2.2.8) states that a firm will choose an optimal interior financial policy until the tax on interest is equal to the expected tax on equity. There are two conditions for equation (2.2.8) to be satisfied. Given there is imperfect refundability ($\beta < 1$), an interior debt-asset ratio will be chosen if (i) the personal tax rate on equity is less than that on debt ($\Theta < m$) and the combined personal and corporate tax rate on equity is more than that on debt [$u + \Theta(1-u) > m$]; (ii) corporate taxable income is negative in some states of nature.

The first condition is required for an interior debt policy. If a firm chooses all equity finance then the tax rate on equity must be less than the tax rate on debt. Otherwise, the firm could increase its market value by issuing debt, to take advantage of beneficial interest deductions from the corporate tax. If the firm chooses to be all debt financed, then the effective corporate and personal tax on equity must be more than that on debt. Suppose that corporate taxable income is negative in all states of nature ($\hat{p}_c = 0$), when the firm is fully debt financed. Suppose further there is no loss offset (β=0). Under these conditions, a firm will be all debt financed, if the personal tax rate equity is more than that on debt. Otherwise, the firm will be able to raise its market value by decreasing the debt-asset ratio.

Condition (ii) above can also be important for an interior financial policy. If a corporation pays taxes no matter what state of nature arises ($\hat{p} = 1$), then equation (2.2.8) will only be satisfied if the combined corporate and personal tax rates on equity are equal to the tax rate on debt [$\Theta + (1-\Theta)u = m$]. If this were true, then some marginal investor would be indifferent to holding debt or equity in the firm. If this is the case, then the financial policy of the firm would have no effect on its market value and, consequently, the debt-asset ratio would not matter to the firm. So under what conditions would taxable losses be incurred? DeAngelo and Masulis stress tax shields, such as accelerated depreciation, that contribute to corporate taxable losses, book profitability remaining positive. Even without generous tax deductions, however, taxable losses could be incurred if net revenues are at times negative due to cyclical downturns in the economy. Regardless of the source of taxable losses, their existence with imperfect refundability will lead the firm to be concerned about its financial policy.

It is clear from equation (2.2.8) that the optimum financial policy of the firm depends on corporate and personal tax rates. In addition, any parameters that affect the probability of corporate taxable losses, the level and uncertainty of the return to capital, the interest rate, and the value of tax shields will also affect the optimal debt-asset ratio.

In Table 2.2.1 below the comparative static results are reported. The sign "↑" denotes that an increase in the value of a variable will cause the debt-asset ratio to increase. A "↓" indicates the converse.

Table 2.2.1
The Effect of Exogenous Parameters on the Financial Policy of Firms

Increase in the Value of	Debt-Asset Ratio
Corporate tax rate: u	↑
Personal tax rate on equity: Θ	↑
Personal tax rate on interest: m	↓
Loss offset parameter: β	↑
Interest rate: i	↓
Corporate tax shield: $\chi(s)$	↓
Return to capital: $\rho(s)$	↑
Mean preserving increase in riskiness of the return to capital	↓

The imperfect loss offsetting model, as outlined above, provides a clear prediction concerning the effect of various tax and economic variables on the debt policy of a firm. As with the Miller equilibrium, however, an explicit functional form for the behavioural equation to be estimated cannot be derived from the theory, without restricting the functional relationship between the return to equity and uncertainty, and the probability density function defined over the states of nature.

2.2.3 Managerial Incentive Model

The financial literature has long recognized that the financial policy of a firm influences the decisions taken by managers who have personal objectives different from the maximization of profits. For example, managers may act as if they are minimizing effort or maximizing the size of the firm. Jensen and Meckling (1976), for example, examined how the issuing of voting and non-voting common shares can influence the decisions taken by the managers of firms. Voting shares allow shareholders to monitor the manager and reduce 'agency' costs arising from the reduction of effort by managers.

A model of a firm comprising identical principals and risk-neutral shareowners, is developed below. The shareholders design an optimal contract with an agent, who is the risk averse manager of the firm. The shareowners are interested in the maximization of expected profits and the manager is interested in maximization of his expected utility, defined according to level of labour compensation and effort. The shareowners of the firm observe the profits of the firm, once the state of nature is known. However, they do not know the state of nature when contracting with the manager. Moreover, the shareowners cannot observe the effort level of the manager; thus low profitability could signify, for example, poor economic conditions or low effort on the part of the manager. The manager, however, has more information than the shareowners. He knows his own level of effort although this is chosen subject to uncertainty, because it is chosen before knowing the state of nature.

The shareowners design a reward scheme for the manager, based on the observable ex post profits earned by the firm.[8] Without imposing any restrictions on the optimal incentive payment, this problem would be rather complicated to solve. For this reason, the optimal managerial payment is restricted to be a nonstochastic linear share of equity profits (revenues net of debt interest costs). The shareowners choose an optimal share of profits to be paid to the manager as a reward for his effort. The shareowners also determine the financial policy of the firm (the debt-asset ratio) which will influence the wage or share of profits earned by the manager. The manager chooses his effort to maximize his expected utility, constrained by the optimal contract established by agreement.

Without taxes in the model, it can be shown that the contract has two important features. First, it induces the manager to make more effort. Indeed, a higher debt-asset ratio will induce the manager to make more effort. A higher share of profits will also increase effort, if the manager is not too risk averse.[9] Second, the contract between the manager and shareowners redistributes risk. Because the manager is risk averse and shareowners are risk neutral, it is optimal for the shareowners, rather than the manager, to assume the risk due to uncertain profitability. If the manager and shareowners are both risk neutral, then the manager could own 100% of the firm's shares and the firm could be fully debt-financed,[10] the shareowners investing their wealth in riskless bonds.

The unique aspect of this model is that the firm's debt policy is used by shareowners as a part of an incentive contract with the manager. However, one could develop a different model in which the manager receives a share of the profits of the firm and a salary which is riskless lump sum income. Debt policy which induces a transfer of income from the manager to shareowners can be a perfect substitute with salary income which transfers income from shareowners to managers. If salary income is paid, then there is no special role for debt in an incentive contract since salary and bond payments are simply substitutes in transferring income. Nonetheless, salary and bond payments are not perfect substitutes in the real world. Bondowners have the first claim to the assets and income of the firm when uncertainty is resolved, with workers and governments having the second claim, followed by equity owners. Managerial income in the form of salaries is not riskless since bond holders must be first satisfied. If salaries cannot be paid because the firm earns little profit, then the salaries paid to managers are risky unlike debt payments. A risk averse manager prefers a reduction in the debt-asset ratio (which increases his riskless income) compared to an increase in risky salary income. Risky salary income is not used here to avoid the complexities introduced by including contracts that comprise such income.

A model with taxes is more complicated. The aim here is to show how taxes influence the debt-asset choice of a firm experiencing agency costs. The simple structure of the incentive payment makes comparative static exercises possible, if not simple.

In the model described below it is assumed that all contracts are feasible. If limited liability is assumed, then both the manager and the shareowners need not pay for losses incurred by the firm, and this affects the nature of contract [see Frank (1984) for a discussion of this issue]. To avoid these complications, unlimited liability is assumed although this is not a trivial assumption. The manager and shareowners are permitted to have negative consumption (which is the same as assuming that other income is available to cover contingencies).

The manager has an additive expected utility function. This is concave over uncertain labour income, M(s), and linear in effort, e,

$$EU[M(s)] - ve. \qquad (2.2.9)$$

Uncertain labour income is equal to a share of before-corporate-tax profits, α, which is taxed at the personal rate Θ^m.[11] Before-tax profits are equal to revenue, $f(e,\bar{K},s)$, less interest costs on debt finance, $i\gamma\bar{K}$. Revenues are strictly concave with respect to effort and, as before, the capital stock of the firm is fixed and equal to one. Thus managerial income is defined by the identity:

$$M(s) \equiv (1-\Theta^{m})\, \alpha\, \{f(e,s) - \gamma i\}. \qquad (2.2.10)$$

The shareowners are risk neutral and identical. They are interested in expected income, EC(s), where C(s) is income earned in the state of nature s. The shareowners and the manager have the same expectations but they differ in respect to risk aversion.

The income earned by shareowners is equal to the after-tax return to equity (net of the incentive payment to the manager) and the after-tax return on an alternative asset which is a riskless bond. The return on riskless bonds is taxed at the personal rate m and the return on equity is taxed at the personal rate Θ. The return to equity before payment of corporate taxes is $(1-\alpha)\{f(e,s) - \gamma i\}$, since the payment to the manager is deductible from corporate taxable income. This return is taxable at the corporate tax rate, u.[12] The shareowners have an exogenous level of wealth, W, which is invested in equity or the riskless bond. The amount of equity invested in the firm is $(1-\gamma)$ so that the amount of the riskless bond is equal to $\{W - (1-\gamma)\}$.

Given the above assumptions, the income of the shareowners is given by

$$C(s) = (1-\Theta)(1-u)[(1-\alpha)\{f(e,s) - \gamma i\}] + (1-m)i[W - (1-\gamma)]. \qquad (2.2.11)$$

If there were no taxation ($\Theta = m = u = 0$), then an increase in the debt-asset ratio, γ, would raise the return to equity owners by αi. However, this increase in the debt-asset ratio would reduce the manager's income, thereby reducing his effort and lowering the return to capital.

In designing an optimal contract with the manager, the shareowners take into account the reaction of the manager's effort with respect to his wage payment. This may be analyzed as follows.

The manager maximizes his expected utility in equation (2.2.9) with respect to effort, subject to the constraint in equation (2.2.10). Substituting the expression for M(s) of (2.2.10) into (2.2.9), the following first-order condition is obtained:

$$(1-\Theta^m)\ \alpha\ EU'f_e(e,s) - v = 0 \quad , \qquad (2.2.12)$$

where $f_e > 0$ is marginal productivity of effort in state s and $U' > 0$ is marginal utility of income in state s.

The manager chooses his effort level by equating the marginal benefit (i.e. the after-tax-value of additional profits) to the marginal disutility of additional effort (v). It can be shown that the effort level will depend on the tax parameter Θ^m, the share of profits, α, and the debt-asset ratio, γ, where the latter influences the value of the riskiness of profit, through the marginal utility term. The contract parameters, α and γ, are controlled by shareowners and their effect on the manager's effort are[13]

$$\frac{\partial e}{\partial \alpha} \gtrless 0; \quad \frac{\partial e}{\partial \gamma} > 0$$

An increase in the debt-asset ratio unambiguously raises the effort of the manager. The intuition behind this result is that the manager, being risk averse, has to work harder to avoid income losses due to greater indebtedness of the firm. The increase in the share of profits, however, does not necessarily lead to more effort, for the following reason. If the share of profits increases, the manager is rewarded for more effort and will thus work harder. However, an increase in the share of profits increases the amount of risk borne by the manager, and this will deter him from working. As shown in the footnote, the more risk averse the manager is (as measured by the degree of relative risk aversion), the more likely it is that he will reduce effort with a larger profit share. Thus, on balance, the profit share has an ambiguous effect on managerial effort.

The shareowners choose the incentive payment for the manager, parameterized by the share of profits, α, and the debt-asset ratio γ, subject to two constraints: (i) the effort chosen by the manager must maximize his expected utility; and (ii) the expected utility of the manager must be at least as great as the level of utility that he could obtain by working elsewhere.

The first constraint may be introduced by defining the indirect utility function of the manager, $V(\alpha, \gamma; \Theta^m, i)$[14], because it is assumed that effort is chosen to maximize his expected utility. The second constraint is common to agent-principal problems in that shareholders, the principals, must choose an optimal contract to ensure that the manager will not desire to go elsewhere. Let V be the utility level obtained by the manager by working elsewhere (V can be viewed as the level of bargaining power available to the manager). The shareholders solve the following problem

$$\max_{\alpha,\gamma} E\, C(s)$$

$$\text{subject to } V(\alpha,\gamma) - \bar{V} \geq 0,$$

in which C(s) is defined by equation (2.2.11). Let λ be the Lagrange multiplier associated with the managerial expected utility constraint. The shareholders choose α and γ to maximize expected utility, knowing the level of utility that the manager can obtain elsewhere.

The first-order conditions are

$$-(1-\Theta)(1-u)(Ef-\gamma i) + \lambda(1-\Theta^m)EU'(f-\gamma i)$$

$$+ (1-\Theta)(1-u)(1-\alpha)Ef_e \frac{\partial e}{\partial \alpha} = 0; \qquad (2.2.12)$$

$$-(1-\Theta)(1-\alpha)i(1-u) + (1-m)i - \lambda(1-\Theta^m)\alpha\ i\ EU'$$

$$+ (1-\Theta)(1-u)(1-\alpha)Ef_e \frac{\partial e}{\partial \gamma} = 0 \qquad (2.2.13)$$

Consequently,

$$\frac{(1-\Theta)(1-u)(Ef-\ i)}{(1-\Theta^m)EU'(f-\gamma i)} = \lambda + \frac{(1-\alpha)(1-\Theta)(1-u)Ef_e \frac{\partial e}{\partial \alpha}}{(1-\Theta^m)EU'(f-\gamma i)} \qquad (2.2.14)$$

$$\frac{\alpha(1-m) + (1-\alpha)[u + \Theta(1-u) - m]}{(1-\Theta^m)\alpha EU'} = - \frac{(1-\alpha)(1-\Theta)(1-u)Ef_e \frac{\partial e}{\partial \gamma}}{\alpha(1-\Theta^m)\ EU'\ i} \qquad (2.2.15)$$

To gain an understanding of the meaning of these two equations, consider some polar cases first. If the manager's effort has no effect on output ($f_e = 0$), then the right hand side of each of (2.2.14) and (2.2.15) would be equal to λ. In this case there is no incentive problem. Moreover, if there are no tax rates, then

$$\frac{(Ef - \gamma i)}{EU'(f-\gamma i)} = \lambda = \frac{1}{EU'} .$$

For this equality to be satisfied, either (i) the marginal utility of the manager must be independent of the state of nature, so that $\lambda = 1/U'$; or (ii) the manager receives no income, which would be the case were U' infinite. In case (i), the manager who is risk averse does not bear risk. Consequently, the share of profits is set equal to zero by the shareowners. In case (ii), the manager has no income whereupon his level of utility may be less than that obtainable elsewhere. However, this is a trivial case, since the manager's effort has no effect on profitability. The manager is not needed for production, so he can be dismissed by the shareowners.[15]

The second polar case is more interesting. Suppose that the manager is risk neutral (U' is independent of all states of nature by assumption). In the absence of taxation, this implies (since $\frac{\partial e}{\partial \gamma} = 0$ by footnote 13)

$$1 = \lambda U' + (1-\alpha)\, Ef_e \frac{\partial e}{\partial \alpha}$$

$$1 = \lambda U'$$

The second term on the right hand side of the first equation above is the 'agency' cost associated with managerial effort. If effort had no effect on output, then the optimal contract ensures that the weighted marginal utility of income of the manager (U') is equal to that of shareowner (which is 1). For the last two equations to be satisfied, $(1-\alpha) = 0$. Thus the manager would obtain all the profit of the firm. The debt-asset ratio would be selected to ensure that the manager obtains a level of utility equal to $\bar{V}$. In this case, all capital would be financed by riskless debt, the manager being the residual claimant and liable for all losses. This is the case of a classical entrepreneurial firm.

If the manager is risk averse, then the optimal share of profit and debt-asset ratio are chosen so that the manager is both 'insured' and induced to work harder. If the share of profit increases (reduces) the effort level of the manager ($\frac{\partial e}{\partial \alpha}$), then the share of profit would be smaller (greater) than the level consistent with reducing the amount of risk imposed on the manager. The debt-asset ratio is chosen by shareowners to induce more effort. However, more risk is imposed on the manager so that a debt-asset ratio of unity is never chosen. The more risk averse is the manager, the lower will be the debt-asset ratio of the firm.

Taxation clearly influences the optimal share of profits and the optimal debt-asset ratio. As seen in equations (2.2.14) and (2.2.15), taxes will influence the optimal contract depending on two factors: (a) the effective tax rate on equity faced by shareowners compared with the effective tax rate faced by the manager (i.e. $u + \Theta(1-u) \gtreqless \Theta^m$); and (b) the difference in the effective tax rate on equity compared with the debt faced by shareowners $(u + \Theta(1-u) - m)$.[16]

In case (a), let the effective tax rate on shareowners be more than the tax rate on the manager, or $(1-\Theta)(1-u) < (1-\Theta^m)$. In (2.2.14), this implies that the share of profits will be larger (ignoring the effects of taxes on U' and $\frac{\partial e}{\partial \alpha}$), since profit income is deductible for shareowners and taxable in the hands of the manager.

In case (b), a higher (lower) effective tax rate on equity income compared to debt income accruing to shareowners encourages the firm to issue more (less) debt. This can be seen from equation (2.2.15). The debt-asset ratio will be increased (reduced), if equity income is more (less) heavily taxed than bond income earned by the shareowner. An increase in debt also reduces income to the manager who is compensated by an increase in the share of profits paid to him.

The optimal debt-asset ratio is determined by balancing the firm's marginal benefit of interest deductibility (when the tax rate on equity is more than on debt) with 'agency' costs. Let 'agency' costs be A' then, from (2.2.15),

$$u + \Theta(1-u) - m = A' \qquad (2.2.16)$$

in which

$$A' = \left[\frac{\alpha}{(1-\alpha)} \{\lambda(1-\theta^m)EU' - (1-m)\} - \{(1-\Theta)(1-u)Ef_e \frac{\partial e}{\partial \gamma}\}/i \right].$$

Agency costs are of two forms. The first depends on the value to shareholders of the income given to the manager, and hence depends on attitude of the manager toward risk. The second is the value to the shareowners of inducing the manager to work harder with a higher debt-asset ratio (the second term in A' is negative in value). If the firm issues debt for tax reasons, then marginal agency costs, A', will be positive for an interior solution, where the debt-asset ratio lies between zero and one.

The optimal debt-asset ratio will be affected by any of the variables exogenous to the firm: (i) corporate and personal tax rates; (ii) the ability of the manager; (iii) the attitude of the manager towards risk; (iv) the rate of interest; and (v) volatility in the return to capital. Comparative statics results are rather complicated and will not be presented. However an intuitive discussion of the results is provided below.

The effect of each of the exogenous variables on the optimally chosen debt-asset ratio is generally ambiguous, even with restrictions on managerial preferences. The reason for this can be made clear by considering the comparative static results when there is an increase in the corporate tax.

When the corporate tax rate is increased and the return to equity falls, the managerial incentive payment is infuenced in two ways. First, as seen from equation (2.2.14), shareowners could recover this loss in equity by reducing the share of profits paid to the manager (which affects the effort of the manager, depending upon his preferences towards risk). To maintain the same level of expected utility, the debt-asset ratio would then have to be reduced. Thus a higher corporate tax reduces the debt-asset ratio. Second, as seen from equation (2.2.15), the higher corporate tax rate makes debt financing more attractive. The increase in the debt-asset ratio induces the manager to work harder. However, his level of expected utility falls and, to compensate him for this, the shareowners must increase the share of profits paid to him. Thus a higher corporate tax rate that reduces the return to equity will have an ambiguous effect on the debt-asset ratio: it depends on the extent to which the shareowners adjust the share of profits paid to the manager. If the manager is very risk averse, the shareowners may find it more appealing to reduce the share of profits and increase debt financing, rather than the reverse.

The ambiguity with respect to comparative static results in this model arise from the nature of a two-decision-variable problem: exogenous changes in tax rates, firm volatility and interest rates, have opposing effects on the share of profits and the debt-asset ratio that are optimally chosen by the shareowners.

One further point is made that is important to the empirical implementation of this model. The value of agency costs (A') clearly depends on the manager's attitude towards risk; the more risk averse he is, the less likely that debt is used as a source of finance. The attitude of the manager towards risk, however, is difficult to measure since there is no statistic that can be observed. There is a way out of this dilemma, but it requires the theory to be amended. Without providing details, we describe the amended theory as follows.

Suppose the manager not only derives labour income but also earns a return on his wealth invested in bonds and equities issued by all firms in the economy. By investing in a non-perfectly correlated risky alternative asset, the manager can diversify risk in the labour income that he receives from his corporation. If it is further assumed that all labour and capital income is normally distributed, then we can show that agency costs (A') depends positively on (i) the covariance between the return to the manager's effort and the return on the alternative asset and (ii) relative risk aversion. If the return to managerial effort and to the firm's capital are highly correlated, and if the return received on the alternative asset and on the whole stock market are highly correlated, then managerial risk aversion can be estimated by measuring relative risk aversion and the covariance between the return on the firm's capital stock and stock market. Both of these can be estimated by measuring the "beta" estimated from capital-asset pricing models, adjusting the "beta" for the debt-asset ratio of the firm. The "beta" is the covariance of the return earned on a firm's shares with the return earned on the whole portfolio divided by the variance of returns earned on the whole portfolio. This "beta" serves as proxy for managerial risk: the higher the "beta", the greater are agency costs and the lower is the debt-asset ratio.

2.2.4 Bankruptcy Cost Model

The fourth model that is used to explain the financial policy of firms is one that incorporates a trade-off between tax relief arising from the deductibility of borrowed financing costs and the expected bankruptcy costs associated with the issuing of debt. This model has been extensively analyzed in the literature [see, e.g. Kim (1978), Harris (1978) and Gordon (1982)]. The intuition underlying the equilibrium is quite simple. The benefit to the firm of issuing debt occurs when the effective personal tax rate on interest income is lower than that on equity income for the marginal investor. A firm under these circumstances may increase its market value by reducing equity finance in favour of debt finance. On the other hand, additional debt relative to assets increases the likelihood of bankruptcy. Upon bankruptcy, the firm will be reorganized or liquidated, incurring real resource costs associated with trustee fees, the loss in the value of intangible assets (goodwill) and other attendant costs. These bankruptcy costs are deadweight losses to the bond and equity owners of the firm. If bankruptcy costs per dollar of debt increase with higher debt-asset ratios, then firms will choose a unique debt-asset ratio such that marginal bankruptcy costs are equal to the additional tax relief associated with issuing one more dollar of debt. An implication of this model is that a firm will be fully equity financed when there is no taxation.

While the general intuition is fairly simple to understand, the model to be presented below incorporates certain complications. In particular, limited liability will be introduced explicitly, so that equity owners lose no more than their initial equity investment in a firm. The debt issued by the firm is risky to bond holders, since the firm's owners no longer use their personal resources to pay back the principal and interest promised to bond holders. Bankruptcy will be declared when the firm, rather than its equity owners, is not able to meet contractual obligations with bond holders. The interest rate negotiated between the firm and the bond holder will reflect the probability of bankruptcy and the loss in income, including transaction costs, that arise from the firm's inability to compensate bond holders at the time of bankruptcy.

As defined above, bankruptcy arises when a firm is unable to pay its creditors principal repayments and interest because the value of assets is insufficient to cover the contractual obligations of the firm. This is a fairly good description of Canadian laws which does not allow firms to bankrupt themselves simply to avoid contractual obligations that firms may have with respect to their organization (i.e. such as contracts with labour unions). Canadian law explicitly allows secured creditors to have the first claim to assets, followed by workers and government, then preferred equity owners and finally common share owners. Two sources of finance are considered in the model below: secured credit and common stock.

The model may be outlined as follows: At the beginning of a period, bond and equity owners create a limited liability contract of the following form. If the firm is not declared bankrupt at the end of the period, the bond holder is paid interest at the rate i and receives the principal of dollars of debt lent to him at the beginning of the period. If the total value of assets is again set equal to unity, then γ is the debt-asset ratio. If the firm is declared bankrupt at the end of the period, the bond holders have total claim on the end-of-period assets of the firm, and the equity owners receive nothing. Nevertheless, bond holders will receive less than their promised payment of $(1+i)\gamma$.

The payments owing to equity and bond holders at the end of the period depend on (i) the state of nature, which has an influence on the profitability of the firm; (ii) corporate and personal taxes; and (iii) the level of interest rates.

At the beginning of a period, equity owners invest $(1-\gamma)$ dollars of wealth in the firm. The wealth held by equity owners at the end of the period depends on whether the firm is declared bankrupt or not. Let $\rho(s)$ be the uncertain return on a unit of capital, s denoting the state of nature. As in the loss offset model, s is treated as a continuous variable with a minimum value of 0 and a maximum value of $\bar{s}$. The return to capital is increasing in s. The firm produces, at the end of the period, revenues equal to $\{1+\rho(s)\}$. If the firm is not bankrupt, the equity owners receive, at the end of the period, wealth equal to revenues earned by the firm net of the payment owing to bond holders $\{\gamma(1+i)\}$ and net of corporate and personal taxes. The corporate tax base is assumed to be revenues net of depreciation of capital (which is equal to one) less the interest cost of debt: $\{\rho(s)-\gamma i\}$. The corporate tax is levied on taxable income at the rate u. Personal taxes are assumed to be levied on the difference between the end of period value of the firm and the initial cost of the investment. The value of the firm at the end of period is

$$\pi(s) = 1+\rho(s)(1-u)-\gamma\{1+i(1-u)\} = (1-\gamma)+\{\rho(s)-\gamma i\}(1-u). \qquad (2.2.17)$$

The initial cost of the investment is $(1-\gamma)$. The base used for personal tax on equity is income, $\{\rho(s)-i\}(1-u)$, which is assumed taxable at the rate Θ. Note that corporate and personal tax bases can be negative. If so, a full loss offset is assumed, so that a distinction may be made between the implications of the bankruptcy cost model and the loss offset tax model.

The firm is declared bankrupt when the bond holders realize that revenues of the firm are insufficient to meet contractual obligations to bond holders. Dividends paid to the equity owners are zero. Define s_B as the state of nature when the equity and bond owners of the firm are indifferent between the firm being bankrupt and not. This will occur when the revenues of the firm, including refundable corporate taxes, just cover the interest and principal paid to the bond owners; that is when

$$1+\rho(s_B) - \gamma(1+i) - u\{\rho(s_B)-\gamma i\} = 0 \quad . \qquad (2.2.18)$$

In this state of nature, bond owners receive a payment equal to $1+\rho(s_B) - u\{\rho(s_B)-\gamma i$ $[= \gamma(1+i)]$; equity owners receive no income and incur a capital loss equal to the initial cost of equity issues, $(1-\gamma)$. Equity owners receive a refundable tax credit at the rate Θ for capital losses. Thus the end of period wealth held by equity owners is:

No Bankruptcy: $Y^E(s) = 1-\gamma + \{\rho(s)-\gamma i\}(1-u)(1-\Theta) \quad \forall\ s \in [s_B,\bar{s}]$;

Bankruptcy: $Y^E(s) = \Theta(1-\gamma) \quad \forall\ s \in [0,s_B]$.

The equity value of the firm, V_E, is equal to the discounted expected return after tax income accruing to equity owners at the end of the period. Assuming that equity owners can invest in a riskless asset yielding interest at the rate i^*, which is taxable at the rate m, then the discount rate will be equal to $\{1+i^*(1-m)\}$. The value of equity is thus

$$V_E = \frac{\int_0^{\bar{s}} p_s Y^E(s)ds}{\{1+i^*(1-m)\}} \qquad (2.2.19)$$

where p_s is the probability estimate of the occurrence of state s.

In choosing the debt-asset ratio, the owners of the firm will anticipate how the interest rate paid on bonds will be affected by leverage. The bond rate of interest is determined in competitive bond markets where bond holders will continue to hold bonds until the after-tax expected interest paid on risky bonds is equal to that paid on riskless bonds. To complete the model, these bond markets are examined.

The return paid on risky bonds issued by the firm is described as follows. If the firm is not bankrupt in the states of nature given by $s_B \leqq s \leqq \bar{s}$, then bond owners receive the principal and negotiated interest. If interest is taxed at the rate m, then the end-of-period wealth of the bond holders will be equal to $\gamma\{1+i(1-m)\}$.

If the firm is bankrupt, bond owners receive the remaining assets of the firm less any transaction costs associated with bankruptcy. The value of the firm upon bankruptcy is equal to the revenues of the firm plus any corporate refundable tax credits. Denote i(s) as the rate of interest paid at bankruptcy. The equity owners receive no income which implies equation (2.2.17) is set equal to zero; this will hold for all states of nature $0 \leqq s < s_B$. Substituting i(s) for i in (2.2.17) and rearranging,

$$i(s) = \frac{(1-u)^{-1} + \quad (s)}{} - (1-u)^{-1} , \qquad s \in [0, s_B) . \tag{2.2.20}$$

Note that the interest rate, i(s), is decreasing with the debt-asset ratio:

$$\frac{\partial i(s)}{\partial \gamma} = \frac{-[(1-u)^{-1} + \rho(s)]}{\gamma^2} < 0 \quad .$$

The end of period value of debt is equal to $\gamma\{1+i(s)\}$ net of bankruptcy costs associated with liquidation or reorganization of the firm. These bankruptcy costs are borne by the bond owners, although they are anticipated when the bond interest rate is negotiated with the firm. Let $\gamma(s)$ be the return net of bankruptcy costs per dollar of bankrupt bonds and $C(\gamma,s)$ be the total bankruptcy costs incurred in state s. Note that bankruptcy costs are strictly increasing with respect to the debt-asset ratio ($\frac{\partial C}{\partial \gamma} > 0$) and marginal bankruptcy costs rise with a higher debt-asset ratio ($\frac{\partial^2 C}{\partial \gamma^2} > 0$). Under these assumptions, the return received by bond owners is $r(s) = i(s) - \{C(\gamma,s)/\gamma\}$ which is assumed to be taxed at the personal rate m (bond owners and equity owners face the same tax rate). The end of period wealth of bond holders is:

$$\begin{aligned} &\text{No Bankruptcy:} \quad Y^B(s) = \gamma\{1+i(1-m)\} \qquad s \in [s_B,\bar{s}]; \\ &\text{Bankruptcy:} \quad Y^B(s) = \gamma\{1+i(s)(1-m)\} \qquad s \in [0,s_B]. \end{aligned} \tag{2.2.21}$$

Bond market equilibrium implies that the expected return on risky bonds issued by the firm will be equal to the riskless rate net of tax interest, $\{1+i^*(1-m)\}$. Thus,

$$\int_0^{\bar{s}} p_s Y^B(s)ds = \{1+i(1-m)\}. \tag{2.2.22}$$

Substituting into equation (2.2.22) the expressions for $Y^B(s)$ in (2.2.21) and rearranging yields

$$(1-p)i + \int_0^{s_B} p_s \; r(s)ds = i^* \; . \tag{2.2.22'}$$

where $\hat{p}$ is probability that firm will bankrupt itself. Since a full loss offset tax has been assumed, the determination of the interest rate i is independent of the personal tax rate.

The ultimate objective of this exercise is to see how an increase in the debt-asset ratio influences the interest rate payable on the firm's bond in non-bankrupt states of nature. Differentiation of (2.2.22') with respect to γ and using the expression for i(s) in (2.2.20) yields

$$(1-\hat{p})\,\frac{\partial i}{\partial \gamma} = \frac{1}{\gamma}\int^{s_B} p_s[r(s) + \frac{\partial C(\gamma,s)}{\partial \gamma} + (1-u)]ds > 0. \qquad (2.2.23)$$

It should be noted that the probability of bankruptcy also changes (as well as s_B) but the terms associated with the effect of γ on the integral limits cancel out.

Expression (2.2.23) states that a change in the quality of bonds arising from increased leverage will cause bond owners to demand a higher rate of interest. Bankruptcy costs will contribute also to the higher interest rates demanded by bond owners.

The solution of the model for optimal policy will arise from the equity owners maximizing the discounted value of equity wealth accruing at the end of the period, which appears in equation (2.2.19). Taking the derivative of (2.2.19) with respect to γ, using (2.2.23) and rearranging the first-order condition yields

$$i^*[u+\Theta(1-u)-m] = [\int_0^{s_B} p_s \frac{\partial C}{\partial \gamma} ds]\,(1-\Theta)(1-u) \qquad (2.2.24)$$

The left-hand side of equation (2.2.24) is the marginal benefit of issuing debt. This is the tax relief corresponding to the higher combined corporate and personal tax on equity compared to the tax rate on debt. The right-hand side of equation (2.2.24) is the marginal bankruptcy cost, adjusted for taxes, that derives from issuing debt. These costs are deadweight losses to both equity and bond owners of the firm. It is clear that, in the absence of taxes, (2.2.24) would not be satisfied unless marginal bankruptcy costs are zero ($\frac{\partial C}{\partial \gamma} = 0$), implying in this particular case that leverage would not matter to the firm.

Comparative static results are easily derived in this model. These may be summarized as follows. An increase in the corporate tax rate or personal tax on equity leads to more leverage: it is more beneficial to issue debt, for tax reasons, and marginal bankruptcy costs are increased due to increased leverage. Similarly, a higher personal tax rate on interest income reduces leverage. Other results include the following: a mean preserving spread in risk reduces the debt-asset ratio, since bankruptcy becomes more likely. A higher return to capital in bankrupt states of nature would increase the debt-asset ratio as well.

A special feature of the bankruptcy cost model is in regard to transaction costs arising from bankruptcy. If there is an increase in expected bankruptcy costs for a given level of debt, then the debt-asset ratio will be lower. This suggests that the composition of assets held by firms may influence leverage, because assets that are difficult to liquidate will lead to greater bankruptcy costs.

2.2.5 The "Pecking Order Hypothesis" and Asymmetric Information Models

The static tradeoff models of the previous section imply that firms adjust their financial policies so that target debt-asset ratios are achieved. An alternative view that may be taken is that firms first exhaust their cheapest sources of finance before turning to the more expensive sources. This is the "pecking-order hypothesis" as termed by Myers (1984) although the idea is much older. Donaldson (1962), for example, argued that firms prefer (i) internal to external finance and (ii) debt to new equity issues. The amount of debt and new equity issues therefore depends on the investment needs and internal financial resources of the firm. If firms intend to make large investments and have limited retained profit (due to low past profitability), then the required debt issue will be large. Firms that earn a high past return to capital and intend to acquire little capital, use little debt. The debt-asset ratio could thus vary from year to year (inversely related to the return to capital and correlated with the growth in assets).

The theoretical argument underlying the "pecking-order hypothesis" has recently been developed by Myers and Majluf (1984) in a model that allows for asymmetric information. The managers, who operate in the interest of the current shareowners, know the quality of a risky investment opportunity while the market (outside investors) cannot distinguish between the quality and luck of the firm. The firm has a choice of investing in the risky project or investing in a safe alternative asset (such as a Treasury Bill). The model is similar to Akerlof (1970) except that the seller can alter the investment opportunities (or the "product").

We can model the asymmetry of information in a simple way. Let $\tilde{q}\pi(s)$ be the value of income generated by a new project where $\tilde{q}$ is an index of quality and s is the state of nature. The manager knows the true value of q but does not know the state of nature. The market knows neither the state of nature or the quality of the firm but knows that the distribution of quality across firms is independent of the distribution of profits across states of nature. The market's perception of the value of the firm's investment is thus $\bar{q}E\pi$, where $\bar{q}$ is the average quality of firms and $E\pi$ is the expected profit generated by the project.

The current shareholders must decide whether to undertake the project which costs ΔK units, or invest the funds in an alternative asset yielding

$i\Delta K$ in income. As the current owners of the firm know the quality of investment, then the value of the project is $\tilde{q}E\pi = \tilde{V}\Delta K$, where $\tilde{V}$ is the price of the firm's equity. If the project is financed by internal funds with an opportunity cost of $i\Delta K$ then the ex ante value of the firm rises by $(\tilde{V}-i)\Delta K$. However, if the project is financed by raising new equity, then the value of the firm will be bidded down from $\tilde{V}(K+\Delta K) - \bar{V}(K+\Delta K)$ if $\tilde{V} > \bar{V}$ and increased if $\tilde{V} < \bar{V}$. Let us consider the first case. If the current owners know that the firm is of high quality then a project is undertaken if $\tilde{q}E\pi - i\Delta K + (\bar{V}-\tilde{V})K > 0$. The term $(\bar{V}-\tilde{V})K$ is the capital gain to current shareowners (loss if negative) arising from the market's imperception of the quality of the firm. If the loss to current owners is sufficiently high then the firm may choose not to invest in an otherwise profitable investment opportunity. If the firm had sufficient internal cash it would undertake the investment. The problem for the firm is that external sources of finance bear a higher cost as a result of the market's imperception.

If the firm is of low quality, it could profit from issuing equity that is valued too "high". But outside investors would learn that low quality firms seek funds from the market, while high quality firms do not. Thus expectations would not be fulfilled since only low, not average, quality firms seek funds from the market.

This model with asymmetric information suggests that an "inconsistency" arises because firms cannot creditably communicate their quality to the market. Clearly, inside and outside investors could both gain if some mechanism were adopted such that quality could be communicated. Both Ross (1977) and Leland and Pyle (1977) modelled a "signalling" equilibrium by which high and low quality firms communicate their quality via a signal that is perceived to be correlated with quality. A sufficient condition for a signalling equilibrium is that the costs of acquiring the signal must be inversely related to quality so that low quality firms would not wish to acquire the signal. In Ross's model, bankruptcy costs imposed on the firm are the cost of using a signal which is the debt-asset ratio. High quality firms issue more debt relative equity since the bankruptcy faced by the manager is more likely avoided by the firm. Thus, in Ross's model, high debt-asset ratios are a signal of high quality. In Leland-Pyle, the entrepreneur's share of equity is an indicator of quality -- the greater the share held by the inside investor (the entrepreneur), the higher the firm's quality as perceived by the market. In the model of Myers and Majluf, the ratio of external to internal finance or the dividend/payout ratio, which are both costly signals from a tax point of view, could serve as an indicator of quality.

If no signalling equilibrium evolves, then a "pecking order" of sources of finance is used. Internal finance is preferred to debt and debt to new equity. This suggests that the growth of assets (especially fixed rather than intangible assets) and the current probability of a firm influence the debt-asset ratio of the firm. The former has a positive effect, the latter a negative effect. Neither of the two variables are important in the static-tradeoff models except that high expected, rather than current, profitability would affect the debt-asset ratio in the static-tradeoff models. Note that tax payments reduce cash flow and hence increase the debt-asset ratio in a "pecking-order" model. Higher tax shields, increased refundability and lower statutory corporate tax rates reduce the debt asset ratio, as prediced by the earlier "static-tradeoff" models.

If a signalling equilibrium evolves, then financial policies serve as signals. Taxes affect the signalling equilibrium since the costs of providing signals depend on the tax system. If the cost of external source of finance (debt) is reduced by taxes then all firms choose a higher debt-asset ratio in a "signalling" equilibrium. In this sense, tax effects in models with asymmetric information could be the same as in the "static-tradeoff" models developed so far.

2.3 Extensions and Complications

The theories outlined in Section 2.2 make use of several assumptions that are important to the comparative static results. These assumptions included the following: (a) a closed economy; (b) no inflation; (c) a fixed capital stock; and (d) no adjustment costs. The implications of these assumptions are examined below.

2.3.1 Open Economy

Canadian capital markets are well integrated with those of the rest of the world. Moreover, Canadian capital markets are 'small' relative to the rest of the world, in the sense that the availability of Canadian domestic savings has a negligible impact on world interest rates. The implication of openness and smallness is that the supply of financing available to individual businesses is perfectly elastic with respect to the world interest rate.[18] Business financing is thus independent of Canadian domestic savings behaviour, in the following sense. If Canadian domestic savings rise (for example, due to a reduction in personal tax rates on domestic savings), then domestic savings will either 'crowd out' foreign savings or be invested in assets abroad earning the same return as on Canadian assets. Because, Canadian savings have a negligible impact on world interest rates, Canadian businesses face a cost of finance which is independent of the availability of Canadian savings. The smallness of Canadian capital markets also implies that when Canadian businesses seek finance, they are able to acquire it at a cost of finance which is independent of the availability of domestic savings. If Canadian domestic savings is fixed in quantity, for example, each dollar sought by Canadian businesses is obtained from world markets.

Even the cost of equity finance may be determined by world markets (including the risk premium on Canadian equity). Public corporations in Canada list their shares on foreign stock exchanges and their shares, issued at Canadian stock exchanges, may be traded by foreign investors. The cost of equity financing for these corporations is determined in markets comprising Canadian equity and those of other corporations in the world. Small and medium-sized corporations do not actively trade shares on stock markets, so their costs of finance (and risk premium on equity) could be much more sensitive to domestic behaviour [see Booth and Johnston (1984) who found that the valuation of share listed on Canadian and foreign stock exchanges are not sensitive to personal tax changes].

The important issue relevant to the present study is how openness and smallness of Canadian capital markets affect the financial behaviour of Canadian businesses, taking into account taxation in Canada and abroad. Before solving this problem, there are two important details to settle. First, there is the question of the identity of the marginal investor. Given the discussion above, it is clear that domestic saving may not be marginal to Canadian businesses in an open economy. Any changes in Canadian savings will be more or less offset by changes in foreign savings. The marginal investor arbitrages across assets for the entire world, although a good working hypothesis is that the marginal investor is generally a U.S. citizen.

The second detail is concerned with international tax arrangements. Many countries, in particular the United States, allow residents to credit foreign tax liabilities on repatriated income against home country tax liabilities. If the foreign tax liability is lower than that in the home country, then the effective tax rate on resident investment abroad is the home country's tax-rate. Not all foreign taxes may be credited. Some countries allow only those foreign taxes on income generated in a specific country to be credited against home country tax liabilities. The U.S., however, provides a global tax credit, allowing residents to aggregate income from all sources and countries. This permits an averaging out of high and low foreign tax liabilities to be credited against U.S. liabilities. Nevertheless, only certain foreign tax liabilities can be credited. If a U.S. investor receives a dividend from a foreign corporation, that individual can credit foreign withholding taxes, but not the corresponding corporate income tax, against his home country tax liabilities.

Keeping these two details in mind, how do foreign taxes affect Canadian business financing decisions? For this purpose it is useful to distinguish between foreign individuals and foreign corporations investing in Canadian assets. It is assumed that the marginal investor is a U.S. resident.

When an American invests in a Canadian corporation, he is able to credit Canadian withholding taxes against personal U.S. tax liabilities. He is not able to credit Canadian corporate taxes. If the U.S. investor equates the after-tax return on Canadian corporate securities with that of the U.S., the effective tax rate on Canadian equity will be the combined Canadian corporate tax rate and the U.S. personal tax rate on equity returns; the effective tax rate on interest earned from holding Canadian assets will be the U.S. tax rate. In this case, Canadian personal tax rates will not have any effect on Canadian business financing.

If the U.S. resident is a corporation, it can credit the Canadian corporate tax and withholding tax liabilities against U.S. corporate taxes. However, U.S. taxes are levied only on repatriated income (dividends and interest) so that Canadian corporate taxes, which are paid on undistributed profits, are not credited against U.S. tax liabilities. As shown by Hartman (1981), the effective corporate tax rate on the equity finance of Canadian companies owned by U.S. corporations is the Canadian corporate tax when retained earnings is the marginal source of equity finance. Moreover, if the Canadian tax rate is lower than that in the U.S., retained earnings will be preferable as a source of finance compared to debt, since U.S. tax liabilities owing on income generated by Canadian corporate assets can be deferred by the U.S. corporation. U.S. companies would then be more equity financed. If the U.S. tax rate is lower than the Canadian tax rate, debt financing by the Canadian company would be preferred.

In the empirical work, the open economy assumption is invoked. It is assumed that Canadian-controlled public companies are financed at the margin by foreign individuals. Foreign-controlled firms in Canada are excluded, for the following reason. The debt-asset ratio of a foreign-controlled corporation depends on the ability of the parent to credit all Canadian taxes against their home country's tax liabilities. It is not known whether the effective Canadian tax is higher or lower than the foreign corporate tax rate, so it is not known whether debt or equity finance is preferred.

2.3.2 Inflation

Inflation has an effect on financial policy in several ways, according to whether inflation is fully anticipated or not. Most debt issued by businesses is not indexed so that the value of the principal is denominated in nominal dollars. Interest paid must compensate the creditor for the erosion of the real value of debt when prices rise. Creditors and borrowers who hold unindexed debt must form expectations about future inflation rates and these *inter alia* become a basis for setting interest rates. The *expected* or *anticipated* rate of inflation is an important determinant of nominal interest rates. The higher the expected inflation rate, the higher will be nominal interest rates. One particular argument is that interest rates rise point for point with inflation rates. This has been called the *Fisher* effect. With taxation, the impact of inflation on interest rates is more complicated.

Unanticipated inflation will also affect financial policy. If inflation rates are higher (lower) than anticipated, then the old debt previously negotiated at lower (higher) interest rates will be of lower (higher) present value. The reduction in the present value of debt due to unanticipated inflation will result in a transfer of wealth from creditors to debtors. Without issuing any new debt, the market value debt-asset ratio will decline with unanticipated inflation. Firms will therefore issue more debt at book value, if they wish to maintain their market value debt-asset ratio.

When inflation is *uncertain*, the financial policy of firms can also be affected. In particular, inflation is more difficult to predict the longer the term of the debt. Inflation uncertainty is especially important to a decision to issue long-term rather than short-term debt. The term structure of debt will not be of great concern to this study, since the tax consequences are not very important. Interest, regardless of the term of debt, is deductible from the corporate tax base and is taxable in the hands of the lender. The lender pays taxes on nominal interest: uncertain inflation has no direct impact on these nominal tax liabilities paid by the investor. In this section, the discussion is confined to how expected and unanticipated inflation affect the choice of the debt-asset ratio.

The capital market equilibrium that was discussed in Section 2.2 can be amended to take into account *expected inflation*. From earlier discussion, a firm will issue debt until the after-corporate-tax cost of debt is equal to that of equity. With inflation, the real cost of equity finance is the nominal opportunity cost of equity (ρ_E) less the inflation rate (π). The real cost of debt is the nominal after-corporate-tax cost of debt {i(1-u)} less the inflation rate. The real cost of finance is reduced by inflation, since the value of a firm's liabilities is denominated in nominal dollars. Asset prices rise with inflation and the capital gains accruing to the firm are generally untaxed. Thus the real value of firm's assets remains constant. As the value of assets must be equal to the value of liabilities, firms can issue more debt and equity at a rate equal to the inflation rate. In equilibrium, the real cost of equity and debt finance issued by the firm is equal so that

$$\rho_E - \pi = i(1-u) - \pi \quad . \qquad (2.3.1)$$

The issue of concern is how inflation affects the debt-asset ratio of the firm. The solution depends on how interest rates adjust with inflation. If a firm issues debt and equity such that equation (2.3.1) holds, then interest rates adjust with higher inflation such that financial equilibrium is restored and

$$\frac{\partial \rho_E}{\partial \pi} = \frac{\partial i}{\partial \pi}(1-u) \quad . \qquad (2.3.2)$$

How the nominal costs of debt and equity are affected by inflation depends on arbitrage in capital markets. One form of arbitrage is to consider a closed economy in which the Canadian taxpayer is the marginal investor. This has been a central assumption in most analyses. A second assumption is to consider a small open capital market.

In a closed economy, the marginal investor will arrange his portfolio until the real after-tax return on debt and equity are equal. Using the same relation as before, the real after tax return on equity and debt is the nominal interest rate (ρ_E and i respectively) net of taxes payable on nominal interest ($\Theta\rho_E$ and mi respectively) and any special costs associated with bankruptcy, agency costs, etc. Let δ denote these special costs which were more formally examined in Section 2.2. It is assumed that these costs reduce the return to debt. In equilibrium, the marginal lender will earn the same after-tax return on all assets. Consequently,

$$\rho_E(1-\Theta) - \pi = i(1-m) - \pi - \delta . \qquad (2.3.3)$$

The additional costs associated with issuing debt can depend on inflation in two ways. First some costs associated with debt financing may be higher due to inflation, such as the reduction in the present value of the carry forward of losses and unused deductions. Second, marginal costs may be higher, if the firm becomes more levered.

Suppose further that the real after tax return to savings invested in business capital is constant (implying a perfectly elastic supply of savings to the business sector). If this were true, then both the nominal return to debt and equity must adjust in face of inflation, so that the real after tax return is constant. This implies

$$\frac{\partial i}{\partial \pi}(1-m) - \frac{d\delta}{d\pi} - 1 = 0 \Rightarrow \frac{\partial i}{\partial \pi} = \frac{1}{(1-m)} + \frac{d\delta}{d\pi}\frac{1}{(1-m)} \; ; \qquad (2.3.4)$$

and

$$\frac{\partial \rho_E}{\partial \pi}(1-\Theta) - 1 = 0 \Rightarrow \frac{\partial \rho_E}{\partial \pi} = \frac{1}{1-\Theta} \tag{2.3.5}$$

Both equations (2.3.4) and (2.3.5) imply that interest rates on debt and equity adjust by more than one point for each point of inflation. This is the tax-adjusted Fisher effect. It should be noted that the effect of inflation on the costs of issuing debt (δ), bringing about additional leverage, will also affect the corporate interest rate adjustment.

If equations (2.3.4) and (2.3.5) are substituted into (2.3.2), it is possible to determine how interest rates adjust by examining the following equilibrium:

$$\frac{1}{(1-\Theta)} = \frac{(1-u)}{(1-m)} + \frac{d\delta}{d\pi}\frac{(1-u)}{(1-m)} \tag{2.3.6}$$

Consider first the Miller model in which the resource costs of issuing debt are zero (δ=0) and the effective tax rate on equity is equal to that on debt $\{u + \Theta(1-u) = m\}$. Under these two conditions, equation (2.3.6) is immediately satisfied and

$$\frac{1}{(1-\Theta)\,(1-u)} = \frac{1}{(1-m)} .$$

The implication of this condition is that inflation is neutral with respect to financial policy. The marginal investor is indifferent between holding debt and equity, and effective tax rates on debt and equity are equal. An increase in the inflation rate will raise the interest rate on debt by the reciprocal of one less the personal tax rate on interest. These higher interest payments are deductible from the profits of the firm whereupon the additional cost of interest is offset by lower taxes paid on equity at the rate $\{u + \Theta(1-u)\}$. Thus in the Miller model expected inflation has no impact on the debt-asset ratio.

Consider now the other financial models in which resource costs are incurred in the issuing of debt ($\delta > 0$) and the effective tax rate on equity is more than on debt $\{u + \Theta(1-u) > m\}$. Rearranging (2.3.6) yields the financial equilibrium when the inflation rate rises, namely

$$\frac{1}{(1-\Theta)\,(1-u)} = \frac{1}{(1-m)} + \frac{d\delta}{d\pi}\,\frac{1}{(1-m)} \quad . \tag{2.3.7}$$

In these cases, equation (2.3.6) will be satisfied only when $\frac{d\delta}{d\pi} > 0$, $\{$since $\frac{1}{(1-\Theta)\,(1-u)} > \frac{1}{1-m}\}$. This implies that the debt-asset ratio will rise when the inflation rate increases.

The imperfect loss offsetting and bankruptcy cost models both predict that higher inflation rates will cause the debt-asset ratio to rise in a closed economy, since the tax rate on equity is more than that on debt. The managerial incentive model is a little more complicated. An increase in inflation rates could cause the managerial incentive payment, in the form of the manager's share of the profit of the firm, to adjust and affect the optimal debt-asset choice. This would be in addition to the direct effect of inflation noted for the other two models which also operates for the managerial incentive model.

With the small open economy assumption for Canadian capital markets (as discussed in Section 2.3.1), the marginal investor is assumed to be a foreigner. The analysis then follows that developed above, except now the linkage between Canadian and U.S. markets is considered. The discussion follows Boadway et al. (1984).

A U.S. investor will hold Canadian and U.S. assets until the after tax returns on these assets are equal. In U.S. dollars, the return on Canadian assets is the interest rate (i on debt or ρ_E on equity) plus the exchange rate appreciation of the Canadian dollars in terms of U.S. dollars ($\dot{e}$). The return on debt is taxed at m*, equity returns at Θ* and exchange rate gains at C* (where an asterisk denotes values in the U.S.). The interest paid on U.S. debt is i* (taxed at the rate m*) and the return on equity is $\rho_E{}^*$ (taxed at the rate Θ*). When the after-tax rates of return are equal for both Canadian and U.S. investments, then the following capital market equilibrium will hold:

$$i(1-m^*) + \dot{e}\,(1-C^*) = i^*\,(1-m^*); \qquad (2.3.8)$$

$$\rho_E(1-\Theta^*) + \dot{e}\,(1-C^*) = \rho_E\,(1-\Theta^*). \qquad (2.3.9)$$

If purchasing power parity holds, then the expected rate of appreciation in the Canadian dollar exchange rate for the U.S. investor will be equal to the difference between the U.S. and Canadian expected inflation rates ($e = \pi^* - \pi$). Substituting this expression into equations (2.3.8) and (2.3.9), the following expressions for determining interest rates in Canada are derived

$$i = i^* + \{(\pi-\pi^*)(1-C^*)\}/(1-m^*);$$

$$\rho_E - \rho_E{}^* + \{(\pi-\pi^*)(1-C^*)\}/(1-\Theta^*).$$

Under the small open economy assumption, an increase in the Canadian inflation rate relative to U.S. inflation will cause nominal returns on debt and equity to rise according to

$$\frac{\partial i}{\partial \pi} = (1-C^*)/(1-m^*); \qquad (2.3.10)$$

$$\frac{\partial \rho_E}{\partial \pi} = (1-C^*)/(1-\Theta^*). \qquad (2.3.11)$$

The return paid on debt and equity will rise by more than a point, if the U.S. capital gains tax on currency appreciation is less than that on interest and the return to equity.

To determine how the financial policy of firms will be affected by inflation in an open economy, equations (2.3.10) and (2.3.11) are substituted into equation (2.3.2) and the resource cost of issuing debt is also included:

$$\frac{(1-C^*)}{(1-\Theta^*)} = \frac{(1-C^*)\ (1-u)}{(1-m^*)} + \frac{d\delta}{d\pi}\frac{(1-u)(1-C^*)}{(1-m^*)} ,$$

which yields

$$\frac{1}{(1-\Theta^*)(1-u)} = \frac{1}{(1-m^*)} + \frac{d\delta}{d\pi}\frac{1}{(1-m^*)} . \qquad (2.3.12)$$

Equation (2.3.12) is the same as equation (2.3.7), except personal tax rates applied on U.S. income are used. The interpretation of this condition for capital market equilibrium in an open economy is the same as the one discussed for the closed economy, except that the marginal investor is a U.S. citizen. In the Miller model expected inflation has no impact on financial policy while in the other models, the debt-asset ratio will increase with a higher rate of expected inflation.

The above discussion of financial policy assumes that personal tax rates faced by the marginal investor are unaffected by the inflation. As pointed out by Gordon (1982), inflation contributes to a higher taxable capital income earned on debt assets relative to equity assets. Higher inflation could thus raise the personal tax rate on debt relative to the tax rate on equity, thereby reducing the supply of debt funds and increasing the supply of equity funds to businesses. This effect would counter the direct effect of expected inflation rates on financial policy as discussed above.

As discussed in the introduction to this section, unanticipated inflation creates a transfer of wealth from creditors to borrowers. It also causes the value of long-term debt to fall and the market value of equity to rise. The market value debt-asset ratio will thus temporarily fall. Once inflation is known to be higher (or lower) than expected, businesses in the next period can readjust the debt-asset ratio by selling more debt and reducing equity financing.

The degree to which businesses adjust their market value debt-asset ratios depends on adjustment costs. If there is no difficulty faced by businesses in adjusting their financial ratios, then the adjustment will be immediate. Measured on an annual basis, the market value of the debt-asset ratio could be unaffected by unanticipated inflation. However, borrowers and lenders may revise their expectations due to errors in prediction and belief that the expected inflation rate has changed. This latter effect will be incorporated into the measure of the expected inflation rate which influences the debt policy of the firm.

If adjustment costs are incurred in revising the debt-asset ratio, then unanticipated inflation could affect the observed debt-asset ratio until full adjustment takes place. The desired debt-asset ratio will not be affected by unanticipated inflation.

In empirical work (including that reported in Chapter 3), it is difficult to measure the market value of debt without the available data. If data are unavailable, the next best alternative is to make use of book values. One proxy measure of the debt-asset ratio is the book value of debt divided by the market value of equity plus the book value of debt (or perhaps the book value of equity, if the market value of equity is difficult to measure). How is this particular measure of the debt-asset ratio affected by unanticipated inflation? Suppose that inflation is higher than expected, causing the existing market value debt-asset ratio to fall relative to the desired ratio. Firms then immediately issue more debt to adjust the actual market value debt-asset ratio back to the desired one. If one uses the book value of debt, rather than its market value, to measure the debt-asset ratio, then the book debt-asset ratio should rise from one year to the next, even though the market value debt-asset ratio has not changed. Thus unanticipated inflation would cause the book measure of the debt-asset ratio to rise, even if there are no adjustment costs.

2.3.3 Separability of Financial and Investment Decisions

The models presented in Section 2.2 assume that firms can choose their financial policy independently of the amount of capital invested in the firm. An empirical implication of each of the models in Section 2.2 is that the observed debt-asset ratio is unrelated to the size of firms in the economy. This can be clearly seen by examining the second term of equation (2.2.3) for example, where the value of the firm is linear in the debt-asset ratio and the scale of the firm. In the financial models presented in Section 2.2, the advantage of issuing debt is unrelated to the capital stock decision of the firm.

Under a more general formulation of each of the financial models, it is not possible to show separability between financial and investment decisions. Intuitively, the financial policy of the firm will depend on the scale of the firm, so long as the cost of issuing debt is related in some way to the scale of the firm. For example, consider the tax loss model of section 2.2.2 where constant returns to scale in production are assumed. When a firm operates with a different technology (e.g., decreasing returns to scale) the marginal product of capital is inversely related with the size of the firm. When a firm increases its scale, it drives down the marginal product of capital thereby increasing the potential to incur marginal taxable losses which are only partially written off current or future taxable income. A firm's choice of its debt-asset ratio will be affected by its scale. Indeed, the debt-asset ratio will be lower in this instance [see Mintz (1983)]. Other similar conclusions on separability can be cited for the managerial incentive and bankruptcy cost model.

There are some circumstances in which the firm's financial policy is independent of the scale of the firm, even though there are decreasing returns to scale in production. A good example of this is to consider a reformulation of the bankruptcy cost model of Section 2.2.4. Here, it is assumed that the expected total costs of bankruptcy depend on both the debt-asset ratio and the scale of firm: $EC(\gamma,K,s)$. Liquidation or reorganization costs incurred with bankruptcy depend not only on the composition of assets and liabilities, but also on the scale of firm. Bankruptcy costs are assumed to be increasing with the scale of the firm and marginal bankruptcy costs also increase with the scale of the firm, since it may be more difficult to sell off or reorganize the assets of a larger firm [see Warner (1977)]. It is further assumed that the marginal return to capital falls with scale. Let $\rho(K,s)$ be total operating income before the deduction of interest payments and let $\rho'(K,s)$ be the marginal product of capital in state s.

The shareholders' after tax discount rate is ρ_E as in Section 2.2. In equilibrium he will hold equity and debt assets until the after tax discount rate on equity is equal to that of debt plus expected bankruptcy costs per dollar of debt: $EC/\gamma K$. This implies that the equilibrium before-tax interest paid on debt, i, is:

$$i = \rho_E/(1-m) + EC/\gamma K.$$

All other variables have the same interpretation as before.

The net wealth of the shareowner is the present value of the after-tax return to equity less the initial cost of equity $(1-\gamma)K$. Net wealth is denoted by W_E and

$$W_E = V_E - (1-\gamma)K,$$

in which

$$V_E = [(1-\Theta)(1-u)\{E\rho(K,s)-\gamma iK\}]/\rho_E \quad .$$

The shareowner maximizes his net wealth by simultaneously choosing the optimal capital stock of the firm (K) and the debt-asset ratio (γ). The first-order conditions are

<u>Capital Stock:</u>

$$E\rho' = i + (1-\gamma)\frac{\rho_E}{\{(1-u)(1-\Theta)\}} + E\left(\frac{\partial C}{\partial K} - \frac{C}{K}\right)\frac{(1-m)}{\{(1-u)(1-\Theta)\}} \qquad (2.3.13)$$

Financial Policy:

$$\frac{\rho_E}{\{(1-u)(1-\Theta)\}} = i + E\left(\frac{\partial C}{\partial \gamma} - \frac{C}{\gamma}\right) \frac{(1-m)}{\{(1-u)(1-\Theta)K\gamma\}} \qquad (2.3.14)$$

where $\frac{\partial C}{\partial \gamma} > \frac{C}{\gamma}$ and $\frac{\partial C}{\partial K} > \frac{C}{K}$, if the cost function is strictly convex.

The firm invests in capital until the expected marginal return to capital is equal to the weighted average of the before-tax cost of equity and debt plus expected marginal bankruptcy costs arising from additional capital invested in the firm. Financial policy is determined in equation (2.3.14), in which the cost of debt plus expected marginal bankruptcy costs arising from a higher debt-asset ratio is equal to the before tax cost of equity financing. The latter result is consistent in interpretation with the model of Section 2.2.4.

Will financial policy be independent of the size of the firm? Close examination of equation (2.3.14) reveals the choice of the debt-asset ratio does depend on the size of the capital stock. The greater the amount of capital invested in the firm, the higher will be the interest rate paid on debt ($\frac{\partial i}{\partial K} > 0$) and the higher will be expected marginal bankruptcy costs arising from a higher debt-asset ratio ($E\frac{\partial^2 C}{\partial \gamma \partial K} > 0$ and $E\frac{\partial C}{\partial K} > 0$).

It is, however, possible for financial policy to be determined independently of the scale of firm. If bankruptcy costs are a separable function of the debt-asset ratio and the scale of the firm and multiplicative in K, then the capital stock will not influence the costs of issuing debt. In this case, it can be shown that $\frac{\partial C}{\partial K} = \frac{C}{K}$ and that the second term of (2.3.14) is independent of K.

While financial policy may be shown to be independent of the scale of firm for some specific formulations of the bankruptcy cost function, the investment policy of the firm is always dependent on financial policy. In equation (2.3.13), investment depends on the weighted average of the costs of debt and equity finance plus the expected marginal bankruptcy costs arising from a larger size of the firm. If expected bankruptcy costs are multiplicative of the form cited, then the cost of capital is simply the weighted average of the costs of debt and equity finance, the weights depending on financial policy [see Auerbach (1979) and Boadway et al. (1984)]. In this special case, the firm's decision problem may be constructed in two stages. First, the firm chooses its debt-asset ratio to minimize the cost of capital:

$$\underset{\gamma}{\text{Min}} \rightarrow r = \gamma i + \{(1-\gamma)\rho\}/\{(1-u)(1-\Theta)\} \; .$$

With the minimized value of the capital stock, the firm then chooses the capital stock to maximize the present value of cash flow discounted by the weighted average cost of capital:

$$\underset{K}{\text{Max}} \rightarrow \frac{E\rho(K,s)}{r} - K \quad .$$

The minimized value of the cost of capital, r, does not depend on K. It would be easy to show that the present value of the firm's cash flow is maximized when the expected marginal return on capital is equal to weighted average cost of capital.

Without separability, the discount rate, r, will not only depend on the debt-asset ratio, but also the amount of capital invested in the firm. If K is chosen optimally, the appropriate rule for the investment policy of the firm under the two-stage procedure may be derived as

$$E\rho'(K) = r + \frac{E\rho(K)}{r^2}\frac{\partial r}{\partial K} \quad ,$$

in which

$$\frac{\partial r}{\partial K} = \frac{\partial r}{\partial \gamma}\frac{\partial \gamma}{\partial K} + E(\frac{\partial C}{\partial K} - \frac{C}{K})\frac{(1-m)}{(1-u)(1-\Theta)K} \quad .$$

With minimization of the cost of capital, $\frac{\partial r}{\partial \gamma} = 0$ when financial policy is chosen optimally. Under the two-stage procedure, the rule for investment may be written

$$E\rho' = \gamma i + (1-\gamma)\frac{(1-m)}{\{(1-u)(1-\Theta)\}} + \frac{E\rho}{r^2 K}E(\frac{\partial C}{\partial K} - \frac{C}{K})\frac{(1-m)}{\{(1-u)(1-\Theta)\}} \quad . \qquad (2.3.15)$$

Only when the cost of bankruptcy is multiplicative in the capital stock (which implies $\frac{\partial C}{\partial K} = \frac{C}{K}$) would the two-stage procedure be correct. This can be seen by comparing equations (2.3.15) and (2.3.13) where the latter term differs by a multiple of the third term.

One further point may be raised with regard to the separability of financial and investment policies. When such separability holds, the analysis of changes in tax policy on the cost of capital is much simpler. For small changes in the corporate tax rate, the financing effects which affect the cost of capital can be ignored. This is an important result which was fundamental to the analysis of tax policy on investment undertaken by firms [see Boadway et al. (1984)]. To see this point, consider the cost of capital formula derived for the special case of separability,

$$r = \gamma i + \{(1-\gamma)\rho_E\}/\{(1-u)(1-\Theta)\}. \qquad (2.3.16)$$

Differentiating with respect to the corporate tax rate,

$$\frac{\partial r}{\partial u} = \frac{-(1-\gamma)\rho_E}{(1-u)^2(1-\Theta)} + \frac{\partial r}{\partial \gamma}\frac{\partial \gamma}{\partial u} .$$

The first term is the direct effect of an increase in the corporate tax rate on the cost of capital of the firm, and the second term is the financial effect of an increase in the corporate tax rate on the cost of capital. With separability, the second term is equal to zero because the debt-asset ratio is chosen which minimizes the cost of capital ($\frac{\partial r}{\partial \gamma} = 0$). In this case, comparative static effects arising from tax policy changes can ignore the effect of changes in financial policy on the incentive to invest. Without separability, financial effects will, of course, matter.

In the empirical work, financial policy is assumed to be determined independently of the size of the firm. In this way, econometric work does not need to include as an explanatory variable the size of the firm. If separability is not assumed, then it is necessary to be concerned with the relationship between the debt-asset ratio and the size of the firm. A two-equation system would be needed to examine this relationship, since both the capital stock and financial variables are determined simultaneously. This requires both theory and empirical work to explain the capital stock decision of the firm. Unfortunately, such a worthwhile effort goes beyond the mandate of this study, and must remain a topic for further research.

2.3.4 Adjustment Costs and Financial Policy

The final extension to the financial models discussed in Section 2.2 is with regard to adjustment costs (which were touched upon briefly with regard to unanticipated inflation). The models in Section 2.2 are quite appropriate to analyze long-run equilibrium. However shocks in exogenous variables (e.g. change in tax and interest rates) would require firms to adjust their debt-asset ratios to reflect unexpected changes in exogenous variables.

Adjustments in the debt-asset ratio can be immediate, in which case no explicit modelling of adjustment is needed. Another view is that adjustment costs impede the ability of firms to revise their financial policy immediately, so that desired and actual debt-asset ratios can diverge for a period of time. One argument for the slowness of adjustment is related to the difficulty of issuing long-term debt and equity which requires time to contract. However, adjustment would likely take less than one year, which is the assumption of empirical work reported in Chapter 3.

If the observed debt-asset ratio is slow to adjust to the desired debt-asset ratio, then some form of partial adjustment may be applied [see Gordon (1982)]. Let $\gamma_t{}^*$ be the desired debt-asset ratio at time t and γ_t be the actual debt-asset ratio. The desired debt-asset ratio depends on current exogenous variables affecting the decision of the firm. If the current desired debt-asset ratio differs from the previous year's actual debt-asset ratio then adjustment may be assumed to follow the rule

$$\gamma_t = \lambda\gamma_t{}^* + (1-\lambda)\,\gamma_{t-1}$$

in which λ is a numerical coefficient between zero and one.

The main problem with this procedure is that it is ad hoc. The partial adjustment factor, λ, is independent of time and of the exogenous variables (such as interest rates and tax rates). This suggests that adjustment costs in issuing debt and equity are independent of all other factors. However, it may be possible that the resources devoted to adjusting the financial policy could depend on the level of particular exogenous variables. For example, a firm with more variability in its earning stream might commit itself to adjusting its debt-asset ratio more quickly.

2.4 Conclusions

In the model developed by Miller, there is no relationship between debt-asset ratios and taxes, except for the distinction among firm types taxed at different corporate tax rates; each firm is indifferent to its method of finance. However, an aggregate debt-asset ratio is determined, depending on the amounts of savings available from high- and low-taxed households, the former owning equity and the latter owning debt.

The other financial models characterize firms that select an optimal interior debt-asset ratio. These models include cases in which the debt policy influences the costs of finance through (i) the ability to use tax shields and losses, (ii) the need to induce managers to work harder and (iii) the desire to reduce bankruptcy costs. Table 2.4.1 summarizes the results for each of these models. The models generally predict the same effects, although the managerial-incentive model tends to have some ambiguous conclusions. Each model also includes an exogenous variable not included in the other.

In Chapter 3, the empirical work will not test each model individually,

Table 2.4.1

Comparative Static Effects of
Exogenous Variables on the Debt-Asset Ratio

	Losses Model	Managerial Incentive Model	Bankruptcy Cost Model
Corporate Tax Rate	↑	↑↓	↓
Firm Volatility in Earnings	↓	↑↓	↓
Tax Shield	↓	—	—
Refundability of Taxes	↑	—	—
Expected Bankruptcy Costs	—	—	↓
Managerial Risk	—	↓	—
Personal Tax Rate on Equity (Bonds)	↑ (↓)	↑↓	↑ (↓)
Expected Inflation	↑	↑↓	↑

Note: "↑" indicates a positive effect of the exogenous variable on the debt-asset ratio.
"↓" indicates a negative effect.
"↑↓" indicates ambiguity.
"—" indicates no predictable relationship.

since there is no reason to believe that one model is more likely to hold than another. Indeed the models may be regarded as complementary not competitive, and the empirical work reflects this.

The empirical work of Chapter 3 is restricted by assumptions concerning the environment in which firms operate. These include the smallness and openness of Canadian capital markets, the separability of financial decisions from the investment policy of the firms, and the adjustment of debt-asset ratios to desired levels. Finally, the models explicitly assume risk neutrality (except for the managerial incentive model). However, if risk aversion is assumed, many of the comparative static results derived in Section 2.2 are more difficult to interpret, since wealth effects induced by tax changes become important. Little would be gained from this analysis, since many of the earlier results reported in this chapter would still apply.

FOOTNOTES

1. With a full loss offset the government completely credits any losses incurred at the rate of tax used by the corporation or the investor.
2. This statement is, of course, true ex ante. Agents purchase term debt such that the interest yield reflects the ex ante evaluation of inflation over the term of the debt. There are important risk factors that exp.ain the use of the short- and long-term debt, and taxation itself can influence the risk borne by the investor. However, this issue is not dealt with here.
3. If * is the dividend tax rate, then using Canadian tax law

$$\Theta^* = (m^*-d)(1+g) \text{ which implies } \alpha^* = (1 - \frac{fd}{m^*})(1+g)$$

in which d = combined federal and provincial dividend tax credit (about 35%) and g is the gross up rate on dividends (currently 50%). If Θ^* is the accrued capital gains tax rate then α would be at most 1/2, but likely smaller taking into account the value of postponing the tax on realized capital gains.
4. It is possible for the manufacturing firm to own the debt issued by the nonmanufacturing firm.
5. See Mintz (1983) for an explicit discussion of these tax allowances.
6. Solving for $\frac{\partial V}{\partial \gamma} = 0$ implies

$$\int_0^{\bar{s}} p_s \; i[1-u(s)](1-\Theta)ds + i(1-m)$$

$$+ \frac{\partial s_c}{\partial \gamma} p_{s_c} [1-u(s_c)][\rho(s_c) - \gamma i] + i(s_c)\, X(s_c)$$

$$- \frac{\partial s_c}{\partial \gamma} p_{s_c} (1-u)[\rho(s_c) - \gamma i] + u\, X(s_c) = 0$$

At s_c, $CT(s) = 0$ so $u(s_c) = u$ and the third and fifth terms cancel out. Using the definition of u, (2.2.8) may be derived.

7. Note that (2.2.8) could be satisfied even if tax shields were zero [$X(s) = 0$]. In this case corporate profits and taxable income are identical. If corporate profits are negative then shareholders experience a capital loss in share values.

8. This can be contrasted with Grossman and Hart (1980) who assume that the payment to the manager depends on <u>ex ante</u> profitability of the firm (i.e. the market value of the firm). In Grossman-Hart, the manager can remove capital funds from the firm.

9. The Arrow-Pratt measure of relative risk aversion would need to be less than one.

10. The assumption that there is no bankruptcy on the part of the firm (unlimited liability) is maintained.

11. It is assumed that all forms of compensation is deductible from corporate taxable income. In Canada, remuneration through stock options is not deductible and for private corporations one-half of the income is taxable in the hands of the employee.

12. It is assumed here, for simplicity, that corporate tax shields are zero in value. For empirical work, tax shields are included in the model.

13. The expressions for the comparative static conditions in (2.2.12) are as follows (the second derivatives U" and f_{ee} are assumed negative):

$$\frac{\partial e}{\partial \alpha} = \frac{-(1-\Theta^m)EU'(1-R)f_e}{A} \gtreqless 0 \quad \text{if} \quad R \lesseqgtr 1$$

$$\frac{\partial e}{\partial \gamma} = \frac{(1-\Theta^m)^2 \alpha^2 i \, EU''f_e}{A} > 0$$

where $A \equiv (1-\Theta^m)\alpha[EU'f_{ee} + (1-\Theta^m)\alpha EU''f_e^2] < 0$

$R \equiv -U''\alpha(1-\Theta^m)(f-\gamma i)/U' > 0$ (measure of relative risk aversion).

14. Assuming that the shareholders' programming problem is strictly concave, so that this procedure is valid.

15. This suggests the possibility of a contract not being feasible for all combinations of α and γ in the general problem. We could introduce a lump-sum transfer to ensure the constraint to the shareowners problem will be met by a feasible contract. A lump-sum transfer would be needed to ensure that the manager receives some income. Without taxes, this transfer however would be a perfect substitute for changing the debt-asset ratio. That is, an increase in γ can be offset by an increase in the lump-sum transfer which implies shareowners can choose any debt policy. Feasibility without a lump-sum transfer in the general case is assumed.

16. Taxation also influences the marginal utility of the manager (U') so one should not interpret this discussion as one on comparative static results.

17. If the owner of firm issues debt to finance equity held in the business, then the firm will be indifferent to its financial policy, if personal bankruptcy costs are of the same magnitude as corporate bankruptcy costs [Webb (1983)].

18. Burgess (1985) points out, in a paper prepared for the Economic Council of Canada, that the aggregate economy-wide supply of savings from the foreign sector is not perfectly elastic with respect to the rate of interest, even if capital markets are small and open. Burgess shows that the social opportunity cost of foreign saving will rise if the economy is open, but not small, in the goods market. If Canada is not a price taker in the goods market, then the repayment of debt obligations will be more costly the larger the debt, since export revenues will be difficult to obtain. For a specific individual firm, however, the supply of savings could remain perfectly elastic with respect to the rate of interest.

CHAPTER 3

EMPIRICAL RESULTS

3.1 Introduction

The aim of this chapter is to present and discuss an empirical implementation of the theories developed in Chapter 2, using Canadian data. A recent survey of empirical work concerning the effects of taxation on capital structure is given in Aivazian and Turnbull (1985), but apart from mention of an earlier version of the present study, none of this is concerned with applications to Canadian data. In fact, this chapter represents the first attempt to develop an econometric model of capital structure for Canada. Given this brief background, it should be made clear what the empirical work seeks to achieve.

Ideally, the first aim of any empirical work in economics should be to test the theory upon which the work is based. Such an aim is in mind in the present context, but the tests are subject to various limitations which render them crude and, to some extent, unreliable. The most serious limitations arise as a consequence of the availability of data. Of the data files concerning Canadian capital structure that are available in machine readable form, the most comprehensive is the COMPUSTAT file. From 1970-82, this file comprises inter alia 164 different Canadian cotnrolled companies. Among these, there are missing observations from time to time. If the companies are standardized by accounting year, it is difficult to obtain a complete portfolio of observations on more than 40 companies for the entire period. For this reason, different samples have been selected each year (see Section

3.2 below) and 40 then represents the minimum sample size in any one year. The principal methodological implication of these facts is that sample selection and size have been determined by data availability, not by design to test the theories of Chapter 2. As a consequence, the link between the variables that are ideally required in theory and those that may in practice be calculated from the data in the file is more or less tenuous (see Section 3.2 below and Appendix 3.1 to this chapter). Therefore, some trial calculations, using different practical definitions of variables, have been undertaken.

For example, it is easy to calculate debt-asset ratios from the file and it is straightforward to determine a reasonable measure of the volatility of earnings for each firm. Experience suggests that these measures are rather closely related to the corresponding measurements that would arise were theory to be strictly applied [see e.g. Aivazian and Turnbull (1985) pp. 22-46]. Moreover, the results using debt-asset ratios may be compared, when further work is completed, with the results arising from the use of proper market evaluations of debt-equity ratios. On the other hand, the measurement of the refundability of taxes and of expected bankruptcy cost for each firm are much more problematic using the data on the file. Consequently, the link between measurement in theory and practice is much more tenuous for these variables.

Appendix 3.1 lists five alternative definitions of refundability and two of expected bankruptcy cost. For these two variables, then, there are ten different sets of trial calculations that may be undertaken. In fact, for reasons to be explained below, one of the two bankruptcy cost measures was a priori preferred and both sets produced very similar results. Of the five different trial measures of refundability, none produced significant results consistently over the years. Thus, if the theory is presumed, then the measurements used do not capture refundability; or, if one of the measurements used does indeed capture refundability as prescribed by theory, then the theory must be rejected. Since neither the former nor the latter presumption is entirely reasonable, the results must be regarded as conditional on an inability to test the role of refundability in the overall theory. Nothwithstanding this conclusion, refundability happens not to be a serious problem in the samples used, because it is of no importance to most of the companies comprising the samples.

Some of the variables required in the theory of Chapter 2 are simply not available from the COMPUSTAT file. Of these, some are available from another source and one simply cannot be calculated. For example, managerial risk, measured according to the Scholes-Williams (1977) \, is taken from the Laval tape. Inflation rates are based upon the Consumer Price Index using the methods of Boadway et al. (1984). The corporate tax rate (which varies over provinces, industries and time) is calculated as a weighted average as described in Section 3.2 below. However, the theory of Chapter 2 predicts that changes in personal income tax rates on debt and equity income will affect capital structure. The tax rate applying here is that of the marginal investor. In fact, the marginal investor is not identifiable; neither the province of residence nor the nationality and country of residence of the marginal investor can be known. Consequently, it is not possible to include this tax rate in the calculations. Failure to include a variable which theory requires to be included in general causes biases and inconsistencies in the coefficients of the remaining variables of a regression. Thus it is of some importance to examine how the results will be affected by excluding the tax rate of the marginal investor.

Insofar as risk neutrality is assumed, the marginal investor refers to the last investor induced to trade in the assets of any company in the market. The marginal investor's income tax rate in these circumstances is the same for all firms at one point in time, but many vary over time because the tax rate may vary over time. If, on the contrary, risk varies by firm, so too will the marginal investor and hence also the tax rate applying to the marginal investor. However, if risk variation is allowed for by an appropriate variable in a cross-section, then the marginal investor's personal tax rate will be absorbed into the effect of risk, because it is risk alone that induces the tax rate to have an effect. Thus only variation in the personal tax rate over time needs to be considered. Exclusion of the tax rate then affects only the coefficients of the time-varying variables, like inflation, but not the cross-section coefficients. Seen in this light, the exclusion of the marginal investor's personal income tax rate on debt and equity earnings would seem to be much less serious than it might first appear. What would otherwise be its effect in a cross-section gets absorbed into the cause of its importance, namely risk, while its effect over time is in part ascribed to the time-varying effects. Thus individual effects like risk and inflation will be quantitatively affected, but without seriously endangering the general qualitative tenor of the results.

Generally in regression studies, two routes are open when there is missing information, whether this is in the form of inexact or missing observations. First, exogenous correlates of what should be included may be used to assess the impact of the exclusions. Second, some of the variation left unexplained may be decomposed according to an error components model, thereby allowing an assessment of the origin and size of the missing effects. However, the general theoretical analysis of inexact or missing observations presumes knowledge of a valid specification of the empirical model, including specification of the functional form and the properties of the variables comprising it in relation to the unobservable errors. In cross-section analyses of firms, functional form and heteroskedastic errors are often cause for concern, because estimates and tests may vary greatly according to the specification used. Functional form is a problem in part because no natural form is suggested by economic theory and in part because the data are limited by the cross-section available. It is common to presume linearity and to test for significant departures from it, even when non-linearities are suspected. If linearity cannot be denied, then the statistical specification may be augmented to allow for an additive error components model. For example, the theory of Chapter 2 predicts that there is a relationship between risk and equilibrium capital structure, not necessarily linear. In the work reported below, this relationship is approximated by the addition of a term comprising an appropriate standard error to represent risk associated with a firm. No evidence of non-linearity is found in the estimated equations. However, having gone this far, no extensions into error component models have been considered. This remains a topic for future research.

In regard to heteroskedasticity, the potential danger in the present context does not seem great in any given year, because debt-asset ratios are, by their very nature, defined to be normalized by scale (assets representing the size of a corporation). Of greater danger is heterogeneity in residual variation across years, insofar as pooling of cross-sections is seen to be reasonable. The results below attempt to test for heteroskedastic errors using Bartlett's test, but go no further. This evidence favours the hypothesis of homogeneous variances.

With all these limitations, it is clear that the results should be regarded as preliminary and suggestive rather than final and definitive. The essential aim has been to produce results that are satisfactory for the task in hand, namely (a) to appraise the viability of the theory described earlier in order (b) to evaluate the marginal response of debt-asset ratios to variations in Federal and Provincial tax rates, in the presence of deductible allowances that vary by industry and time. In the empirical work, then, the corporate tax rate is regarded as the focus variable. In the event, the calculated responses have revealed remarkable strength and stability, notwithstanding quite substantial variations in other influences, except where the cross-section variation in tax rates precludes reliable estimation. In fact, this is a novel and important finding of the work. Previous cross-section studies of a similar kind for the United States have been unable to evaluate responses of the debt-asset ratio to changes in tax rates, because the available data contain little or no variation in tax rates. The tax rates used in this study, which were constructed by the authors, are a weighted average of provincial rates (which in fact have varied among provinces and, within a province, among industries) according as the proportion of each firm's activity in each province, together with the federal rate (which, in a special way, has varied among industries). Since no two firms are identical in this respect, the resulting calculated tax rates characteristically vary enough to enable estimation of their impact on the debt-asset ratio.

3.2 Samples and Data

All calculations reported below are within the framework of classical linear regression. Thus, referring to Table 2.4.1, and letting the subscripts i refer to a firm and t to time, the general form of the model to be considered is

$$D_{it} = \alpha_{0t} + \alpha_{1t}U_{it} + \alpha_{2t}\sigma_{it} + \alpha_{3t}\beta_{it} + \alpha_{4t}S_{it} + \alpha_{5t}\rho_{it} + \alpha_{6t}C_{it} + \gamma_1\pi^e_t + \gamma_2\pi^u_t + \varepsilon_{it} \quad (3.2.1)$$

in which:

D_{it} = Debt-asset ratio of firm i at time t;

U_{it} = Corporate tax rate applicable to the i'th firm at time t;

σ_{it} = The volatility of earnings of the i'th firm at time t;

β_{it} = Managerial risk as measured by the Scholes-Williams (1977) β, adjusted for thin trading and to remove influence of the debt-asset ratio, for firm i at time t;

S_{it} = Tax shield applicable to firm i at time t;

ρ_{it} = Refundability of taxes for the i'th firm available at time t;

C_{it} = Expected bankruptcy costs of firm i at time t;

π_e = Expected rate of inflation at time t;

π_u = Unanticipated rate of inflation at time t.

The α's (α_{0t}, α_{1t}, ..., α_{6t}) are coefficients which vary from year to year, whereas γ_1 and γ_2 are constant from year to year, since the only variation in the expected and unanticipated rates of inflation is from year to year. The error ε_{it} is presumed to be independently normally distributed over all i and t with variance ω^2_t. Some heteroskedasticity therefore is permitted, at this stage, in the specification.

This model is based on the "static-tradeoff" models, described in detail in Chapter 2. At the end of this chapter we also report some results testing the "pecking-order" hypothesis of Myers (1984) which requires the inclusion of variables not included in equation 3.2.1.

Before discussing the individual variables, it should be noted that the basic sample available comprises 164 Canadian controlled, public corporations (according to Statistics Canada, STC 61-517) on the COMPUSTAT File and the time period for which these data are available is 1970-82 inclusive. Private corporations and foreign controlled companies are excluded from the sample. However, missing data for various companies reduces the actual numbers of companies in each year according to those given under Large Sample in Table 3.2.1. Fiscal year varies considerably across companies, and this in itself would imply that different firms would be facing different conditions for any particular t. Consequently, to judge the impact of such additional variation in the data (which cannot in practive be absorbed readily by the introduction of an appropriate variable), the Large Sample of Table 3.2.1 was standardized on accounting year finishing in December. This standardized sample is referred to as the Small Sample in Table 3.2.1. It should be emphasized that inclusion of a firm at one stage does not automatically imply inclusion later on. The samples were selected according to data availability from the 164 available. Thus in the large sample there are never less than 61 corporations, never more than 118, and in the small sample never less than 40, never more than 72. In the pooled samples, the large sample accounts for 1,308 observations while the small sample accounts for 815 observations.

Table 3.2.1: Sample Size by Year, 1970-82

Year	Large Sample	Small Sample
1970	61	40
1971	71	46
1972	83	53
1973	92	57
1974	102	65
1975	108	67
1976	111	70
1977	112	70
1978	113	71
1979	113	68
1980	111	66
1981	118	72
1982	113	70
All years	1,308	815

It will be recalled, from the discussion in Chapter 2, that the direct comparative static effects predicted by imperfect loss offsetting and the bankruptcy cost model are clear cut. In contrast, the managerial incentive model is not clear cut in its predictions of the effects of variations in corporate tax rates, earnings volatility, expected and unanticipated inflation. Indeed, the only clear cut prediction of the managerial incentive model is that managerial risk, measured in equation (3.2.1) as β_{it}, should have a negative effect on the debt-asset ratio. Equation (3.2.1) may be regarded as the algebraic counterpart of Table 2.4.1; in the table, the three models taken together predict measurable responses in respect of eight variables, and consequently eight variables appear on the right-hand side of equation (3.2.1). The net predicted marginal effects of these eight variables may be obtained by 'summing' along the rows of Table 2.4.1. Since the managerial incentive model is ambiguous in predicting the effects of the corporate tax rate (U_{it}), firm volatility (σ_{it}), expected inflation (π^e_t) and unanticipated inflation (π^u_t), the net marginal responses of these variables (α_{1t}, α_{2t}, γ_1 and γ_2 respectively) are also ambiguous, unless the managerial incentive effects turn out to be in the same direction as the other two models or to be dominated by them. With regard to the corporate tax rate, for example, the view was taken that its net effect on the debt-asset ratio would be positive, since firms would likely bear higher 'agency' costs to take advantage of the lower after-tax cost of debt finance. Similarly, firm volatility was expected to yield negative effects. Referring to equation (3.2.1), α_{1t}, α_{5t}, γ_1 and γ_2 are predicted to be positive. Thus the debt-asset ratio is predicted to rise as corporate tax rates increase, as refundabiity increases (since more loss offsetting allows firms to use tax shields, thereby reducing the marginal cost of issuing debt), and as the expected and unanticipated inflation rates increase. With unanticipated inflation, companies will experience a fall in the market value of their debt. They react to this by issuing more debt, at book value. The consequent increase in the total book value of debt is designed to maintain the same debt-equity ratio, measured in market values (c.f. Chapter 2). Therefore, had accurate measures of the market value of debt and equity been available, unanticipated inflation would be expected to have had no effect on the market value of the debt-asset ratio. At the same time, the debt-asset ratio is predicted to fall the more volatile are firms' earnings, the greater are managerial risks, the higher are expected bankruptcy costs, and the greater are tax shields (which are less valuable to a non-tax-paying company).

Detailed definitions of the variables are given in the Appendix to this chapter. However, a few general comments are called for here.

The dependent variable, D_{it}, is defined as the debt-asset ratio, taken from balance sheet data. Though in principle it would be preferable to use the debt-asset ratio, as determined by capital market valuations, balance sheet values have been used principally as a matter of convenience and on the knowledge that ratios based on book and market values are rather closely correlated. In fact, an attempt was made to go part way toward using market valuation by applying end-of-year prices to determine the value of equity and measuring debt via the balance sheet [see Bradley, Jarrell and Kim (1984)]. This 'experiment' proved to be without interest. While corporate tax rate effects remained positive and significant (the coefficient was larger), some other unexpected results were obtained. The fact is that a mixture of balance sheet and market values introduces an extra -- and unnecessary -- dimension of variation, namely that caused by applying different valuations in the same ratio, and this is unhelpful in a cross-section in which analysis is characteristically burdened by low corelations. The results based upon market valuations of equity are not reported. Further work is being done to develop a market value estimate of debt as well as equity.

The corporate tax rate that is required in the calculations is the marginal rate applying to each company at each point in time. This is difficult to obtain exactly, because in each time period, the marginal rates applying to each company vary according to (i) the activity of the company in each province in which the company operates, and (ii) the industry into which the company is classified. Therefore, in the calculations, a weighted average of provincial marginal rates plus the federal marginal rate has been used, the weights varying from firm to firm according as the proportion of the firm's total activity in each province. This is adjusted in two ways. First, up to the end of 1973 the rate is adjusted for mining companies by a factor of 2/3, in view of the 'automatic' federal depletion allowance which was 1/3 of taxable income. After 1973 'automatic' depletion was discontinued, although it was maintained in some provinces (Ontario and Saskatchewan). Second, in 1974 and 1975, a federal tax abatement was given to oil, gas and mining firms in lieu of depletion. From 1976 oil, gas and mining corporations were allowed by the federal government an earned depletion allowance equal to 1/3 of eligible expenditures, up to a limit of 25% of earnings in any one year, the excess being carried forward. The time taken to claim earned depletion was naturally affected by financing. The greater the leverage of a company, the longer it might take to claim the full allowance. Moreover, if it was expected that the limit would be effective for the life of the investment, then the effective corporate tax rate would be only 3/4 of the statutory rate. The method of introducing this peculiarity into the calculations was to affix a binary variable to the slope coefficient of the tax rate for resource companies from 1974 to 1982. After 1980, earned depletion was discontinued for oil and gas companies, although allowances carried forward from previous years remained available.

The variable σ_{it} measures the volatility of earnings. This is calculated as the variance of forecasted earnings for the next five years, (t+1) to (t+5), using data for the previous seven years, (t-6) to t. Corresponding to σ_{it} is a second measure, β_{it}, which accounts for managerial risk. This is the Scholes-Williams (1977) beta (S-W-β) using monthy data,adjusted for thin trading and to exclude the influence of the debt-asset ratio. Thus if D_4 is the average debt-asset ratio for the previous 4 years, the adjusted-β that is used is S-W-$\beta(1-D_4)$. In keeping with the need to avoid artificially created correlations (and hence problems of endogeneity), the adjustment of

S-W-β does not include the debt-asset ratio being determined at time t.

The tax shield S_{it} is measured as the difference between deferred tax liabilities now and last year, divided by the tax rate and normalized by total assets. Other tax shields, such as research and development expenditures, are not reported in the COMPUSTAT file. In respect of refundability, ρ_{it}, four different measurements of this effect were considered, none of which proved a consistent addition to the explanation of D_{it}. These are explained in the Appendix. Since refundability (ρ_{it}) is in part tied to whether or not a corporation paid taxes the year before, a binary variable was introduced to capture the mean effect of this variable, taking the value zero in t if taxes were paid in (t-1), otherwise unity. In this way the prior expectation of the direction of influence would be opposite to that shown in Table 2.4.1, i.e. a negative coefficient would be the mean effect. Both the tax shield and refundability data are erroneously measured. As explained in Chapter 1, companies do not need to claim in a year the total of their capital cost allowances and other deductions, and these can be carried forward indefinitely. When companies do not claim all of their allowable deductions, taxable losses and deferred tax liabilities become understated in the published data. The data giving a true picture of tax shields and taxes that are refunded to corporations making losses are, regrettably, not published.

The expected cost of bankruptcy is difficult to measure since, while a measurement representing the cost of bankruptcy might readily be obtainable, it is very much more difficult to find an associated probability measure. Attempts based upon linear discriminant analysis have been used to estimate the probability of bankruptcy, given certain financial ratios, and these have proved useful in a number of applications [see Altman (1966)]. Based upon this work, the probabiity of bankruptcy used to estimate the expected cost of bankruptcy in the calculation below makes use of Altman's Z-PROB. The cost of bankruptcy is taken to be correlated with the ratio of intangible assets to total assets, on the ground that, the greater the proportion of intangible assets in total assets, the further must the value of the company fall upon bankruptcy. Thus the expected cost of bankruptcy is the cost divided by Z-PROB, Z-PROB being estimable according to a specified linear combination of operating income after depreciation, current assets, the ratio of sales to current assets, and the ratio of operating income after depreciation and interest paid to total liabilities. Notwithstanding the apparent sophistication of these calculations, expected bankruptcy cost does not seem to have been reliably estimated, or if it has, then the bankruptcy cost model has not, in this respect, been upheld by the data. Unfortunately it has not proved possible to apply the methods of Castanias (1983) since these presume a knowledge of the debt-asset ratio, which is being determined.

3.3 Analysis

The empirical analysis of the data just described in section 3.2 has been undertaken in two steps. First, equation (3.2.1) has been estimated using the cross-sections for each year 1970-82, for each sample. In these calculations $\gamma_1 = \gamma_2 = 0$ has been imposed since neither expected nor unanticipated rates of inflation have varied from company to company in any one year. The principal aims of this exercise are:

(i) to appraise the viability of the economic specification of the fitted equation;

(ii) to appraise the various alternative definitions of the independent variables within the context of equation (3.2.1);

(iii) to evaluate possible mis-specification and to take corrective

-tion where possible;

(iv) to examine year by year variations in the estimated coefficients so as to ascertain the possibilities for pooling the cross-sections over time.

Having completed the cross-sectional analysis, the second step was to pool the data in an appropriate way while introducing appropriate time effects, and rates of expected and unanticipated inflation. The problems that arise at this stage are:

(v) whether or not a pooled model is viable, and

(vi) what form it should take.

(vii) given (vi), what is the most sensible stochastic specification of the pooled model, and in particuar,

(viii) how should inflation be introduced?

Perhaps the most difficult problem to tackle is (vii), because it is upon the stochastic specification that estimation and inference essentially depend. However, the scale of the estimation problem has essentially precluded much exploration in this area at this time. Indeed, only one or two pooled specifications have been estimated. The models estimated are reasonable, but no alternative specifications are available with which to judge the possibilities for improvement. Further research in this area is continuing.

3.4 Results

The first set of results is given in Table 3.4.1 and comprises sets of 3 regressions for each year: one excluding the tax shield variable, another including it but excluding the refundability (binary) variable, and finally a regression including all the variables. The numbers given in parentheses under each estimate refer to t-statistics. The following observations may be made.

Table 3.4.1: Estimates of Equation (3.2.1) and Associated Statistics, Large Sample, 1970-82

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1970	0.086 (0.442)	0.945 (2.717)	-0.770 (0.753)	-0.188 (2.447)	-	0.812 (1.423)	-0.119 (1.412)	61	0.275	3.131
1970	0.046 (0.231)	1.022 (2.863)	-0.711 (0.683)	-0.204 (2.616)	42.461 (0.553)	0.857 (1.482)	-	61	0.254	2.875
1970	0.076 (0.383)	0.971 (2.722)	-0.810 (0.781)	-0.192 (2.459)	30.061 (0.392)	0.810 (1.408)	-0.115 (1.344)	61	0.277	3.227
1971	0.093 (0.573)	0.900 (3.002)	-1.073 (1.653)	-0.081 (1.315)	- -	0.216 (0.505)	-0.041 (0.647)	71	0.241	2.695
1971	0.071 (0.428)	0.923 (3.072)	-0.995 (1.503)	-0.076 (1.233)	45.017 (0.753)	0.181 (0.416)	-	71	0.243	2.643
1971	0.076 (0.456)	0.916 (3.031)	-0.983 (1.474)	-0.073 (1.163)	40.193 (0.661)	0.157 (0.358)	-0.035 (0.540)	71	0.246	2.671
1972	0.140 (0.910)	0.949 (3.114)	-1.502 (1.717)	-0.092 (1.827)	-	-0.314 (1.302)	-0.012 (0.187)	83	0.256	2.243
1972	0.124 (0.816)	0.967 (3.222)	-1.094 (1.228)	-0.117 (2.271)	77.194 (1.493)	-0.299 (1.306)	-	83	0.277	2.317
1972	0.125 (0.816)	0.959 (3.173)	-0.988 (1.062)	-0.116 (2.217)	80.613 (1.532)	-0.269 (1.113)	-0.028 (0.422)	83	0.278	2.337
1973	0.310 (2.452)	0.728 (2.878)	-0.804 (2.346)	-0.181 (4.964)	-	-0.114 (0.411)	-0.062 (1.083)	92	0.462	2.254
1973	0.317 (2.403)	0.724 (2.815)	-0.864 (2.432)	-0.178 (4.892)	-33.315 (0.744)	-0.148 (0.529)	-	92	0.458	2.266
1973	0.346 (2.581)	0.680 (2.618)	-0.878 (2.474)	-0.184 (5.019)	-36.787 (0.821)	-0.138 (0.495)	-0.065 (1.134)	92	0.466	2.290

Table 3.4.1 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1974	0.580 (3.997)	0.245 (0.826)	-1.491 (4.214)	-0.203 (4.604)	-	0.094 (0.503)	-0.201 (2.909)	102	0.329	2.062
1974	0.621 (4.099)	0.117 (0.383)	-1.440 (3.910)	-0.191 (4.070)	8.180 (0.230)	0.080 (0.396)	-	102	0.271	2.150
1974	0.576 (3.924)	0.251 (0.840)	-1.493 (4.198)	-0.205 (4.515)	8.275 (0.241)	0.106 (0.545)	-0.201 (2.895)	102	0.330	2.058
1975	0.436 (2.263)	0.483 (1.179)	-1.758 (4.926)	-0.137 (2.734)	-	0.114 (0.586)	0.067 (0.760)	108	0.257	2.323
1975	0.465 (2.372)	0.428 (1.039)	-1.753 (4.825)	-0.132 (2.656)	-20.964 (0.411)	0.129 (0.672)	-	108	0.254	2.330
1975	0.447 (2.249)	0.468 (1.121)	-1.776 (4.854)	-0.136 (2.710)	-12.706 (0.242)	0.111 (0.568)	0.062 (0.681)	108	0.257	2.332
1976	0.483 (2.088)	0.345 (0.690)	-1.199 (3.627)	-0.161 (2.757)	-	-0.059 (0.185)	0.063 (0.984)	111	0.200	2.131
1976	0.578 (2.532)	0.175 (0.355)	-1.347 (3.969)	-0.152 (2.616)	-63.632 (1.878)	-0.108 (0.344)	-	111	0.218	2.087
1976	0.558 (2.384)	0.214 (0.425)	-1.353 (3.967)	-0.151 (2.598)	-58.803 (1.648)	-0.109 (0.345)	0.030 (0.449)	111	0.220	2.081
1977	0.474 (1.985)	0.405 (0.791)	-1.544 (3.828)	-0.173 (3.140)	-	0.164 (0.467)	0.140 (1.621)	112	0.214	2.048
1977	0.535 (2.250)	0.316 (0.620)	-1.515 (3.750)	-0.184 (3.370)	-63.209 (1.355)	0.294 (0.835)	-	112	0.208	2.043
1977	0.491 (2.055)	0.393 (0.769)	-1.612 (3.945)	-0.175 (3.178)	-49.116 (1.031)	0.223 (0.628)	0.120 (1.358)	112	0.222	2.029

Table 3.4.1 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1978	0.442 (1.879)	0.569 (1.128)	-0.897 (2.255)	-0.313 (6.192)	-	-0.043 (0.092)	0.029 (0.547)	113	0.328	2.150
1978	0.430 (1.806)	0.589 (1.158)	-0.826 (2.196)	-0.315 (6.192)	13.226 (0.413)	-0.008 (0.016)	-	113	0.328	2.104
1978	0.421 (1.762)	0.608 (1.190)	-0.915 (2.286)	-0.316 (6.198)	18.467 (0.558)	-0.030 (0.064)	0.036 (0.663)	113	0.330	2.148
1979	0.414 (1.663)	0.519 (0.981)	-0.952 (2.321)	-0.149 (3.317)	-	-0.432 (0.850)	-0.008 (0.120)	113	0.228	1.925
1979	0.407 (1.638)	0.525 (0.995)	-0.980 (2.459)	-0.151 (3.352)	17.658 (0.489)	-0.415 (0.817)	-	113	0.230	1.936
1979	0.407 (1.626)	0.526 (0.990)	-0.978 (2.355)	-0.151 (3.334)	17.504 (0.472)	-0.416 (0.813)	-0.001 (0.020)	113	0.230	1.936
1980	0.606 (2.485)	0.032 (0.065)	-0.836 (2.460)	-0.124 (3.134)	-	0.041 (0.249)	0.066 (0.926)	111	0.240	2.143
1980	0.640 (2.539)	-0.025 (0.049)	-0.818 (2.390)	-0.120 (2.929)	-18.353 (0.567)	0.046 (0.273)	-	111	0.236	2.123
1980	0.635 (2.514)	-0.023 (0.045)	-0.820 (2.395)	-0.120 (2.922)	-15.101 (0.463)	0.047 (0.280)	0.062 (0.863)	111	0.242	2.134
1981	0.328 (1.363)	0.600 (1.216)	-0.559 (2.649)	-0.160 (3.664)	-	0.020 (0.085)	0.174 (3.484)	118	0.296	1.872
1981	0.544 (2.124)	0.239 (0.459)	-0.518 (2.402)	-0.165 (3.685)	-73.952 (2.505)	0.039 (0.166)	-	118	0.261	2.125
1981	0.456 (1.827)	0.368 (0.726)	-0.561 (2.685)	-0.155 (3.566)	-51.965 (1.761)	0.012 (0.052)	0.151 (2.960)	118	0.315	1.859

Table 3.4.1 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1982	0.436 (2.023)	0.462 (1.043)	-0.266 (2.049)	-0.304 (6.161)	-	0.153 (1.595)	0.174 (3.823)	113	0.368	2.190
1982	0.429 (1.944)	0.514 (1.135)	-0.410 (2.914)	-0.263 (5.172)	-122.296 (3.006)	0.132 (1.349)	-	113	0.338	2.379
1982	0.436 (2.060)	0.468 (1.078)	-0.372 (2.746)	-0.284 (5.788)	-92.322 (2.305)	0.151 (1.603)	0.149 (3.267)	113	0.398	2.143

Table 3.4.2: Estimates of Equation (3.2.1) and Associated Statistics Using an Alternative Series for β, Large Sample, 1970-82

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1970	0.097 (0.505)	0.961 (2.772)	-0.898 (0.892)	-0.230 (3.090)	32.071 (0.430)	0.994 (1.750)	-0.107 (1.279)	61	0.317	2.921
1971	0.121 (0.749)	0.887 (3.005)	-1.033 (1.588)	-0.137 (1.984)	26.967 (0.449)	0.377 (0.833)	-0.036 (0.569)	71	0.275	2.343
1972	0.218 (1.487)	0.867 (3.032)	-0.979 (1.115)	-0.217 (3.797)	78.358 (1.623)	-0.140 (0.602)	-0.030 (0.485)	83	0.353	2.578
1973	0.369 (2.938)	0.638 (2.600)	-0.754 (2.229)	-0.217 (6.114)	-29.339 (0.693)	-0.011 (0.042)	-0.068 (1.258)	92	0.519	2.415
1974	0.554 (4.069)	0.332 (1.192)	-1.279 (3.847)	-0.280 (6.265)	8.550 (0.272)	0.153 (0.871)	-0.186 (2.897)	102	0.423	2.464
1975	0.453 (2.467)	0.549 (1.427)	-1.430 (4.107)	-0.276 (5.069)	2.450 (0.050)	0.233 (1.278)	0.022 (0.264)	108	0.364	2.397
1976	0.498 (2.334)	0.472 (1.026)	-1.036 (3.264)	-0.320 (5.472)	-32.844 (0.997)	0.150 (0.522)	-0.002 (0.034)	111	0.354	2.277
1977	0.384 (1.792)	0.744 (1.612)	-1.410 (3.844)	-0.313 (6.301)	-49.336 (1.161)	0.266 (0.843)	0.075 (0.947)	112	0.380	2.207
1978	0.388 (1.717)	0.698 (1.445)	-0.767 (2.017)	-0.344 (7.472)	5.030 (0.162)	-0.066 (0.151)	0.028 (0.534)	113	0.402	2.369
1979	0.422 (1.829)	0.564 (1.151)	-0.793 (2.120)	-0.244 (5.583)	12.279 (0.359)	-0.299 (0.636)	0.009 (0.140)	113	0.341	1.962
1980	0.631 (2.638)	0.027 (0.056)	-0.609 (1.884)	-0.197 (4.588)	-6.703 (0.218)	0.002 (0.013)	0.052 (0.765)	111	0.317	2.170
1981	0.425 (1.890)	0.491 (1.078)	-0.377 (2.003)	-0.262 (6.440)	-38.582 (1.443)	-0.037 (0.180)	0.127 (2.750)	118	0.443	1.805
1982	0.432 (2.268)	0.518 (1.326)	-0.268 (2.168)	-0.351 (8.153)	-53.121 (1.443)	0.091 (1.068)	0.131 (3.211)	113	0.512	2.037

(i) Between about 20% and 50% of the variation in debt-asset ratios is accounted for in the calculations.

(ii) The evidence does not deny the hypothesis of linearity.

(iii) The sign of the tax rate coefficient (save for 1980) is consistently positive, as it should be. However, while from 1970-73 it is generally reliably estimated, thereafter its influence is unstable and of varying significance.

(iv) The coefficients of σ and β are consistently negative, as they should be according to theory, and one or other, usually both, are significant in the explanation of debt-asset ratios.

(v) The tax shield and cost of bankruptcy variables have unreliable coefficients, varying between significance and insignificance, while changing in sign.

(vi) The refundability parameter is sometimes negative and significant, sometimes positive and significant, but usually insignificant.

Two points are worth developing. First, the measurement of β: the definition of this variable involves extraction of the influence of the debt-asset ratio, but it is not entirely clear which debt-asset ratio is involved. In the event, the mean of the previous 4 years has been used, and the results are quite encouraging. If the influence of the current debt-asset ratio is used, then the estimates change and generally strengthen, as Table 3.4.2 indicates. However, the strengthening comes principally in R^2 and the coefficient of β, which suggests rather strongly a spurious effect caused by failure to exclude influence of the dependent variable from the measurement of β.

The second point concerns taxes. As indicated in section 3.2, a tax abatement was given to resource firms in 1974 and 1975 and earned depletion was granted for resource companies from 1976 onwards. The time value of earned depletion depends on financing. Moreover, as Table 3.4.1 demonstrates, the tax rate is not significant from 1974 to the end of the period. When an allowance is made for tax abatement in 1974 and 1975 and earned depletion from 1976 onward, the effects of taxes become a little more prominent and reliable; the same holds true for estimates based upon the small sample. Both of these sets of results are presented below.

The results from the first attempt to deal with the special case of resource companies are presented in Table 3.4.3. To understand these, equation (3.2.1) must first be reformulated by replacing $\alpha_{1t}U_{it}$ by $\alpha_{1t}(1 + \lambda_t\delta_{it})U_{it}$, λ_t being constant in year t and δ_{it} being a binary variable which takes the value unity if the i'th company at time t is involved in resource production, otherwise zero. In Table 3.4.2 there are two columns under U, the first denoted 'overall' and the second 'resource'. In the 'overall' column, estimates α_{1t} are presented with corresponding t-ratios. In the 'resource' column, the estimates and t-ratios refer to $\alpha_{1t}\lambda_t$. According to theory, $\alpha_{1t}\lambda_t$ should be negative, since reaction to a given tax rate, U_{it}, must be smaller for resource companies, in view of the fast write-off; however, the tax rate effect on the debt-asset ratio should still remain positive for resource companies, that is, $\lambda_t < 0$, but $|\lambda_t| < 1$ and hence $\alpha_{1t}(1 + \lambda_t) > 0$. It follows that the sum of the 'overall' coefficient of U_{it} and the resource coefficient should be positive: $(\alpha_{1t} + \alpha_{1t}\lambda_t) > 0$. This condition is upheld in Table 3.4.3 and, generally speaking, the composite parameter $\alpha_{1t}\lambda_t$ is significantly different from zero. There is also a slight improvement in the general performance

Table 3.4.3: Estimates of Equation (3.2.1) and Associated Statistics, with Two Alternative Responses to the Tax Rate, Large Sample, 1976-80

Year	Constant	U Overall	U Resource	σ	β	S	C	ρ	n	R^2	D-W
1976	0.363 (1.592)	0.571 (1.163)	-0.299 (2.813)	-0.805 (2.303)	-0.109 (1.821)	-	-0.310 (0.970)	0.065 (1.049)	111	0.256	1.975
1976	0.452 (1.962)	0.411 (0.832)	-0.260 (2.337)	-0.931 (2.468)	-0.111 (1.863)	-39.369 (1.132)	-0.304 (0.951)	-	111	0.257	1.985
1976	0.414 (1.752)	0.480 (0.952)	-0.270 (2.398)	-0.925 (2.446)	-0.109 (1.821)	-30.845 (0.838)	-0.311 (0.972)	0.048 (0.725)	111	0.261	1.970
1977	0.431 (1.775)	0.483 (0.933)	-0.108 (0.989)	-1.366 (3.092)	-0.155 (2.682)	-	0.126 (0.356)	0.128 (1.463)	112	0.221	2.004
1977	0.494 (2.018)	0.385 (0.740)	-0.086 (0.732)	-1.356 (2.953)	-0.169 (2.892)	-48.606 (0.956)	0.244 (0.679)	-	112	0.212	2.011
1977	0.456 (1.857)	0.452 (0.868)	-0.076 (0.649)	-1.468 (3.154)	-0.162 (2.756)	-36.615 (0.711)	0.181 (0.500)	0.116 (1.310)	112	0.225	2.003
1978	0.224 (0.969)	1.002 (2.033)	-0.331 (3.641)	-0.398 (0.994)	-0.252 (4.948)	-	-0.499 (1.086)	0.021 (0.408)	113	0.403	1.932
1978	0.177 (0.756)	1.087 (2.187)	-0.350 (3.810)	-0.322 (0.851)	-0.252 (4.987)	32.941 (1.075)	-0.476 (1.042)	-	113	0.408	1.875
1978	0.169 (0.718)	1.105 (2.214)	-0.349 (3.796)	-0.408 (1.020)	-0.254 (4.998)	37.991 (1.202)	-0.498 (1.084)	0.035 (0.680)	113	0.411	1.921
1979	0.217 (0.868)	0.916 (1.732)	-0.306 (2.948)	-0.388 (0.883)	-0.116 (2.598)	-	-0.774 (1.533)	-0.013 (0.201)	113	0.286	1.880
1979	0.172 (0.688)	0.986 (1.874)	-0.343 (3.217)	-0.383 (0.902)	-0.118 (2.652)	48.241 (1.342)	-0.771 (1.542)	-	113	0.298	1.902
1979	0.172 (0.688)	0.984 (1.858)	-0.343 (3.203)	-0.391 (0.892)	-0.118 (2.640)	48.813 (1.322)	-0.770 (1.531)	0.005 (0.075)	113	0.298	1.901

Table 3.4.3 (cont'd)

Year	Constant	U Overall	U Resource	σ	β	S	C	ρ	n	R^2	D-W
1980	0.468	0.304	-0.223	-0.573	-0.090	-	0.010	0.066	111	0.273	2.166
	(1.888)	(0.603)	(2.182)	(1.614)	(2.145)		(0.060)	(0.942)			
1980	0.444	0.360	-0.233	-0.570	-0.092	8.708	0.003	-	111	0.267	2.166
	(1.676)	(0.670)	(2.111)	(1.599)	(2.181)	(0.254)	(0.016)				
1980	0.434	0.370	-0.238	-0.568	-0.092	12.919	0.003	0.069	111	0.274	2.179
	(1.636)	(0.690)	(2.154)	(1.592)	(2.162)	(0.373)	(0.018)	(0.978)			

Table 3.4.4: Estimates of Equation (3.2.1) and Associated Statistics, Small Sample, 1970-82

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1970	0.108 (0.549)	0.991 (2.696)	-1.567 (1.509)	-0.237 (2.605)	-	0.615 (0.895)	-0.189 (2.024)	40	0.429	1.632
1970	0.003 (0.015)	1.202 (3.171)	-1.740 (1.598)	-0.262 (2.838)	179.115 (1.548)	0.647 (0.921)	-	40	0.403	1.391
1970	0.065 (0.329)	1.090 (2.920)	-1.877 (1.771)	-0.242 (2.676)	142.107 (1.244)	0.589 (0.862)	-0.167 (1.779)	40	0.454	1.568
1971	0.184 (1.051)	0.818 (2.524)	-2.709 (2.284)	-0.089 (1.198)	-	-0.015 (0.028)	-0.175 (2.286)	46	0.376	2.089
1971	0.166 (0.885)	0.833 (2.422)	-2.698 (2.121)	-0.104 (1.319)	35.672 (0.525)	-0.070 (0.117)	-	46	0.301	1.837
1971	0.176 (0.982)	0.825 (2.509)	-2.657 (2.185)	-0.086 (1.140)	17.263 (0.264)	-0.069 (0.120)	-0.172 (2.208)	46	0.377	2.072
1972	0.171 (1.047)	0.883 (2.689)	-1.427 (1.371)	-0.094 (1.733)	-	-0.292 (0.607)	-0.135 (1.471)	53	0.349	1.894
1972	0.182 (1.083)	0.881 (2.615)	-1.836 (1.759)	-0.116 (2.027)	24.377 (0.917)	-0.234 (0.476)	-	53	0.322	1.850
1972	0.142 (0.852)	0.917 (2.769)	-1.023 (0.903)	-0.108 (1.911)	57.029	-0.263 (0.543)	-0.163 (1.681)	53	0.360	1.893
1973	0.233 (1.670)	0.927 (3.281)	-1.183 (2.556)	-0.185 (4.986)	-	0.808 (1.485)	-0.053 (0.778)	57	0.606	1.985
1973	0.308 (2.082)	0.833 (2.919)	-1.402 (2.957)	-0.193 (5.173)	-61.131 (1.367)	0.626 (1.130)	-	57	0.615	1.922
1973	0.303 (2.035)	0.846 (2.940)	-1.363 (2.835)	-0.195 (5.174)	-58.177 (1.287)	0.633 (1.136)	-0.044 (0.650)	57	0.619	1.981

Table 3.4.4 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1974	0.526 (3.422)	0.402 (1.241)	-1.953 (4.726)	-0.212 (4.820)	-	-0.372 (0.841)	-0.039 (0.397)	65	0.453	1.663
1974	0.526 (3.432)	0.391 (1.220)	-1.965 (4.749)	-0.214 (4.841)	17.755 (0.554)	-0.361 (0.816)	-	65	0.454	1.621
1974	0.521 (3.357)	0.408 (1.251)	-1.970 (4.725)	-0.216 (4.813)	17.002 (0.526)	-0.362 (0.813)	-0.035 (0.360)	65	0.455	1.617
1975	0.440 (2.206)	0.490 (1.124)	-2.133 (5.336)	-0.128 (2.343)	-	-0.409 (0.748)	0 (•)	67	0.375	1.917
1975	0.427 (2.106)	0.498 (1.134)	-2.073 (4.861)	-0.129 (2.349)	24.094 (0.430)	-0.388 (0.702)	-	67	0.377	1.906
1975	0.427 (2.106)	0.498 (1.134)	-2.073 (4.861)	-0.129 (2.349)	24.094 (0.430)	-0.388 (0.702)	0 (•)	67	0.377	1.906
1976	0.366 (1.619)	0.576 (1.160)	-1.767 (5.262)	-0.117 (1.941)	-	-1.008 (1.306)	0.151 (2.227)	70	0.379	2.543
1976	0.446 (1.932)	0.403 (0.798)	-1.661 (4.731)	-0.128 (2.031)	56.582 (0.927)	-0.781 (0.981)	-	70	0.341	2.446
1976	0.287 (1.244)	0.713 (1.422)	-1.681 (4.979)	-0.132 (2.172)	88.630 (1.476)	-0.926 (1.207)	0.173 (2.510)	70	0.400	2.427
1977	0.637 (2.597)	-0.038 (0.072)	-2.184 (4.901)	-0.072 (1.163)	-	-1.031 (1.211)	0.079 (0.656)	70	0.288	2.506
1977	0.670 (2.767)	-0.093 (0.177)	-2.182 (4.852)	-0.077 (1.249)	-16.204 (0.333)	-1.013 (1.187)	-	70	0.284	2.576
1977	0.641 (2.589)	-0.041 (0.076)	-2.198 (4.856)	-0.073 (1.163)	-11.757 (0.238)	-1.035 (1.206)	0.075 (0.609)	70	0.288	2.522

Table 3.4.4 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1978	0.511 (1.883)	0.271 (0.459)	-0.823 (1.846)	-0.226 (3.268)	-	0.042 (0.054)	-0.045 (0.590)	71	0.202	2.362
1978	0.472 (1.740)	0.350 (0.593)	-0.903 (2.115)	-0.242 (3.473)	35.399 (1.037)	0.034 (0.044)	-	71	0.211	2.311
1978	0.480 (1.753)	0.332 (0.557)	-0.852 (1.905)	-0.238 (3.383)	32.852 (0.942)	0.059 (0.076)	-0.032 (0.414)	71	0.213	2.310
1979	0.572 (2.271)	0.116 (0.215)	-0.894 (1.767)	-0.152 (2.251)	-	0.097 (0.112)	0.195 (0.937)	68	0.223	2.044
1979	0.554 (2.193)	0.109 (0.201)	-0.804 (1.579)	-0.114 (2.095)	-4.074 (0.105)	0.134 (0.154)	-	68	0.212	1.984
1979	0.572 (2.254)	0.114 (0.210)	-0.900 (1.730)	-0.152 (2.226)	2.528 (0.064)	0.095 (0.109)	0.197 (0.926)	68	0.223	2.035
1980	0.505 (1.832)	0.191 (0.335)	-0.134 (0.236)	-0.143 (2.752)	-	1.075 (1.248)	0 (•)	66	0.262	2.338
1980	0.645 (2.327)	-0.074 (0.129)	0.067 (0.119)	-0.132 (2.591)	-70.031 (2.055)	1.017 (1.210)	-	66	0.310	2.392
1980	0.645 (2.327)	-0.074 (0.129)	0.067 (0.119)	-0.132 (2.591)	-70.031 (2.055)	1.017 (1.210)	0 (•)	66	0.310	2.392
1981	0.438 (1.553)	0.336 (0.574)	-0.833 (1.761)	-0.103 (1.699)	-	0.482 (0.651)	0.337 (4.763)	72	0.406	1.706
1981	0.687 (2.033)	-0.054 (0.078)	-0.575 (1.109)	-0.131 (1.982)	-92.057 (2.574)	0.330 (0.403)	-	72	0.277	2.115
1981	0.641 (2.122)	-0.045 (0.073)	-0.813 (1.745)	-0.096 (1.600)	-56.963 (1.727)	0.353 (0.482)	0.306 (4.246)	72	0.432	1.607

Table 3.4.4 (cont'd)

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1982	0.374 (1.382)	0.574 (1.031)	-0.228 (0.648)	-0.307 (4.620)	-	0.368 (0.541)	0.225 (3.933)	70	0.395	2.071
1982	0.448 (1.553)	0.481 (0.811)	-0.523 (1.299)	-0.244 (3.331)	-117.531 (2.419)	0.213 (0.294)	-	70	0.313	2.422
1982	0.399 (1.484)	0.530 (0.959)	-0.423 (1.124)	-0.278 (4.021)	-66.918 (1.400)	0.401 (0.593)	0.198 (3.304)	70	0.413	2.085

Table 3.4.5: Estimates of Equation (3.2.1) and Associated Statistics Using an Alternative Series for β, Small Sample, 1970-82

Year	Constant	U	σ	β	S	C	ρ	n	R^2	D-W
1970	0.050 (0.261)	1.138 (3.115)	-1.830 (1.780)	-0.272 (3.052)	131.315 (1.180)	0.658 (0.992)	-0.155 (1.688)	40	0.481	2.344
1971	0.201 (1.144)	0.821 (2.541)	-2.602 (2.181)	-0.139 (1.661)	6.882 (0.106)	0.106 (0.185)	-0.167 (2.174)	46	0.398	2.407
1972	0.239 (1.465)	0.814 (2.568)	-1.183 (1.118)	-0.197 (3.080)	48.729 (0.850)	-0.076 (0.164)	-0.128 (1.380)	53	0.427	2.207
1973	0.323 (2.259)	0.795 (2.862)	-1.244 (2.697)	-0.215 (5.739)	-48.830 (1.132)	0.651 (1.215)	-0.049 (0.739)	57	0.647	2.290
1974	0.496 (3.391)	0.467 (1.517)	-1.709 (4.303)	-0.262 (5.796)	10.321 (0.341)	-0.335 (0.799)	-0.032 (0.349)	65	0.516	2.031
1975	0.397 (2.064)	0.621 (1.488)	-1.694 (3.987)	-0.236 (3.624)	33.326 (0.625)	-0.245 (0.464)	0 (•)	67	0.440	1.989
1976	0.224 (1.055)	0.964 (2.079)	-1.354 (4.191)	-0.274 (4.237)	90.571 (1.661)	-0.850 (1.210)	0.156 (2.460)	70	0.497	2.429
1977	0.540 (2.292)	0.293 (0.568)	-2.026 (4.715)	-0.201 (3.140)	-11.885 (0.256)	-0.953 (1.181)	0.051 (0.438)	70	0.370	2.582
1978	0.475 (1.791)	0.372 (0.646)	-0.833 (1.917)	-0.262 (4.003)	21.316 (0.638)	-0.094 (0.124)	-0.024 (0.322)	71	0.258	2.407
1979	0.563 (2.296)	0.195 (0.369)	-0.855 (1.727)	-0.217 (3.088)	3.256 (0.085)	-0.055 (0.065)	0.253 (1.277)	68	0.273	2.083
1980	0.563 (2.225)	0.145 (0.278)	0.552 (1.092)	-0.224 (4.313)	-66.504 (2.118)	0.635 (0.813)	0 (•)	66	0.413	2.315
1981	0.498 (1.845)	0.314 (0.569)	-0.264 (0.671)	-0.232 (4.352)	-41.335 (1.383)	0.113 (0.171)	0.243 (3.655)	72	0.541	1.728
1982	0.381 (1.616)	0.598 (1.237)	-0.039 (0.115)	-0.370 (6.363)	-14.736 (0.339)	0.289 (0.489)	0.174 (3.354)	70	0.550	2.036

Table 3.4.6: Estimates of Equation (3.2.1) and Associated Statistics, with Two Alternative Responses to the Tax Rate, Small Sample, 1976-80

Year	Constant	U: Overall	U: Resource	σ	β	S	C	ρ	n	R^2	D-W
1976	0.299 (1.309)	0.697 (1.399)	-0.178 (1.540)	-1.495 (3.973)	-0.078 (1.203)	-	-1.215 (1.566)	0.148 (2.191)	70	0.402	2.488
1976	0.342 (1.465)	0.586 (1.157)	-0.219 (1.816)	-1.304 (3.283)	-0.084 (1.253)	79.246 (1.294)	-1.014 (1.280)	-	70	0.373	2.405
1976	0.182 (0.784)	0.898 (1.794)	-0.221 (1.909)	-1.322 (3.470)	-0.087 (1.360)	111.610 (1.858)	-1.162 (1.525)	0.174 (2.572)	70	0.433	2.335
1977	0.576 (2.280)	0.070 (0.129)	-0.124 (1.002)	-1.927 (3.746)	-0.042 (0.605)	-	-1.172 (1.358)	0.072 (0.592)	70	0.299	2.501
1977	0.599 (2.373)	0.024 (0.045)	-0.129 (0.984)	-1.895 (3.536)	-0.045 (0.638)	0.468 (0.009)	-1.154 (1.334)	-	70	0.295	2.552
1977	0.572 (2.218)	0.074 (0.135)	-0.128 (0.970)	-1.913 (3.546)	-0.041 (0.574)	4.663 (0.089)	-1.175 (1.350)	0.073 (0.594)	70	0.299	2.496
1978	0.242 (0.913)	0.807 (1.406)	-0.337 (3.322)	-0.280 (0.628)	-0.144 (2.083)	-	-0.391 (0.533)	-0.045 (0.642)	71	0.318	2.230
1978	0.181 (0.684)	0.930 (1.632)	-0.352 (3.501)	-0.340 (0.798)	-0.160 (2.333)	46.937 (1.480)	-0.409 (0.567)	-	71	0.336	2.167
1978	0.188 (0.705)	0.913 (1.587)	-0.351 (3.471)	-0.296 (0.669)	-0.157 (2.267)	44.685 (1.378)	-0.387 (0.531)	-0.028 (0.392)	71	0.338	2.158
1979	0.325 (1.216)	0.578 (1.029)	-0.262 (2.254)	-0.352 (0.644)	-0.075 (1.019)	-	-0.173 (0.203)	0.005 (0.022)	68	0.282	1.967
1979	0.304 (1.160)	0.603 (1.084)	-0.286 (2.551)	-0.365 (0.705)	-0.070 (1.286)	26.623 (0.678)	-0.210 (0.248)	-	68	0.287	1.854
1979	0.308 (1.139)	0.598 (1.059)	-0.283 (2.342)	-0.377 (0.686)	-0.074 (0.999)	26.816 (0.676)	-0.210 (0.246)	0.015 (0.069)	68	0.287	1.858

Table 3.4.6 (cont'd)

Year	Constant	U Overall	U Resource	σ	β	S	C	ρ	n	R^2	D-W
1980	0.412 (1.432)	0.386 (0.649)	-0.122 (1.113)	0.012 (0.021)	-0.127 (2.368)	-	0.912 (1.045)	0 (•)	66	0.277	2.508
1980	0.609 (1.995)	0.0004 (0.001)	-0.035 (0.294)	0.095 (0.166)	-0.128 (2.423)	-65.305 (1.723)	0.974 (1.134)	-	66	0.311	2.433
1980	0.609 (1.995)	0.0004 (0.001)	-0.035 (0.294)	0.095 (0.166)	-0.128 (2.423)	-65.305 (1.723)	0.974 (1.134)	0 (•)	66	0.311	2.433

of the equation over the years. Of course, the introduction of λ_t is designed to recognize that the effective corporate tax rate for resource companies is lower than the standard rate. The lower bound of the tax rate for these companies is 75% of the standard rate which implies that λ_t should be negative with absolute value no greater than 0.25. No tests of this hypothesis have been carried out on the large sample for two reasons: first, the estimates of λ_t are generally much larger in absolute value than 0.25; second, the large sample is generally less reliable than the small one, in view of its greater heterogeneity.

Table 3.4.4 corresponds with Table 3.4.1, the former applying to the small sample, the latter to the large sample. Generally, there is a strengthening of the results in Table 3.4.4 compared with corresponding results for the large sample, without dramatic differences. This is to be expected, because the small sample is more homogeneous than the large sample. Similarly, Table 3.4.5 for the small sample corresponds to Table 3.4.2 for the large sample, while Table 3.4.6 for the small sample corresponds to Table 3.4.3 for the large sample. In these four tables, the small sample results are generally similar to corresponding results for the large sample, with a general improvement in the quality of the estimates and a slightly better conformity with economic theory. As with the large sample, the most problematic measurement, as judged by the estimates and corresponding t-ratios, is bankruptcy cost, C_{it}. The coefficient of C_{it} is seldom significant and occasionally has a sign at variance with the predictions of the bankruptcy cost model. When this variable is removed from the calculations, the results displayed in Table 3.4.7 are obtained. These results are the point of departure for pooling; that is to say, the pooled results to be presented below are based upon testing using the regressions of Table 3.4.7, in particular the estimates obtained from excluding none of the right-hand variables of that table.

Before looking at the pooled results, a comment is called for on the implicit values of λ_t in Table 3.4.7. As indicated above, λ_t should be negative and lie in the interval (-0.25,0]. A test of this hypothesis is a one-sided problem, subject to the condition that the estimates are all negative, the null being $\lambda_t \in (-0.25,0]$, the alternative $\lambda_t < -0.25$. In the table, λ_t is consistently negative. In 1976, 1978 and 1980 it is estimated to be -0.24, -0.07 and -0.19 respectively. In 1977 and 1979 the estimates are -0.81 and -0.34 respectively, but neither of these values is significantly different from -0.25 according to the one-tailed test based on $(\lambda_t + 0.025)\alpha_{1t} = 0$ against $(\lambda_t + 0.025)\alpha_{1t} < 0$ (the t-values are 0.782 and 0.445). While it cannot be maintained that the null is strongly supported, the evidence is sufficient for the null not to be rejected. In this rather weak sense, the theory is not denied.

Many different statistical models are appropriate for pooling regressions, the simplest being a reproduction of the separate annual cross-section regressions, under the assumption that the residual variances in these separate regressions are all equal. If this assumption is justified then restricting coefficients over the years in the pooled regression is greatly simplified. If the residual variance in year t is ω^2_t, which has least squares estimate s^2_t based upon ν_t degrees of freedom, t = 1,2,...,T, then Bartlett's statistic, B, is appropriate for testing H_0: $\omega^2_1 = \omega^2_2 = \ldots = \omega^2_T$ against H_α: $\omega^2_1 \neq \omega_2 \neq \ldots \neq \omega^2_T$;

$$B = \frac{1}{C} (\nu \ln s^2 - \Sigma_t \nu_t \ln s^2_t)$$

in which $s^2 = \frac{1}{\nu} \Sigma_t \nu_t s^2_t$, $\nu = \Sigma_t \nu_t$, and

$$C = 1 + \frac{1}{3(T-1)} \{\Sigma_t (\frac{1}{\nu_t}) - \frac{1}{\nu}\} \quad .$$

B has the central $\chi^2(T-1)$ distribution under H_0. Using the residual variances from the regressions of Table 3.4.7, T=13, B=19.95 and the 5% upper tail of the $\chi^2(12)$-distribution is 21.03. Consequently, it is not possible, at the 5% level of significance, to reject the null hypothesis that all variances are equal; thus H_0 is 'accepted'.

Given the result of this test, regressions were calculated using all the data corresponding to Table 3.4.7 for the small sample 1970-82 and introducing, according to equation (3.2.1), expected and unanticipated inflation with separate coefficients. The calculated pooled regressions were restricted in the following ways: (a) the constant term and the 'overall' coefficient of the tax rate were restricted to be equal for all t ($\alpha_{0t} = \alpha_0$ and $\alpha_{1t} = \alpha_1$ for all t); (b) the constant, the 'overall' coefficient of the tax rate and the coefficient of β_{it}, managerial risk, were held constant over t ($\alpha_{0t} = \alpha_0$, $\alpha_{1t} = \alpha_1$ and $\alpha_{3t} = \alpha_3$ for all t); (c) in addition to the restrictions of (b), the coefficient of σ_{it} was also restricted to be equal over the years ($\alpha_{0t} = \alpha_0$, $\alpha_{1t} = \alpha_1$, $\alpha_{3t} = \alpha_3$ and $\alpha_{2t} = \alpha_2$ for all t). In each case, an appropriate F-statistic for linear restrictions was calculated, to test the validity of the restrictions. There are:

(a) F = 0.86 5% critical value F(12,) = 1.75

(b) F = 1.05 5% critical value F(24,) = 1.52

(c) F = 1.17 5% critical value F(36,) = 1.43

Thus, in each case, the restrictions are 'acceptable' to the data. The regression estimates arising from the restricted regression (c) are presented in Table 3.4.8. Further restrictions on this regression are not acceptable to the data.

There are several notable features of Table 3.4.8.

(i) The changing coefficient of the tax rate for resource companies becomes insignificant in 1979 and thereafter, but otherwise is significant, of the 'right' sign and it obeys the requirement $\alpha_1(1 + \lambda_t) > 0$.

(ii) The coefficient of refundability (ρ) is significant (at the 5% level) and negative in 1970 and 1971, but otherwise is insignificant, or positive and significant. Loss offsetting predicts this coefficient to be positive and significant.

(iii) The coefficient of the tax shield variable (which is predicted to be significantly negative) is once (1976) significant, at the 5% level, and positive, once (1982) significant and negative, and otherwise insignificant.

(iv) The 'overall' tax rate coefficient, managerial risk, and firm volatility are each clearly significant and of predicted sign.

(v) Inflation, which unlike the variables under (iv) is not restricted since it is a time series variable only, is significant and of predicted sign. Unanticipated inflation is not quite significant, at the 5% level.

Generally, it is clear that the unrestricted variables, apart from U (resource) from 1974-1978, are not particularly helpful in explaining the variation of debt-asset ratios. On the other hand, the variables S and ρ are difficult to measure reliably. The quality of the unrestricted estimates in Table 3.4.8, plus the difficulty of measuring some variables, suggest that a different method of accounting for the variability of debt-asset ratios be explored, for example an error components model with allowance for between company and between year variation.

Table 3.4.7: Estimates of Equation (3.2.1), without Bankruptcy Costs, and Associated Statistics, with Two Alternative Responses to the Tax Rate, 1976-80, Small Sample, 1970-82

Year	Constant	U: Overall	U: Resource	σ	β	S	ρ	n	R^2	D-W
1970	0.084 (0.406)	0.960 (2.508)	-	-1.395 (1.274)	-0.175 (1.934)	-	-0.195 (1.980)	41	0.341	1.642
1970	-0.033 (0.158)	1.214 (3.128)	-	-1.686 (1.491)	-0.211 (2.340)	222.871 (1.883)	-	41	0.335	1.418
1970	0.030 (0.145)	1.096 (2.849)	-	-1.821 (1.647)	-0.189 (2.123)	186.491 (1.588)	-0.166 (1.697)	41	0.384	1.527
1971	0.173 (0.953)	0.770 (2.306)	-	-2.674 (2.162)	-0.043 (0.575)	-	-0.173 (2.175)	47	0.321	1.871
1971	0.154 (0.806)	0.782 (2.234)	-	-2.643 (2.021)	-0.057 (0.732)	44.033 (0.674)	-	47	0.254	1.682
1971	0.164 (0.888)	0.774 (2.293)	-	-2.601 (2.064)	-0.039 (0.517)	26.235 (0.413)	-0.169 (2.079)	47	0.324	1.839
1972	0.140 (0.840)	0.900 (2.716)	-	-1.564 (1.480)	-0.072 (1.290)	-	-0.125 (1.323)	55	0.327	1.701
1972	0.151 (0.882)	0.895 (2.641)	-	-1.890 (1.791)	-0.094 (1.601)	27.920 (0.451)	-	55	0.307	1.679
1972	0.107 (0.624)	0.946 (2.815)	-	-1.198 (1.054)	-0.086 (1.480)	56.608 (0.885)	-0.151 (1.523)	55	0.337	1.700
1973	0.126 (0.853)	1.134 (3.805)	-	-0.995 (2.179)	-0.164 (4.185)	-	-0.051 (0.685)	61	0.563	1.894
1973	0.237 (1.528)	0.991 (3.319)	-	-1.285 (2.766)	-0.180 (4.588)	-86.373 (1.884)	-	61	0.585	1.893
1973	0.233 (1.490)	1.002 (3.326)	-	-1.258 (2.673)	-0.181 (4.580)	-83.993 (1.811)	-0.038 (0.515)	61	0.587	1.901

Table 3.4.7 (cont'd)

Year	Constant	U: Overall	U: Resource	σ	β	S	ρ	n	R^2	D-W
1974	0.456 (3.003)	0.533 (1.681)	-	-1.512 (4.366)	-0.247 (5.679)	-	-0.044 (0.430)	69	0.455	2.117
1974	0.460 (3.015)	0.517 (1.638)	-	-1.507 (4.347)	-0.245 (5.564)	3.117 (0.094)	-	69	0.453	2.118
1974	0.455 (2.953)	0.535 (1.668)	-	-1.513 (4.333)	-0.247 (5.539)	2.308 (0.069)	-0.043 (0.422)	69	0.455	2.115
1975	0.350 (1.855)	0.677 (1.662)	-	-1.709 (5.276	-0.177 (3.457)	-	0 (•)	71	0.399	2.332
1975	0.331 (1.738)	0.684 (1.675)	-	-1.631 (4.787)	-0.178 (3.462)	42.959 (0.761)	-	71	0.404	2.282
1975	0.331 (1.738)	0.684 (1.675)	-	-1.631 (4.787)	-0.178 (3.462)	42.959 (0.761)	0 (•)	71	0.404	2.282
1976	0.359 (1.548)	0.579 (1.145)	-	-1.353 (5.476)	-0.146 (2.401)	-	0.134 (1.933)	74	0.390	2.862
1976	0.415 (1.782)	0.456 (0.897)	-	-1.314 (5.200)	-0.155 (2.493)	70.774 (1.164)	-	74	0.369	2.775
1976	0.265 (1.127)	0.745 (1.462)	-	-1.305 (5.316)	-0.160 (2.645)	101.608 (1.678)	0.161 (2.282)	74	0.413	2.751
1976	0.293 (1.256)	0.695 (1.371)	-0.180 (1.555)	-1.121 (3.916)	-0.105 (1.602)	-	0.130 (1.883)	74	0.410	2.745
1976	0.314 (1.336)	0.633 (1.246)	-0.222 (1.877)	-1.018 (3.459)	-0.108 (1.630)	91.929 (1.513)	-	74	0.400	2.656
1976	0.165 (0.696)	0.921 (1.814)	-0.222 (1.931)	-1.010 (3.538)	-0.113 (1.757)	122.663 (2.031)	0.160 (2.323)	74	0.444	2.585

Table 3.4.7(cont'd)

Year	Constant	U Overall	U Resource	σ	β	S	ρ	n	R^2	D-W
1977	0.567 (2.234)	0.073 (0.133)	-	-1.281 (4.695)	-0.108 (1.700)	-	-0.012 (0.111)	75	0.265	2.763
1977	0.567 (2.251)	0.080 (0.146)	-	-1.296 (4.812)	-0.107 (1.703)	-15.905 (0.313)	-	75	0.266	2.767
1977	0.572 (2.235)	0.071 (0.128)	-	-1.288 (4.676)	-0.108 (1.697)	-16.712 (0.324)	-0.016 (0.145)	75	0.266	2.773
1977	0.480 (1.864)	0.232 (0.418)	-0.188 (1.533)	-1.032 (3.274)	-0.060 (0.864)	-	-0.010 (0.097)	75	0.289	2.673
1977	0.473 (1.840)	0.242 (0.438)	-0.193 (1.507)	-1.027 (3.199)	-0.058 (0.830)	7.047 (0.134)	-	75	0.289	2.663
1977	0.476 (1.820)	0.236 (0.422)	-0.192 (1.492)	-1.023 (3.141)	-0.059 (0.828)	6.545 (0.123)	-0.009 (0.081)	75	0.289	2.668
1978	0.610 (2.589)	0.094 (0.186)	-	-1.178 (2.923)	-0.226 (3.926)	-	-0.032 (0.423)	80	0.251	2.370
1978	0.588 (2.495)	0.133 (0.264)	-	-1.241 (3.177)	-0.231 (4.026)	26.363 (0.792)	-	80	0.255	2.328
1978	0.592 (2.492)	0.124 (0.244)	-	-1.211 (2.977)	-0.230 (3.969)	24.702 (0.727)	-0.022 (0.295)	80	0.256	2.339
1978	0.481 (2.066)	0.328 (0.661)	-0.245 (2.574)	-0.730 (1.713)	-0.159 (2.593)	-	-0.039 (0.546)	80	0.311	2.347
1978	0.451 (1.938)	0.381 (0.769)	-0.250 (2.632)	-0.800 (1.942)	-0.164 (2.702)	32.489 (1.011)	-	80	0.318	2.296
1978	0.456 (1.943)	0.371 (0.743)	-0.251 (2.627)	-0.759 (1.776)	-0.163 (2.647)	30.419 (0.928)	-0.028 (0.387)	80	0.319	2.307

Table 3.4.7 (cont'd)

Year	Constant	U Overall	U Resource	σ	β	S	ρ	n	R^2	D-W
1979	0.394 (1.943)	0.480 (1.104)	-	-0.652 (2.194)	-0.147 (2.798)	-	0.016 (0.123)	80	0.258	1.846
1979	0.414 (1.999)	0.423 (0.942)	-	-0.680 (2.256)	0.142 (3.306)	14.643 (0.479)	-	80	0.260	1.804
1979	0.418 (1.998)	0.421 (0.929)	-	-0.694 (2.240)	-0.148 (2.804)	15.925 (0.508)	0.028 (0.216)	80	0.261	1.816
1979	0.274 (1.342)	0.704 (1.623)	-0.211 (2.304)	-0.268 (0.803)	-0.102 (1.853)	-	-0.034 (0.267)	80	0.307	1.794
1979	0.307 (1.490)	0.626 (1.407)	-0.213 (2.363)	-0.327 (0.993)	-0.107 (2.416)	21.943 (0.735)	-	80	0.312	1.770
1979	0.303 (1.450)	0.630 (1.404)	-0.215 (2.341)	-0.315 (0.922)	-0.102 (1.857)	21.189 (0.694)	-0.018 (0.141)	80	0.312	1.762
1980	0.350 (1.541)	0.560 (1.193)	-	-0.628 (1.755)	-0.133 (3.262)	-	0 (•)	77	0.300	2.086
1980	0.462 (1.983)	0.349 (0.730)	-	-0.498 (1.381)	-0.122 (3.012)	-58.152 (1.753)	-	77	0.328	2.041
1980	0.462 (1.983)	0.349 (0.730)	-	-0.498 (1.381)	-0.122 (3.012)	-58.152 (1.753)	0 (•)	77	0.328	2.041
1980	0.287 (1.253)	0.687 (1.451)	-0.140 (1.457)	-0.469 (1.260)	-0.111 (2.587)	-	0 (•)	77	0.320	2.156
1980	0.399 (1.638)	0.474 (0.951)	-0.092 (0.899)	-0.419 (1.126)	-0.110 (2.574)	-46.744 (1.314)	-	77	0.336	2.091
1980	0.399 (1.638)	0.474 (0.951)	-0.092 (0.899)	-0.419 (1.126)	-0.110 (2.574)	-46.744 (1.314)	0 (•)	77	0.336	2.091

Table 3.4.7 (cont'd)

Year	Constant	U		σ	β	S	ρ	n	R^2	D-W
		Overall	Resource							
1981	0.161 (0.673)	0.953 (1.921)	-	-0.364 (0.849)	-0.161 (2.828)	-	0.313 (4.419)	81	0.374	1.795
1981	0.284 (1.030)	0.792 (1.401)	-	-0.078 (0.166)	-0.193 (3.130)	-63.772 (1.903)	-	81	0.251	2.027
1981	0.239 (0.948)	0.809 (1.565)	-	-0.303 (0.698)	-0.161 (2.829)	-31.155 (0.983)	0.295 (4.019)	81	0.382	1.787
1982	0.185 (0.811)	0.982 (2.085)	-	-0.144 (0.444)	-0.316 (5.075)	-	0.232 (4.440)	79	0.406	1.980
1982	0.221 (0.904)	0.961 (1.906)	-	-0.336 (0.898)	-0.258 (3.767)	-130.633 (2.810)	-	79	0.322	1.999
1982	0.219 (0.971)	0.924 (1.981)	-	-0.368 (1.063)	-0.286 (4.485)	-76.997 (1.700)	0.203 (3.721)	79	0.429	1.947

Table 3.4.8: Estimation of Equation (3.2.1) with the Coefficients of U, β and σ Restricted, Small Sample, 1970-82

Restricted Estimates		Unrestricted Estimates													
			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Constant	0.067 (0.904)	U (Resource)	-	-	-	-	-0.326 (3.574)	-0.300 (3.620)	-0.229 (2.775)	-0.183 (2.230)	-0.254 (3.435)	-0.111 (1.359)	-0.004 (0.050)	0.076 (0.985)	0.077 (1.020)
U (Overall)	0.788 (7.234)	S	111.350 (1.071)	24.000 (0.408)	74.829 (1.413)	-21.912 (0.537)	-5.177 (0.156)	32.636 (0.712)	128.087 (2.507)	10.115 (0.236)	38.773 (1.281)	38.945 (1.317)	-20.973 (0.661)	-36.415 (1.342)	-110.759 (2.898)
σ	-0.851 (7.761)	ρ	-0.205 (2.292)	-0.163 (2.129)	-0.151 (1.640)	-0.023 (0.261)	0.018 (0.160)	-	0.157 (2.512)	-0.022 (0.244)	-0.013 (0.194)	0.092 (0.799)	-	0.294 (4.617)	0.197 (4.151)
β	-0.143 (9.351)														
Expected Inflation	0.019 (3.656)														
Unanticipated Inflation	0.008 (1.897)														
n	902														
R^2	0.383														

The most important finding of Table 3.4.8 is the strong showing of tax rates (overall), though in a sense this is merely a reflection of results obtained earlier. Perhaps the most surprising results are the strong showing of β and σ. Putting together these positive results and the negative ones concerning the unrestricted estimates, equation (3.2.1) might be reformulated as

$$(3.4.1) \qquad D_{it} = \alpha_0 + \alpha_1(1 + \lambda_t\delta_{it})U_{it} + \alpha_2\sigma_{it} + \alpha_3\beta_{it} + \mu_i + \Theta_t + \varepsilon_{it}$$

in which μ_i and Θ_t are random components, the former varying over firms and the latter over time, ε_{it}, as before, being the residual element varying over both. In this way some variation among firms and over time is allowed for, without specific attribution to identifiable variables. Such a device, while unattractive from the behavioural viewpoint, has the advantage of allowing identifiable effects to be estimated efficiently by removing variation which evidently cannot be captured by variables that the authors have attempted to introduce. In effect, the 'sound' results are preserved, while improving the statistical quality of the estimated explanation. This exercise has not been attempted here and remains a task for future research.

The results of the small sample in Table 3.4.8 are generally similar to results obtained with the large sample. However, step-by-step testing of aggregation over the years was not attempted for the large sample. Thus a pooled calculation with the large sample, with expected (π^e_t) and unanticipated (π^u_t) inflation included and all estimates of cross-section coefficients restricted, namely

$$D_{it} = \alpha_0 + \alpha_1(1 + \lambda\ \delta_{it})U_{it} + \alpha_2\sigma_{it} + \alpha_3\beta_{it} + \alpha_4 S_{it} + \alpha_5\rho$$
$$+ \gamma_1\pi^e{}_t + \gamma_2\pi^u{}_t + \epsilon_{it}$$

yields the following results

α_0 = 0.164 (2.512)	α_4 = -1.523 (0.140)
α_1 = 0.702 (6.738)	α_5 = 0.043 (2.443)
α_1 = -.0213 (6.670)	α_6 = 0.002 (0.038)
α_2 = -0.502 (5.954)	γ_1 = 0.013 (3.363)
α_3 = -0.150 (11.027)	γ_2 = 0.002 (1.154)

At the 5% level, all coefficients are significant except α_4 (tax shield), α_5 (refundability), α_6 (bankruptcy cost) and γ_2 (unanticipated inflation). Comparing this restricted model with its unrestricted counterpart yields an F-statistic of 1.781 which is significant at the 0.1% level. Consequently, pooling cannot be justified by this test. On the other hand, each of the significant coefficients has the sign predicted by the theory of Chapter 2.

3.5 Further Empirical Results

The empirical work reported thus far is essentially a test of the "static-tradeoff" models discussed in Chapter 2: namely, (i) the tax loss offset model, (ii) the managerial incentive model and (iii) the bankruptcy cost model. Another model that has not been tested is the "pecking order" model which predicts that firms prefer internal to debt finance. As discussed in Chapter 2, this model suggests that firms with low growth and high profitability use more equity finance (retained earnings) relative to debt than to high growth and low profitability firms. The other variables, such as the standard deviation in profits and managerial risk, still affect the debt decision which depends on the bankruptcy and agency costs faced by the firm. The effects of the variables in the "pecking order" model are similar to those in the "static tradeoff" models. Firms with high tax shields and low corporate tax rates pay less corporate tax; consequently they have greater access to cash flow generated internally, thereby using less debt finance.

To capture the "pecking order" model, two additional variables are included in the pooled regression. The first is the rate of return to capital (r_{it}) measured as operating income (gross of taxes and interest payments) divided by total assets. Firms with a high current rate of return to capital generate more internal finance and thus rely less on debt. This variable of itself captures the "pecking order" hypothesis. If current profitability of firms is correlated with expected profitabiity, then this new formulation provides a good test of the "static tradeoff" models as well. In Chapter 2, it was predicted in the "static-tradeoff" models that a higher gross-of-tax rate of return to capital would induce firms to increase, rather than decrease, debt finance. This is contrary to the "pecking order" hypothesis".

Unfortunately, the rate of return to capital is affected by other factors which are included in the regression. Firms that are risky (as measured by β) need to earn a higher return to capital to attract equity financing. Since risk leads to lower debt-asset ratios, then a higher return to capital is inversely correlated with the debt-asset ratio. Thus, it is difficult to disentangle the effect of risk from the cash flow effects on financing behaviour.

The second variable included in the regression is the growth rate in fixed assets ($GFIX_{it}$), measured as the difference in fixed assets employed in current and past periods, divided by the amount of fixed assets employed in the previous period. Myers (1984) argued that debt issued by firms would more likely be used to finance the acquisition of fixed rather than intangible assets.

In the empirical work reported in Table 3.4.9, the same methodology is used to test restrictions on the coefficients as in the pooled regression of Table 3.4.8. Estimates based on the small sample discussed in Section 3.2 are reported.

In addition to the inclusion of r_{it} and $GFIX_{it}$ in the regression, some other changes are also introducedin testing the model. First, like Bradley, Jarrell and Kim (1984), tax shields are measured as depreciation divided by total assets. This is based on the argument that firms with more depreciable capital enjoy greater tax shields. The results arising from this change were insignificant and so the tax shield variable is excluded from the final pooled regression. Second, a slope, rather than intercept, dummy is used for the refundability parameter. Firms in a loss position deduct interest at a lower value than fully taxpaying firms, so a slope dummy variable is included for the corporate tax rate of a firm in a loss position. It is expected that the coefficient of the dummy variable should lie between 0 and -1. Third, corporate tax rates for resource firms in 1974 and 1975 are measured as the standard rate less the tax abatement and are no longer distinguished by a dummy variable for these years. This procedure has little effect on results. The dummy variable, for resource firm corporate tax rates only applies to the post-1976 period when resource firms were given earned, rather than "automatic", depletion.

The results reported in Table 3.4.8 are similar to earlier pooled regression results, although there are some important differences:

(i) The rate of return to capital has a negative effect on the debt-asset ratio as predicted by the "pecking order" hypothesis. However, the rate of return to capital also reflects higher risk and tax payments. This is consistent with some of the implications derived from the other models. The negative correlation between the net-of-tax rate of return to capital and the debt-asset ratio was found to be weaker than that of the gross-of-tax rate of return to capital. This is to be expected, since highly levered firms pay less corporate tax than less levered firms. The net-of-tax return to capital and leverage may be correlated for this reason.

(ii) The growth in fixed assets has a positive effect on the debt-asset ratio, as predicted by the "pecking-order" hypothesis.

(iii) The coefficient associated with the statutory corporate tax is significant but smaller compared with the earlier results. The reduced value is partly a result of including the gross-of-tax rate of return to capital. Thus some of the corporate tax rate effects have been included in the coefficient associated with the rate of return to capital.

(iv) The measure of firm risk (σ) is generally of the expected sign but, unlike earlier results, cannot be restricted to be the same for all years. In the years in which the restriction does not apply, the sign of the coefficient is positive but not significantly different from zero.

(v) The dummy variable for resource firms is generally insignificant and the refundability dummy is significant and of expected sign only before 1973.

While there are important differences between these and earlier results, the coefficient of the corporate tax rate remains significantly positive. Thus, the inclusion of "pecking order" hypothesis does not changed the conclusion that the size of corporate tax rate induces more leverage.

Table 3.4.9: Pooled Regression Estimation of Equation with Restricted Coefficients

Small Sample 1970-82

Restricted Estimates

Constant	.467 (10.06)
U	.182 (9.21)
σ	-.391 (-3.33)
β	-.152 (-9.67)
Expected Inflation	.012 (2.17)
Unanticipated Inflation	.006 (1.14)
r	-.558 (-9.67)
GFIX	.204 (4.44)
n	900
R^2	.433

Unrestricted

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
U (Resource)							-.069 (-.93)	-.027 (-.36)	.029 (.42)	.028 (.31)	-.0001 (-.001)	.176 (1.98)	.318 (3.50)
σ										.706 (2.27)	.167 (1.49)		
β												-.166 (-4.24)	-.282 (-5.51)
ρ	-.489 (-2.82)	-.383 (-2.59)	-.457 (-2.35)	-.177 (-.96)	.044 (.173)	-	1.66 (1.22)	-.226 (-1.19)	-.149 (-1.05)	-.080 (-.34)	-	.593 (4.93)	.476 (5.12)

APPENDIX 3.1

The data used in the results reported in Chapter 3 are taken from the COMPUSTAT file of approximately 250 public corporations of which 164 were Canadian controlled in 1978-79, according to Statistics Canada STC 61-517. To define the variables used in the calculations of Chapter 3 and in other calculations not reported, certain items from the COMPUSTAT file are required. These are

ASST = Total assets
DTAX = Deferred taxes and tax credits
TASS = ASST - DTAX
TLCF = Tax loss carry forward
ITAX = Corporate income tax paid
IRAT = Corporate tax rate
OINC = Operating income (before depreciation)
DEPR = Depreciation
CASS = Current assets
CLIA = Current liabilities
INTP = Interest payments
NETS = Net sales
FOID = Forecast of (OINC - DEPR) 5 years into the future
IASS = Intangible assets

Forecasts were developed using the PROC FORECAST procedure in SAS, for each year and each company, using data from the previous 7 years. As indicated in Chapter 3, S-W-β will denote the Scholes-Williams β adjusted for thin trading. This was estimated from the LAVAL tape with monthly data, for five years, beginning in December. Below, subscripts are used only where necessary to avoid ambiguity.

The variables are:

1. Debt-asset ratio: D_{it} = {TASS less preferred stock at liquidation value less common equity less minority interests} TASS

2. Adjusted β: β_{it}. This is defined in 2 ways:

   (i) $\beta_{it} = \text{S-W-}\beta_{it} \times (1 - D_{it})$

   (ii) $\beta_{it} = \text{S-W-}\beta_{it} \times (1 - [\{D_{i,t-1} + D_{i,t-2} + D_{i,t-3} + D_{i,t-4}\} \div 4])$.

   The "alternative series for β" (Table 3.4.2) is 2(i). The rest of the calculations are based upon 2(ii).

3. Refundability: ρ_{it}. This is defined in 5 ways:

   (i) If $TLCF_t = 0$, $\rho_{it} = -\{(100 \times ITAX) \div TRAT \times TASS\}$

   If $TLCF_t > 0$, $\rho_{it} = TLCF_t \div TASS$

   (ii) If $TLCF_{t-1} = TLCF_t = 0$, $\rho_{it} = \{[100 \times ITAX) \quad TRAT] + FOID\} \div TASS$

   If $TLCF_{t-1} > 0$, $TLCF_t = 0$, $\rho_{it} = FOID \div TASS$

   If $TLCF_{t-1} = 0$, $TLCF_t > 0$, $\rho_{it} = (FOID - TLCF_t) \div TASS$

   If $TLCF_{t-1} > 0$, $TLCF_t > 0$, $\rho_{it} = (FOID - TLCF_t) \div TASS$

   (iii) If $TLCF_t = 0$, $\rho_{it} = 0$

   If $TLCF_t > 0$, $\rho_{it} = TLCF_t \div FOID$

   (iv) If $TLCF_t = 0$, $\rho_{it} = -(100 \times ITAX_t) \div (TRAT \times FOID)$

   If $TLCF_t > 0$, $\rho_{it} = TLCF_t \div FOID$

   (v) If $ITAX_{t-1} < 0$, $\rho_{it} = 1$, otherwise zero.

Each of the definitions (i)-(iv) were applied and it was expected that (ii) would perform the 'best'. However, none was particularly consistent and all were regarded as unsuccessful. In the calculations reported in Chapter 3, (v) was applied.

4. Earnings volatility: σ_{it} = standard error of earnings forecasts five years into the future.

5. Tax shield: $S_{it} = (DTAX_t - DTAX_{t-1}) \div TRAT \times TASS$

6. Bankruptcy Cost: C_{it} is measured two ways. The first uses ZPROB.

(i) $$ZPROB = 1.03CASS + 3.07(OINC-DEPR) + 0.4(NETS \div TASS) + 0.6[OINC-DEPR-INTP] \div CLIA$$

$$C_{it} = IASS \div ZPROB$$

(ii) $$C_{it} = (INTP \quad OINC) \times IASS \div TASS$$

In the reported calculation (i) was applied.

CHAPTER 4

CONCLUSIONS AND POLICY IMPLICATIONS

4.1 A Review of the Results

Three issues have been under investigation in this report:

(i) Does leverage affect the valuation of businesses in capital markets?

(ii) Do leverage and financial policy in general have 'real' effects on the allocation of resources in an economy?

(iii) Does taxation affect financing decisions, and if so, does it matter to the firm?

The answer to each of these questions depends very much on the theory used to explain the relations among taxation, financing and investment.

Four models were examined in detail in Chapter 2 and a fifth discussed briefly. The first, based on Miller (1979), considered an economy with households facing different marginal income tax rates arising from the progressive rate structure of the personal income tax. A market equilibrium was established when a marginal investor was indifferent between holding equity and bonds issued by businesses. This implied that the combined corporate and personal tax on equity income was equal to the tax on bond interest for the marginal investor. Higher income households owned only equity and lower income households owned only bonds. In Miller's model, a unique market debt-asset ratio was determined, but each firm was indifferent to issuing bonds and equity, since the marginal investor was willing to hold either type of asset.

Miller's model provides some powerful conclusions to each of the three issues mentioned above. First, leverage in Miller's theory, has no effect on the valuation of each firm (although this is not altogether true for some businesses that are less highly taxed at the corporate level than others). Second, leverage has no real effects on the economy, since household portfolio and business financing decisions have no impact on investment and savings decisions; these depend on the overall level of taxation. Third, while taxation influences the aggregate amount of savings available for bond and equity financing, financial policy itself has no effect on business activity.

Three "static tradeoff" models explaining financial behaviour were also examined in detail. Each model provides different answers to the three basic questions. An optimal debt to asset ratio was determined for each model that maximized the value of the firm. The benefit of issuing bonds arose from a lower tax on interest income compared with the combined corporate and personal tax on equity income faced by a marginal investor. In contrast, these two sets of tax rates are equal in the Miller model. The cost of issuing debt was different from model to model. In the imperfect loss offset model, the cost of issuing bonds was the loss in the expected value of fast write-offs and tax credits that could be completely exploited only when the firm continued to pay taxes. In the managerial incentive model, the cost of issuing bonds was the increase in agency costs which arose from adjustments made to the optimal contract between the manager and shareowners. Finally, in the bankruptcy cost model, the cost of issuing bonds was the increase in expected bankruptcy costs associated with the winding up or liquidation of a business. In all three models, the debt-asset ratio was determined when the marginal benefit of reducing tax payments was equal to the marginal cost of issuing bonds.

The three models just described permit several answers to the three main questions. First, unlike the Miller model, the method used by businesses to finance capital affects the valuation of the firm in all three models. Thus, leverage matters to the firm. Second, two of the models, the managerial incentive and bankruptcy cost models, suggest that leverage can have real effects on the allocation of resources. In particular, bankruptcy and incentive contracts impose resource costs on firms and their owners, and these are undoubtedly influenced by taxation. In the imperfect loss offset model, leverage is determined solely to minimize expected tax payments. While no direct effects on the resource costs of production arise in this model, indirect effects are potentially important. The reduction in the expected value of fast write-offs and other tax shields for investment arising from leverage have potential resource allocative effects on business investment. Third, all three models predict that financial policy is affected by taxation (and this effect matters to the businesses undertaking investment decisions). Leverage is predicted to increase with (i) a higher corporate tax; (ii) a lower value of tax shields; (iii) an increase in the degree to which taxes are refundable. Personal taxes also influence leverage, but the appropriate value of personal tax rates depends on the nature of arbitrage in an open economy such as Canada.

A fifth model considered asymmetric information. Inside investors are unable to communicate to outside investors information about the quality of the firm. In this model, a firm prefers using internal sources of finance because external sources are costly in view of misperceptions in the market about the quality of firms. There would be no asymetry, if firms were able to signal their quality. One signal of quality is the debt-asset ratio which is correlated with quality. Tax effects are similar in this model in the sense that tax benefits in issuing debt result in more use of the signal. However, with no resolution of the informational asymmetry, low tax rates and high tax shields encourage more equity finance via retained earnings which is the cheapest source of finance.

There are other differences in the conclusions reached by the Miller model and the other four models. An important difference concerns the impact of inflation on financial policy. The implication of the Miller model is that inflation has no direct effect on leverage while, with the other models, inflation induces businesses to finance assets with more debt. Other variables affect financial policy in all the models except Miller's: (i) volatility in operating income per dollar of assets; (ii) the covariation of the return on the firm's capital with the return on assets in the rest of economy (a proxy for managerial risk); (iii) proxies for the level of bankruptcy cost, and (iv) the return to capital and the growth in assets.

The contrast between the conclusions reached under the Miller model and those under the other three models provides a basis for examining the impact of taxation and other variables on leverage in Canadian businesses. Insignificant empirical results would have provided albeit weak evidence in favour of the Miller model. Significant empirical results, in line with theoretical predictions, would have suggested confirmation of at least some of the other models. Our conclusions concerning the empirical results were reported in Chapter 3. Four main conclusions were reached:

(i) Corporate taxation has induced Canadian-controlled businesses to become more levered. A one-point increase in the corporate tax rate evidently causes the debt-asset ratio to rise by as much as three-quarters of a point in the pooled regressions.

(ii) Expected inflation, a proxy for managerial risk, and volatility in the earnings stream, affect leverage, as suggested by the three models that predict that taxes influence leverage.

(iii) Refundability of taxes, the value of shields and the proxies or expected bankruptcy cost seem to have little effect on leverage. However, serious data problems were encountered in attempting to measure these variables.

(iv) The current gross of tax rate of return to capital and growth in fixed assets affect leverage as well.

While various econometric specifications were used to examine propositions under consideration and more detailed testing is certainly called for, in all cases the corporate tax rate has a significant influence on leverage in the direction predicted by theory. The main conclusion reached in Chapter 3 is that taxation affects leverage.

An issue raised in Chapter 1 was whether corporations in Canada tend to be too levered under the present tax law. The models developed in Chapter 2 helped in understanding the determinants of financial policy, but they did not provide a set of criteria upon which to base policy conclusions. This is the task of the remainder of this chapter.

4.2 Tax Reform and Financial Policy

The view to be taken toward tax reform is a conventional one. Tax reform should be governed by normative criteria of which three are stressed:

(i) Efficiency: Given the total amount of tax revenue collected, tax reform should lead to a better allocation of resources so that resources are directed toward their best economic use.

(ii) Equity and Fairness: Reform should lead to a more equitable distribution of income: households with the same welfare and characteristics should pay the same tax (horizontal equity) and less well-off households should pay proportionately less tax, compared to more wealthy households (vertical equity).

(iii) Simplicity and Ease of Compliance: Tax reform should reduce complexity of the tax law, so that taxpayers can more easily comply with the law.

In the discussion of tax reform in relation to the financing of businesses, efficiency and simplicity will be stressed as the two most important objectives of tax reform in this area. The goal of fairness and equity is less important, since it is the amount not the form of capital income flowing to the owners of business capital that is important in evaluating the distributive impact of taxation. This is not to argue that tax policy which has no impact on the financing of business would not have distributive effects. However, fairness in the tax system, it is argued, can be accomplished without resorting to explicit policies that favour one form of financing for businesses in Canada.

This leaves two primary objectives for tax reform: efficiency and simplification. The notion of efficiency under the tax system requires further elaboration, before turning to policy recommendations.

4.2.1 The Meaning of an Efficient Tax

An efficient tax is one that can raise tax revenues in a manner that least distorts competitive market behaviour. This presumes that competitive markets can achieve the best economic use of resources. An example of an efficient tax is a tax on land, land being fixed in supply. A tax on the value of land will not change the use to which it is put. Thus a land tax is efficient, since the only effect of it is to reduce the wealth of landowners.

This notion of efficiency is only satisfactory when markets are functioning well. At times, market decision-making can lead to an inefficient allocation of resources, if private actions fail to take into account the social consequences of individual decision-making. For example, it is argued that businesses, if left alone, will not undertake sufficient research and development, since the social benefits of invention which accrue to other firms are not included in the economic reward earned by the inventor. This particular form of inefficiency arises from a breakdown in the operation of markets: no market mechanism can ensure that other firms pay for the benefit arising from the inventive activity of one, when the invention can easily be imitated.

When markets fail, as illustrated in the example just described, government intervention may be needed to achieve an efficient allocation of resources. This can be accomplished through a variety of policies, one of which includes tax policy. In the case of research and development, public intervention has evolved in the following ways: (i) subsidies to private business; (ii) financing of public institutional research (e.g. universities); (iii) tax credits and fast write-offs for research and development; and (iv) patents. The appropriate form of intervention is difficult to evaluate. The salient issue for tax policy is whether or not other forms of public intervention are superior compared with the use of tax incentives to encourage certain forms of activity. If other forms of public intervention are desirable, then an efficient tax would be one that does not affect decision-making (such as the land tax described earlier). However, if tax policy, as a form of public intervention, is desirable, an efficient tax would be one that purposely distorts decision-making to achieve some form of social benefit.

How does this discussion of efficiency apply to business financing? As suggested in the introductory chapter, concern has been expressed that Canadian businesses are under-capitalized in the sense of being insufficiently equity-financed; and that such under-capitalization leads to poor economic performance. Suppose, for a moment, that this is indeed the case. Two views can be expressed in developing a policy with regard to under-capitalization. It is taken as axiomatic that capital markets are efficient. There are no inherent economic obstacles to impede the flow of equity and debt financing to businesses. If there is insufficient equity financing, it must arise from government regulatory and tax policy. The evidence of this study suggests that the latter could arise: taxation evidently encourages debt relative to equity financing, when the tax on equity is more than on debt. If capital markets are efficient, then the objective of public policy should be to develop regulations and taxes that do not favour either form of finance.

The second view is that under-capitalization arises from various imperfections in capital markets that make equity financing difficult. Some of these imperfections arise from problems in obtaining accurate information; for example, when outside investors have difficulty in determining the quality of a business that issues equity, or of ensuring that inside investors, who manage the company, make decisions in the interest of all, including outside, investors. The existence of informational difficulties for outside investors can make equity securities less attractive. Capital markets have developed various institutions that mitigate some of these informational problems. For example: (i) specialists in evaluating business (investment dealers and financial institutions); (ii) the use of signals to indicate the quality of securities (such as the record of past profits and various financial ratios); and (iii) contracting arrangements between 'insiders' and 'outsiders' that encourage businesses to operate in the interest of all investors.

It can be argued that these mechanisms are still insufficient in overcoming various capital market imperfections, especially with regard to equity financing of smaller and growing businesses that are difficult to evaluate. A public policy that would be appropriate in these circumstances would be one with the intent of encouraging equity financing. The main obstacle faced by a government in developing policy in this area is to measure the extent to which these capital market imperfections impede equity financing. Governments can sometimes make society better off by not intervening in a market, rather than by erring in favour of corrective policies.

There is no especially convincing evidence that capital market imperfections exist, with respect to equity financing in Canada. If they do not exist, then the foremost recommendation would be to develop a tax system that creates no differences in the tax treatment of debt and equity. If companies are under-capitalized as a result of market imperfections, then favourable treatment of equity financing would be called for, if tax policy is the desired form of public intervention.

Even if such capital market imperfections exist, it would not be appropriate for tax policy to be used to correct for them. The view is taken here that a more appropriate route is regulatory policy to encourage equity financing. This is in keeping with another objective of tax policy, namely simplicity of the tax system. The tax system can be kept simple by not discriminating among the different forms of assets held by investors. It would be easier to administer the tax code by limiting the number of particular cases that receive special treatment. Adjustment of financial regulations are, in the nature of things, easier to deal with. An example of a simplification of the restrictions on equity financing by financial institutions, in small businesses and venture capital firms is provided by the provisions of the May 1985 Federal Budget with respect to pension plans.

4.2.2 Specific Policy Recommendations

The main thrust of the policy recommendation proposed is to remove the distinction, from the tax point of view, between equity and debt financing. In a closed economy (where capital would be financed by Canadian households), two forms of tax base could be advocated that would be neutral with respect to the financing of business: a consumption base and income base.

The consumption base which has been recommended in the Meade Report (1979) and the U.S. Treasury, Blueprints for Tax Reform (1977) [see also Mintz (1985)], would be neutral with respect to financing in the following sense. The tax base, which is defined as income less savings, would allow both bond and equity investments expenditures to be deducted from the tax base as registered assets. Withdrawals from registered assets would be taxable. Business investments would be taxed in a similar way by taxing cash flow (income less net expenditure on assets). It is also possible to allow for registered loans in which borrowings are taxed and the repayment of debt and the payment of interest are deductible. For the purposes of simplification, compliance, and averaging, non-registered assets and loans would be permitted. This would allow taxes to be 'prepaid': investment expenditures would not be deductible and the interest or imputed income would not be taxed. With perfect averaging of the tax base over time, so that the tax rate is constant, the present value of taxes levied on the return to savings would be equal to zero. Pure profits generated by registered assets would be taxed.

The tax on the marginal return accruing to equity and bond owners would, however, be zero, and neither debt nor equity would be favoured.

Another tax base that could be used as a basis for taxation is a pure income base, as advocated by the Carter Report (1966). Under a pure income tax, all labour and capital income receipts would be taxed at the same rate. This would require full taxation of interest, dividends and capital gains. (On an accrued basis, the corporate tax could be used as a withholding tax on income ultimately flowing to shareowners.) Tax credits for the payment of corporate taxes would be given on the receipt of dividends and capital gains could be exempt, if the rate of corporate tax is equal to the personal tax rate. A pure income tax would require indexation of asset values for inflation and the valuation of imputed income accruing to assets such as housing and non-marketed assets. In this sense, it is much more difficult to impose a pure income tax than a consumption tax. It is likely, under an income tax, that substantial variation in taxes would remain.

Whether a consumption tax or an income tax is levied, the tax system would impose the same rate of corporate and personal tax on equity and bond assets. In a closed economy, removing differences in the taxation of bond and equity assets, by integrating taxes under an income tax or by moving to a consumption base, is recommended. From the standpoint of simplicity, efficiency and horizontal equity, use of a consumption tax base is preferred.

In Chapter 2, the impact of the openness of Canadian capital markets to international capital flows was discussed in detail. When foreign savings are the marginal source of finance for Canadian capital, then foreign tax policy is important in determining the substance of the recommendations. If foreign countries treat interest, capital gains and dividends differently under their tax systems, then neutral treatment of these sources of income received by

Canadian households would not remove the distortionary impact of foreign taxes which are relevant to the financing of Canadian corporations.

As an example, suppose that Canada adopted a fully integrated tax with the corporate tax acting as a withholding tax on income flowing to foreigners. If foreign taxes levied on equity income are more than on debt, then an integrated tax system in Canada would have no effect on financing. It is possible, then, that Canadian businesses would be too highly levered, since it is less costly to issue debt than equity on international capital markets. Canadian tax policy might then be adjusted to reduce the reliance on debt finance. Given the difficulty of measuring the marginal tax rate faced by a foreign investor that is relevant to Canadian business financing, how can Canadian tax policy be used to remove the differential tax treatment of debt and equity finance?

No answer has been found to this problem. In an open economy the only method by which the tax on equity can be reduced is to lower the corporate tax rate. Two policies might then be pursued:

(i) A move to a closer integration of personal and corporate taxes in Canada. This would be desirable for efficiency, simplification and equity reasons.

(ii) A reduction in the level of the corporate tax in Canada in order to reduce leverage. Such a reduction could be achieved by broadening the base of the corporate tax so as to maintain the overall level of corporate tax revenues, as advocated in the May 1985 Budget of the Federal Government.

Base-broadening can be achieved in several ways. In Boadway et al. (1984), it was suggested that a combined withholding and cash flow tax at the corporate level could be developed. This would have to maintain the level of withholding tax on foreign investors and achieve integration for domestic savers who can be taxed on a consumption basis (see the Appendix to this chapter for details). Such a plan for non-Canadian controlled private corporations and all public corporations, is also favoured, while at the same time arguing for a reduction in the corporate tax to reduce discrimination in favour of debt finance. Boadway et al. (1984) have pointed out that it would be possible to broaden the corporate withholding tax by not permitting the deductibility of interest and by permitting tax credits to be paid to Canadian owners of bonds (as in the case of dividends). This would allow equity assets held by foreign investors to be more favourably treated compared with debt, since the combined corporate and personal tax would be more on bonds than on debt. However, broadening the corporate tax base in such a manner would increase substantially the international cost of funds faced by Canadian businesses, since foreign owners of Canadian corporate bonds would not be able to credit Canadian corporate taxes against their home country tax liabilities, under current international tax arrangements. For this reason, a narrow definition of the tax base is favoured along with a lowering of the Canadian corporate tax rate to maintain corporate tax revenues.

What would be the impact on welfare? The gain to Canada in lowering the corporate tax rate is to reduce the distortion on investment and to increase equity financing of businesses. A loss to Canada would arise by reducing corporate tax revenues on foreign-controlled businesses that are credited against foreign tax liabilities, unless the corporate tax base is broadened sufficiently. However, broadening the corporate tax base would be appropriate in that it would reduce the current distortionary effects of the corporate tax on the choice of capital investments, because the corporate tax favours machinery compared to structures and inventories.

APPENDIX

The Boadway-Bruce-Mintz scheme would be to define two tax bases as follows:

Tax Base π 1		Tax Rate
Add:	Receipt from sales and Services	
Subtract:	- Wages and Salaries	$t + u(1-t)$
	- Material expenses	u = cash flow tax rate
	- Economic Depreciation	t = withholding tax rate
Total:	Operating Income	

Tax Base π 2		Tax Rate
Add:	Economic Depreciation	$u(1-t)$
Subtract:	Gross Investment	
Total:	Net Disinvestment	

(If tax base is negative then a credit will be owing)

Capital gains, dividends and interest income received by domestic owners would be given a tax credit equal to $t/(1-t)$. If savers are taxed on a consumption basis, then the credit would be paid to the holder of registered and non-registered assets. Credits being paid on interest could be avoided by subtracting nominal interest from tax base $\pi 1$.

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