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Corporation Tax: A Survey

JACK MINTZ[1]

I. INTRODUCTION

The corporation tax is arguably the most well-studied tax found throughout the world. Countless numbers of professionals study the impact of corporate tax law on the affairs of the corporation. Yet, despite considerable resources that are expended on compliance, the tax in many countries raises only a small portion of revenue for governments. For example, in the G7 countries, taxes paid by corporations account for less than 8 per cent of tax revenues raised by governments, except for Japan where the corporation tax yields about 15 per cent of government revenue.[2] This low revenue yield and high compliance cost have resulted in some experts and politicians questioning the usefulness of the corporate income tax.

Those who question the need for the corporation tax take the normative view that taxes, in the interest of transparency, should be imposed on individuals, not legal entities. After all, as the argument goes, people, not corporations, pay taxes. Even though a corporation has the legal right to hold property and contract with buyers and sellers, and is subject to the criminal and civil law of the state, its activities benefit the owners who own its capital, consumers who purchase its products or services and employees who provide their effort. Any tax paid by the corporation must be passed on through higher prices, lower wages or lower

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[1] Arthur Andersen Professor of Taxation, Faculty of Management, University of Toronto.
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[2] These are arithmetic averages. In contrast, individual income and sales taxes raised almost 24 per cent and 25 per cent of total tax revenues respectively in 1993. See Canada: Department of Finance (1994, Table 105). Many Pacific Rim and developing countries are similar to Japan in terms of their reliance on corporate taxes.

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returns on capital. Thus, if one were to *pierce the veil* behind the legal entity called the corporation, it is argued that the tax ultimately falls on people. So, in the interests of determining the impact of the tax system on the welfare of individuals in society, it is argued 'why not tax people directly rather than indirectly via the corporation?'.[3]

In Section II, an answer will be given to the question, 'why is there a corporation tax?'. It is useful to begin with a normative argument for the corporation tax to understand its basic role in the economy. Following that, incentive effects of the corporate tax are discussed with respect to investment (Section III), financing (Section IV) and risk (Section V). The incidence of the corporation tax is considered in Section VI and conclusions are provided in Section VII.

Prior to turning to the above questions, one caveat should be borne in mind when reading this survey. It is important to point out that the legal terms 'corporations' and 'companies' are used in a more general sense than that conveyed by their strict definition. Much of the discussion below applies, at least in principle, to all forms of businesses: corporations, sole proprietorships and partnerships (the latter two forms are unincorporated businesses). The term 'corporation' applies to a legally constituted entity of its own person. In its strictest sense, the important distinction between the corporation and unincorporated business is related to the concept of 'limited liability'. With limited liability, the corporation is responsible for satisfying legal claims imposed on it; the owners of the corporation are not personally responsible for any losses or damage caused by the corporation. With unincorporated businesses, claims can be made on individual owners, who are personally liable for losses and damages.[4]

II. WHY IS THERE A CORPORATION TAX?

Why do most countries impose a corporate tax on corporations? There are a number of reasons given for corporate taxation but the most important rationales are the following:

- the corporate tax is a benefit tax to ensure that corporations pay for public goods and services that improve their profits;

[3] Public finance theorists have acknowledged the superiority of taxing final goods and services rather than intermediate goods and services. See Diamond and Mirrlees (1971) and Diewert (1987).

[4] In recent years, this distinction between corporations and unincorporated businesses has become blurred. Corporations may own unincorporated businesses, such as partnerships. Moreover, unincorporated businesses have acquired attributes of corporations in the case of 'limited partnerships'. These entities are unincorporated in that no special securities are issued by the corporation to its owners. None the less, limited partnerships reduce the risk faced by partners, who are protected from using personal resources to satisfy any claims.

- the corporate tax is a withholding tax that serves as a backstop to the personal tax;
- the corporate tax captures the rents earned by owners of fixed factors.

Each of these three rationales for the corporate tax is discussed below in terms of its implications for corporate tax design.

1. The Corporate Tax as a Benefit Tax

Taxes may be levied not only to raise revenue but also to capture the benefits that public expenditures may provide to the private sector. For an efficient allocation of resources between the public and private sectors, government may levy 'benefit' taxes so that consumers are aware of the public cost of goods that are supplied to them. In a similar vein, companies operating in many countries benefit from certain public sector activities. The Meade Report (1978) identified the legal construct of limited liability as a special benefit that should be subject to taxation. Perhaps, as a more important concern, public expenditures on infrastructure such as roads, communication networks and even education and training improve the productivity and profitability of businesses.

From the point of view of ensuring an efficient allocation of resources in the economy, one may justify the corporate tax as a user charge or benefit tax to discourage companies from over-using public services. Given this argument, it would seem that the best corporation tax would be assessed on a base that is correlated with the type of government activity that benefits the firm. If public education and training are valuable to the company, a payroll tax on the use of trained workers would be an appropriate benefit tax. Public expenditures on roads and highways justify the use of tolls, motor fuel taxes and car licence fees. Airport and municipal infrastructure expenditures are best covered by airport taxes and development fees.

At times, however, it may be difficult for governments to assess special user charges for administrative reasons. As an alternative, rent or property taxes may be used, since infrastructure expenditures increase the value or profitability of the corporation. However, the value of the corporation depends on more than just infrastructure, so that the rent or property tax is an imperfect mechanism to capture the true benefits associated with public expenditures.

2. The Withholding Role of the Corporate Tax

The most important rationale given for corporate taxation is with respect to its role as a backstop for the personal tax. Governments may follow either of two basic principles for the purposes of taxing individuals: comprehensive income or consumption. Comprehensive income as defined by Simons (1938) is used for consumption and to increase wealth and is derived from labour earnings (wages, salaries and benefits) and capital income (dividends, interest and accrued capital

gains). Consumption can be defined as the value of expenditures on goods and services; this is equal to earnings less savings, by definition. Each of these principles is discussed in turn.

(a) Comprehensive Income Taxation

When governments impose taxes on comprehensive income, the most difficult source of income to tax is 'accrued capital gains'. In principle, individuals would report changes in the market value of assets and pay tax on the annual increment in the value of assets. However, there are a number of difficulties in trying to tax capital gains on this basis. For instance, assets such as private corporate shares have no periodic market value for assessment. Moreover, the taxation of accrued capital gains could force individuals to liquidate assets in order to cover tax liabilities. As a consequence of these problems, almost all governments throughout the world tax capital gains on a realised basis instead (when assets are sold).[5]

As a result of taxing only realised capital gains, investors can shelter their income from taxation by letting tax-free corporations hold their assets instead. For example, consider an individual who could earn income paid directly to him or to an untaxed corporation owned by him. If the income is paid directly to the individual, personal income taxes are paid in the year when the income is accrued. Alternatively, when the income is paid to the untaxed corporation, the accrued income is not subject to tax. The value of the corporate shares held by the investor increases by the amount of accumulated income retained by the corporation. Given that the government taxes capital gains only on a realised basis, rather than on an accrued basis, the investor postpones the payment of personal tax on accrued income by leaving it in the corporation. Only when the investor needs cash from the corporation will personal tax be paid on dividends or capital gains arising from the sale or repurchase of shares.[6] Thus, in principle, one could deduct dividends from the corporate income tax base since there is no need to withhold taxes on such income at the corporate level since it is fully taxed at the personal level. Only withholding at the corporate level is needed for retained earnings of corporations.[7]

Given this rationale for withholding tax on corporate retentions, the corporate tax base would be, in principle, the following:

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[5] See Helliwell (1969) and also Auerbach (1991), who has developed a scheme for the retroactive taxation of capital gains. The basic concept is to calculate a tax penalty that captures the value of interest cost savings due to the postponement of capital gains taxes arising from realised rather than accrual methods.

[6] The treatment of income received when corporations repurchase shares varies considerably by country. Income may be treated as dividends (UK) or capital gains subject to certain restrictions (Canada) or be preferentially treated (France).

[7] In principle, if dividends are subject to personal taxation, the dividends could be deducted from the corporation tax. This proposal was considered in the US Treasury report on integration (1992).

(1) $Y = R - C - \text{Dep} - I - \text{Div}$

where R = accrued revenues;
C = current costs (salaries and material expenditures);
Dep = economic depreciation (and depletion) of assets;
I = interest paid for borrowed capital; and
Div = dividends paid out.

Note that for a comprehensive income tax, the corporate tax should permit companies to deduct the economic costs of depreciation,[8] interest expense and other costs incurred in the production process. This requires the indexation of profits for inflation as well as the correct market valuation of assets to calculate economic depreciation. This issue will be further addressed in Section III when the incentive effects of the corporate tax are considered.

Although the above discussion argues for a corporate tax on retentions, governments rarely allow dividends to be deducted from the corporate income tax.[9] In large part, this is a result of historical legal developments that led to the notion that corporate and individual taxpayers are the same; both would be taxed on net income (interest expenses are deductible but not distributed profits that are paid to the owner of the business). Without dividend deductibility, the corporate tax base becomes the following:

(2) $Y^I = R - C - \text{Dep} - I.$

(revenues net of current costs, depreciation and interest expenses).

Even though legal reasoning was important for the development of the corporate income tax base, there is, however, an important economic motivation for not allowing dividends to be deducted from the tax base. For many countries, the deduction of dividends would result in an erosion in the amount of taxes collected from foreign direct investment. This concern suggests another reason for governments to impose the corporate income tax on equity income: namely, a desire to withhold income accruing to foreigners[10] The value of withholding income from foreigners is enhanced by international tax-crediting arrangements which result in the crediting of corporate income taxes being against the corporate income taxes of capital exporters. Thus the corporate income tax of a capital importer becomes a revenue-sharing device with foreign countries.

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[8] Economic depreciation is the loss in the value of assets from one period to the next. It is equal to the cost of replacing capital net of real capital earned by holding the asset. See Section III for further elaboration.

[9] In some countries, distributed profits may be taxed at a lower rate than undistributed profits (Germany and Austria). This would be equivalent to a partial deduction for distributions. For example, suppose the corporate tax rate is 50 per cent on undistributed profits and 25 per cent on distributed profits. If, instead of a lower tax rate on distributed profits, the firm were allowed to deduct 50 per cent of dividends paid from corporate taxable income, then the tax rate on distributed profits would be reduced from 50 per cent to 25 per cent.

[10] The Royal Commission on Taxation in Canada (1966) (the Carter Report) explicitly recognised this argument for the corporate income tax since a large portion of Canadian industry is owned by US investors.

Under the withholding role of the corporate tax (without the deduction of dividends from the tax base), the corporation pays a tax on income on behalf of the shareholders. To avoid double taxation of dividend and capital gain income earned by individuals, some adjustment is then necessary under the personal tax to ensure that individuals do not pay tax twice on the same income. Three types of systems are possible: (i) a refund of the corporation tax when the corporation distributes income; (ii) a refund of the corporation tax to the shareholders (for example, a tax credit) that reduces personal taxes (i.e. imputation or gross-up and credit system); and (iii) an exemption of dividends and capital gains on corporate shares from personal taxation.[11]

The first system provides a refund of corporate tax to the firm when dividends are distributed. If dividends are not distributed, the corporate tax operates as a tax on retentions. Note, however, that there is an additional tax on retentions if capital gains taxes at the personal level are paid when the investor sells shares.

The second method integrates corporate and personal tax by allowing individuals to claim a credit against personal taxes equal to the amount of corporate income tax paid by the corporation. Each shareholder pays personal tax on the dividends and capital gains, grossed up by the credit.[12] However, most countries provide a credit at the personal level based on dividends received without any imputation given for capital gains.

The third method, the exemption of capital gains and dividends, achieves integration only if the corporate income tax rate is equal to the personal tax rate. With progressive personal tax rates, this condition is nearly impossible to fulfil for all types of investors. As most shareholders tend to be in the top tax bracket, governments often set the corporate tax rate equal to the top personal tax rate on income as a rough way of achieving integration.

In the following example, we show the underlying amounts of tax owing on dividend income with each type of integration system.

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[11] The exemption of dividend and capital gain income at the individual level is pursued in a number of countries. For example, Canada allows a portion of capital gain income to be tax-free to ensure integration at the corporate and personal levels. Mexico exempts dividends paid out of taxed profits (dividends paid from untaxed profits are subject to a withholding tax).

[12] Australia uses this system for the treatment of dividends. Each shareholder receives a form indicating the amount of dividends paid plus the credit equal to the individual's share of corporate income tax. However, most countries with systems of integration do not match the amount of corporate income tax paid by the corporation with the value of the credit received by the investor. Instead, many countries apply a corporate tax on dividend distributions (e.g. UK advance corporation tax) which is credited against the normal corporate income tax (excess amounts can be carried forward). This ensures that the corporations that pay little regular corporate income tax pay out dividends that are taxed as much as the credit given to shareholders.

EXAMPLE

A corporation earns £100 distributed as dividends to the owner:
The personal tax rate is 50 per cent and the corporate tax rate is 40 per cent.

	Refundable tax	*Gross up and credit*	*Exempt personal income*
Profit	£100	£100	£100
Corporate tax (40% rate)	-£40	-£40	-£40
Dividend	£60	£60	£60
Refund of corporate tax (66% of dividend)	£40	£0	£0
Gross dividend (including refund)	£100	£60	£60
Personal tax (50% rate)	-£50	-£50[a]	£0
Dividend tax credit	£0	£40[a]	£0
After-tax income	£50	£50	£60

[a] Tax calculated on dividends grossed up by the corporate tax and the credit is based on grossed-up dividends.

The choice of the method used for integration depends on several factors (see more detailed discussion by McLure (1979) and Cnossen (1993)). The first is whether integration should include both dividends and capital gains. Under the refundable corporate tax and imputation systems, governments rarely provide full integration for capital gain income. The exemption method therefore provides a better method of integration for capital gains on shares even though the system is unlikely to integrate personal and corporate income taxes properly, for the reasons given above.

A second issue is related to the rate of corporate tax on profits. Governments often provide tax incentives and preferential corporate tax rates for specific industrial activities. An integration system that ensures that the credit received by the firm or shareholders is equal to the amount of corporate income tax can undo the value of tax preferences given to the corporation.

A third issue is related to international flows of capital. An imputation system of integration of corporate and personal taxes for only domestic shareholders (tax credits only given at the personal level) leaves untouched the double taxation of income received by foreign shareholders (see OECD (1991)). In an open economy, the corporation may find that its international cost of funds is not affected by integration measures so that integration may not undo the effects of the corporate tax on the cost of capital (Boadway and Bruce, 1992; Devereux and Freeman, 1995). One possible policy is to provide tax credits for foreign shareholders (as in the case of the UK which provides a credit for US shareholders for advance corporation tax). This would result, however, in a loss

TABLE 1

Corporate Income Tax Provisions, 1994

	Canada	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
Income							
Revenues	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercorporate dividends	No (except private)	Exempt except subject to minimum tax (see below)	Exempt except subject to minimum tax (see below)	Exempt except subject to minimum tax (see below)	Exempt with ownership >25%	Exempt except subject to minimum tax (see below)	80% tax-free with ownership >20%
Capital gains	Three-quarters of gain	Short term: as income Long term: 19% except for 33% for portfolio securities	Real property	Real property (full rate)	Yes — land with surtax	Yes	28%
Expenses							
Wages and salaries	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inventory costs[a]	FIFO	FIFO	LIFO	LIFO	LIFO or FIFO	FIFO	LIFO or FIFO
Depreciation	Historical cost	Historical cost	Historical cost	Historical cost	Historical cost	Historical cost	Historical cost
Interest expense	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Losses (operating only)[b]	Three-year c.b., seven-year c.f.	Five-year c.f.; depreciation expenses have indefinite c.f.	Two-year c.b., indefinite c.f.	Five-year c.f.	One-year c.b., five-year c.f.	Three-year c.b., indefinite c.f.	Three-year c.b., 15-year c.f.

Corporate tax rate	Federal: 29.12% Provincial: 8.9–17%	$33^{1}/_{3}$%	Federal: 45% (undistributed profits), 30% (distributed) State: 5–15% (deductible)	Central: 36% Local: 16.2%	Central: 37.5% Prefecture: 13.2% (deductible) Corporate inhabitants: 6–14.7% (deductible) Total tax rate: 51.4%	33%	Federal: 35% State: up to 12% (deductible)
Foreign source income	Yes except dividends from foreign affiliate	Exempt except for pre-compte (see below)	Exempt dividends if ownership >10%, otherwise taxed with credit for foreign taxes	Yes with credit	Yes with global credit	Yes with credit per source	Yes with global credit
Minimum tax	Capital tax reduced by corporate income surcharge Dividends from term preferred shares	Pre-compte: 50% on dividends paid (or 33% of grossed-up dividends)	25% of dividends paid	10% of dividends paid	No	ACT of 25% on dividends paid (or 20% of grossed-up dividends)	20% on income
Consolidation	No	Yes for property transfer	Yes	No	No	No, but relief for source losses	Yes
Capital and property tax	Provincial capital tax: up to 0.5% of assets Property tax	Property tax Business licence tax	0.6–11% of trade capital	Property tax: 0.4–0.6% Transfer tax: 6–17% New equity tax: 0.75%	1.7% on structures 1–4% on depreciable assets	Property tax only	No property tax

[a] FIFO = first-in, first-out; LIFO = last-in, first-out.
[b] c.f = carry-forward; c.b. = carry-back.

of revenue for the capital-importing country. Alternatively, governments could choose not to integrate personal and corporate taxes. However, this would create financial planning opportunities for domestic investors who can try to ensure that income paid from the closely-held corporation is taxed at the lowest rate.

In summary, then, the corporate income tax base in most countries includes both distributed and undistributed profits. There is much variation in the type of tax base found in many countries. Table 1 provides a comparison of the corporate income tax for the G7 countries.

(b) Consumption Taxation

An alternative tax base is consumption, which is the difference between income and savings. Consumption can be taxed at the personal level by allowing individuals to deduct contributions made to registered savings plans while withdrawals of accumulated interest and principal would be fully taxed. Capital income earned by the plan would be exempt from taxation and no deduction for interest expenses would be permitted (this regime applies to Canadian Registered Retirement Savings Plans). Alternatively, the consumption tax can be equivalently levied in present value terms by not permitting a deduction for savings nor taxing the interest and sale of assets (UK Personal Equity Plans) which has been referred to as the non-registered asset treatment.[13]

The main principle is that the interest rate would be exempt from taxation so that the tax has no intertemporal distortion.[14] As the interest rate is the price at which current consumption is exchanged to purchase future consumption goods,

[13] The following example illustrates equivalency of registered and non-registered asset treatments. An individual pays taxes at the rate of 25 per cent and holds an asset for one year. Suppose that the rate of return on the asset is 10 per cent, which is equal to the alternative rate of return on bond assets. For the individual, the present value of taxes paid for registered savings can be shown to be equal to that for non-registered savings:

	Income	*Savings*	*Tax base*	*Tax paid*
Registered savings				
Year 1	£10,000	£2,000	£8,000	£2,000
Year 2	£10,000	-£2,200	£12,200	£3,050
Present value of taxes: £2,000 + £3,050 / 1.1 = £4,773				
Non-registered savings				
Year 1	£10,000	£2,000	£10,000	£2,500
Year 2	£10,000	-£2,200	£10,000	£2,500
Present value of taxes: £2,500 + £2,500 / 1.1 +£4,773				

[14] Bradford (1986) defines a consumption tax as any tax that does not affect the opportunity cost of savings.

taxing interest is equivalent to increasing the price of future consumption relative to current consumption.[15]

As soon as non-registered assets are permitted under a consumption-based personal tax, a problem arises with respect to tax avoidance. For example, suppose a manager chooses to hold shares in a closely-held corporation. Instead of receiving a salary, the manager obtains dividends. Under the non-registered asset system, the manager will obtain tax-free dividends even though the payment is a reward for effort. Unless there is a withholding tax on the business to ensure that earnings are fully taxed, the individual can escape taxation of consumption.

What form of withholding tax would therefore be needed on a business to ensure that all forms of earnings available for consumption are taxed? One possibility would be a business tax on 'cash flow' (revenues from the sale of goods and services (*R*), net of wages and salaries and other current expenditures (*C*) and net capital expenditures (*K*), with no inclusion of financial income or deduction of interest expense):[16]

$$Y^{cf} = R - C - K.$$

Net capital expenditures would be capital purchases (net of disposal of assets). The deduction of net capital expenditures is similar to the expensing of capital (100 per cent depreciation). In principle, it is also similar to expensing of savings at the individual level for a personal tax on consumption. In other words, the business is able to expense savings on behalf of the individual. Below, the properties of the cash-flow tax as a rent tax will be discussed in more detail.[17]

If a business tax is imposed on cash flow, it could withhold returns that would otherwise escape taxation for owners of non-registered assets. If the rate of tax is equivalent to the (top) personal tax rate on consumption, the rents will be withheld on non-registered assets.[18]

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[15] The treatment of inheritances and bequests is an important issue. Bradford (1986) suggests that bequests and inheritances can be ignored: bequests are not deductible from the tax nor inheritances included. However, if bequests are viewed as a form of consumption, it is desirable to include inheritances in the tax base. See the Meade Report (1978) for a comprehensive analysis.

[16] See the Meade Report (1978), Capital Taxes Group (1991), US Treasury (1977), Bradford (1986), Boadway, Bruce and Mintz (1987) and Devereux and Freeman (1991). For a discussion on implementation problems with the cash-flow tax, see Mintz and Seade (1991) and Shome and Schutte (1993).

[17] The above cash-flow tax base has been referred to as the R base (i.e. real transactions). There are other alternative bases used for cash-flow taxes. For example, as the Meade Report (1978) points out, there is an equivalent tax base called the R+F base which includes financial transactions. Under the R+F base, net debt (debt liabilities less loans) would be added to the tax base and net interest expense and repayment of debt would be deducted from the base. Another alternative is the S base, which would tax distributions of profits net of new equity issues.

[18] Given the example in footnote 13 of a 10 per cent rate of return, note that a taxpayer would pay, with non-registered assets, £4,773 in personal taxes. It is assumed capital does not depreciate. The business will pay

No country in the world has attempted to impose a direct personal tax on consumption. However, most countries rely on some form of consumption taxation. The consumption treatment is available in many countries for retirement savings (for example, pension plans) and sometimes housing (imputed rental income may not be taxed and expenses such as mortgage interest are not deductible).[19] What is most interesting is that over 50 countries now use only a withholding tax on business as a tax on personal consumption (without taxing individuals directly). This is the value added tax (VAT) which applies to sales of firms with a deduction for (or credit for tax on) purchases from other businesses. The only difference between the tax base in equation (3) above and the VAT is that wages and salaries are not deductible from the VAT base.[20] However, this is not surprising since there is no tax on wages and salaries at the personal level under the VAT system.[21] Thus we can think of the VAT as a withholding tax for the purposes of taxing consumption on a non- registered asset basis.

3. The Corporate Tax as a Rent Tax

A third justification for the corporate tax is that it could be an efficient method of taxing the rents earned from non-reproducible factors of production such as entrepreneurship, land and natural resources.[22] Taxing rents, which are the return

cash-flow taxes on the difference between revenues and the cost of investment in each year. In the example, the business tax paid at a 25 per cent rate would be equal to the following:

	Revenues	*Net capital expenditure*	*Tax base*	*Tax owing*
Year 1	£0	£2,000	£2,000	-£500[a]
Year 2	£400	-£2,000	£2,400	£600
Present value of taxes: -£500 + £600 / 1.1 = £45				
Total personal and business taxes = £4,773 + £45 = £4,818				

[a] The firm would claim a refund equal to £500 or carry forward loss at 10 per cent to claim against future profits.

Note that a non-registered asset treatment with the cash-flow tax yields the equivalent amount of tax paid as the registered asset case (£4,818) without a cash-flow tax.

[19] For example, Canada treats owner-occupied housing in this manner.

[20] Only the origin-based VAT can be equivalent to a payroll and rent tax on a corporation. A payroll and rent tax on corporations is an origin-based tax: it applies to production consumed by residents or non-residents (consumption of foreign goods and services by consumers is exempt from taxation). A VAT that exempts export sales and taxes imports is a destination-based tax that falls on consumption of residents only. If the consumption tax applies to all goods and services, there is no difference between the origin and destination bases since the exchange rate will adjust for the tax (Lockwood, de Meza and Myles, 1994). However, with exempt goods and services, the two taxes will not be equivalent.

[21] VATs are used in many developing countries where it may be difficult to tax individuals on their wages and salaries except by withholding at the firm level.

[22] The concept of using the corporate tax to tax rents is originally discussed by the Meade Report (1978).

to factors over and above that needed to compensate them for their use, is efficient since investment and financing decisions of business are not distorted. In some countries, the government may be the landowner; a tax on rents accruing to land would serve as a royalty payment for the use of land. Even if the government did not own the property, it may find that taxation of rents is an efficient tax (this point was initially made by George (1879) and subsequently shown in the optimal tax literature (Atkinson and Stiglitz, 1980)).

On a periodic basis, rents are measured as the revenues earned by the corporation net of the imputed costs of production. Imputed costs include current expenditure (*C*) on labour compensation and material costs as well as the costs of holding capital. Capital costs in turn are economic depreciation (Dep) and the financing costs of both debt (interest, *I*) and equity financing (the opportunity cost of equity, OCE). The tax base for annual rent tax is therefore:

$$(4) \qquad Y^R = R - C - \text{Dep} - I - \text{OCE}$$

The difference between the rent tax and the corporate income tax (equation (2) above) is imputation of the cost of equity financing (OCE) which makes the rent base smaller than the income tax base.

It is difficult to measure the periodic rent base correctly. It requires the proper imputation of the cost of depreciation and the real cost of debt and equity. The measurement of cost of depreciation is based on the replacement cost of capital, correcting for any real capital gains earned by holding assets. The real cost of financing requires a correction for inflation that erodes the value of assets that are fixed in nominal terms. Moreover, to ensure that government shares both gains and losses in income (risk), it is necessary to allow for the refundability of losses by providing the equivalent of a tax credit equal to the rate of tax times the loss.[23]

An alternative to the periodic rent tax is the cash-flow tax as described above (equation (3)). The difference between the cash-flow base and the periodic rent base is that the former allows for the expensing of capital while the latter allows for the deductibility of the imputed costs of capital for depreciation and financing.[24] Since expensing is simple compared with measuring depreciation and financing costs, the cash-flow tax is arguably much easier to implement. There would remain a need to allow for the refundability of losses since it is likely that the firm would have a negative cash flow in early years. Moreover,

[23] Examples of refundability include the carrying back of losses (providing an immediate credit to the firm) or carrying forward losses at a rate of interest. Refundability is discussed further in Section V.

[24] Boadway and Bruce (1984) show that any combination of depreciation and financing costs that satisfies the condition that the capital costs are fully deductible in present value terms results in a corporate tax on rents. For example, one could allow depreciation to be deducted based on any rate applied to the undepreciated capital cost of an asset that is indexed each period at the rate of interest. See Capital Taxes Group (1991) and Devereux and Freeman (1991) which provide for an alternative but equivalent tax base that allows for the opportunity cost of equity to be deducted.

there are complications with international transactions (for example, transfer price issues) when other countries do not rely on a cash-flow tax (Mintz and Seade, 1991). None the less, there are some jurisdictions that have implemented forms of cash-flow taxes as rent taxes on resource companies (British Columbia and Australia) or as a general tax on corporations (Croatia). Under these regimes, capital is expensed and losses are carried forward at a rate of interest. Perhaps more experimentation with cash-flow taxes will be attempted in the future.

III. TAXES AND INVESTMENT

Most research has concentrated on the impact of corporate taxes on the investment behaviour of firms. A typical analysis of the effect of taxation on capital stock (the corresponding flow is investment) is to consider a neo-classical firm that is perfectly competitive in product and input markets. The firm adjusts its capital stock, perhaps subject to adjustment costs or completely irreversibly. Given that capital decisions affect profitability over many years, the firm must formulate expectations about future economic variables (for example, input and output prices) and tax regimes (corporate tax rates, depreciation rates, etc.). The usual model treats tax variables as unchanging over time, although some analyses may try to incorporate changes in tax policy regimes. The taxes considered for analysis include the corporate income tax, capital tax, property tax and resource tax. Specific tax incentives for capital may also be modelled, such as investment tax credits and allowances, accelerated depreciation and tax holidays.

The firm maximises the value of its equity or, alternatively, the present value of cash flow which is equal to its value of equity and debt. The firm thus chooses the optimal path of investment, taking into account relevant economic and tax variables. The firm invests in capital until the value of marginal product (less adjustment costs) is equal to the user cost of capital (Jorgenson, 1963). The user cost of capital can be thought of as the 'rental or lease price' of capital which is equal to depreciation, risk and financing costs, adjusted for taxes. The cost of risk is discussed in Section V. At this point, it would be useful to explain, in detail, the cost of depreciation and financing.

The cost of depreciation. The cost of depreciation, in economic terms, is the reduction in the value of the asset over a given period. Suppose a firm purchases a machine for £q_0. Over the period, the machine physically deteriorates by an amount δ so that only 1- δ units of the machine are left at the end of the period. Suppose further that identical new machines can be sold for, in real terms, £q_1 per unit at the end of the period. The reduction in the value of the machine over the period is thus equal to $q_0 - (1 - \delta)q_1 = (\delta - x)q_1$ where $x = (q_1 - q_0) / q_1$. The term $\delta - x$ is the 'economic depreciation rate' which is equal to the rate of physical wear and tear less the rate of real capital gains accrued from

holding an asset (evaluated at the cost of replacement). Note that even land 'depreciates' in economic terms; even though physical depreciation may be zero ($\delta = 0$), there may be real capital gains or losses from the holding of land.

The cost of finance. The cost of finance is the imputed cost of borrowing money from financial markets. Given the absence of risk, the cost of finance, denoted as *r*, is equal to the net-of-corporate-tax cost of issuing debt and equity. If ρ is the nominal opportunity cost of investing equity in the firm (before the payment of personal taxes) and π is the rate of inflation, the real cost of equity finance is $\rho - \pi$. For example, if equity owners require a 10 per cent nominal return on investments, prior to the payment of personal taxes, and inflation is 5 per cent, then the real cost of equity finance is 5 per cent.[25] If *i* is the nominal bond interest rate, which is deductible from corporate taxable income at the corporate tax rate, *u*, then the real cost of debt finance is therefore $i(1 - u) - \pi$. For example, if 10 per cent is the payable interest rate on corporate bonds, the corporate tax rate is 40 per cent and the inflation rate is 5 per cent, then the real cost of debt finance to the firm is only 1 per cent. How actual financing costs of equity and bonds relate to each other is discussed in the next section since the cost of finance depends on arbitrage in financial markets.

As will be discussed in Section IV, the optimal choice of financing will depend on both tax and non-tax considerations. Using the formulation of Auerbach (1979), the firm can be characterised as minimising its cost of finance by choosing its optimal debt / equity ratio prior to making its investment decision.[26] Thus the firm would have a discount rate that would be a weighted average of the cost of debt and equity finance. Letting the proportion of investment to be financed by debt be β (therefore $1 - \beta$ is the proportion financed by equity), the cost of finance is equal to

$$(5) \qquad r = R - \pi = \beta I(1 - u) + (1 - \beta)\rho - \pi$$

where *R* is the nominal cost of finance.

1. The User Cost of Capital

Taking into account these depreciation and financing costs, one can derive the user cost of capital which is the minimum return needed for investment to take place. Note, first, that the cost of buying a capital good is £*q* per unit. If the government provides an investment tax credit which reduces corporate income tax payments by an amount equal to a percentage of gross investment, φ, the cost

[25] The differences between new equity and retentions as sources of equity finance for the firm are ignored at this point. The firm's opportunity cost of retentions and new equity may differ for both non-tax and tax reasons.

[26] The weighted cost of finance would be used to discount tax depreciation allowances. Not all of the literature uses this approach. In King and Fullerton (1984), for example, there is no presumption that firms would use a weighted cost of finance.

of each purchased capital good is reduced to £q(1 - φ). In addition, when a capital good is purchased, the government provides tax depreciation deductions that are of value to the firm. Let £Aq be the present value of tax depreciation allowances.[27] Thus the effective cost of buying an asset is equal to £q(1- φ - uA). Under the assumption that the firm optimally chooses its capital stock, the user cost of capital can be easily derived. The return earned on the last pound of investment equals gross income[28] net of corporate taxes and is given by F'(1 - u). The cost of holding capital is equal to the annual cost of depreciation and financing costs multiplied by the effective purchase price of capital, (r + δ - x) q(1 - φ - uA). For the optimal investment decision, the marginal return is equal to the marginal cost of holding capital, so this implies

(6) $\quad (1 - u)F' = (\delta - x + r)q(1 - \varphi - uA).$

Under steady-state conditions, the firm holds capital stock so that the return per pound of investment is constant over time and this can be obtained by rearranging the above expression:

(7) $$P = \frac{F'}{q} = \left[\frac{\delta - x + r}{1 - u}\right](1 - \varphi - uA)$$

The right-hand side of equation (7) multiplied by the price of capital, q, has been interpreted as the user cost of capital for a firm that invests in depreciable assets such as machinery, structures and land. Other formulas, more complicated than shown here, have been derived for inventories (King, 1977; Boadway, Bruce and Mintz, 1982) and natural resources (Boadway, Bruce, McKenzie and Mintz, 1987).[29]

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[27] There are a number of schemes permitted for tax depreciation. The most common ones are initial (or investment) allowances (with an immediate write-off of a percentage of the asset) and annual allowances usually provided on a declining balance basis or straightline basis. The tax value of depreciation allowances is equal to the corporate tax rate, u, multiplied by the depreciation deduction given in each period and discounted by the firm's nominal cost of finance (R in equation (5)). Initial allowances may or may not be used to reduce the cost basis of assets that are depreciated. Under declining balance depreciation given at the rate α as a percentage of the cost of the asset, the write-off, per pound of the cost base, in each period $u\alpha(1 - \alpha)^t$, discounted by $(1 + R)^{t-1}$. The present value of tax depreciation on a declining basis is A = uα/(α = R). Thus if the firm's discount rate is R = 10 per cent, the tax depreciation rate is 20 per cent and the corporate tax rate is 50 per cent, then A = 0.33. Under straightline depreciation (a percentage constantly written off each year based on the life of the asset), the tax value of the write-off is equal to ξ = uq/T in each period, with T being the life of the asset. The present value of tax depreciation under straightline depreciation is equal to PV = u[1 - $(1 + R)^{-T+1}$]/TR. If the life of the asset is 10 years, then PV = 0.29.

[28] Adjustment costs can be included by subtracting them from the net revenues earned by the firm as current expenses or by adding them to depreciation costs if adjustment costs are capital in nature.

[29] The user cost of capital for inventories held for less than one year is equal to F' = (r + σπ)/(1 - u) with σ = 0 if governments allow inventories to be expensed or valued according to LIFO (last-in-first-out implies that the

Expression (7) suggests that the corporate tax system affects the user cost of capital in three ways:

- the corporate tax reduces gross income thereby increasing the user cost of capital (as shown in the denominator);
- the corporate tax reduces the effective purchase price of capital through depreciation allowances and investment tax credits;
- the corporate tax reduces financing costs by allowing companies to write off nominal interest expenses.

The above discussion is based on a model that considers capital as a stock that yields a flow of income over time (point input and flow of output process). However, some types of industries require capital to be built from ongoing expenditures on current inputs to produce a stock (flow of input and point output process). This particularly applies to research and development, exploration and development by resource companies and construction projects.

2. Neutrality of the Corporate Tax

One can show that the corporate tax would be neutral with respect to investment decisions of a firm under a rent or cash-flow tax. Under the cash-flow tax, investment is expensed ($A = 1$), there is no investment tax credit ($\varphi = 0$) and interest is not deductible ($r = \beta i + (1 - \beta)\rho - \pi$). Under these conditions, the user cost of capital, which becomes $q(r + \delta - x)$, is independent of the corporate tax.[30]

Governments, however, rarely try to achieve neutrality by taxing only rents. They purposely try to influence investment behaviour by giving special exemptions or deductions such as accelerated depreciation allowances for manufacturing investments, investment tax credits for machinery and lower corporate tax rates for specific industries. Table 2 provides a list of special concessions provided by the G7 countries under the corporate tax.

Governments may also provide tax holidays for firms, although the above expression (equation (7)) is inappropriate. Under a tax holiday, the qualifying company (usually a new company) is exempt from paying taxes for several years. Once the holiday is completed, the firm begins paying corporate income taxes. Thus, when a firm invests in long-lived assets, such as structures, the government taxes the income after the holiday is over and this can affect the cost of capital during the holiday. As Mintz (1990) shows, the holiday investment will bear taxes if the tax depreciation allowances after the holiday are of less

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price of the latest inventory is used to assess cost) or $\sigma = 1$ if inventories are valued according to FIF0 (first-in-first-out implies that the price of the oldest inventory is used to assess cost).

[30] Similarly, if the real cost of equity and debt financing is deductible, $r = [\beta i + (1 - \beta)\rho - \pi][1 - u]$, and depreciation deductions are equal to economic depreciation based on the replacement cost, the user cost will be independent of the corporate income tax (e.g. under declining balance methods, $\alpha = \delta - x$ and undepreciated cost is increased by inflation each period so that tax depreciation is equal to $u\alpha(1 - \alpha)^t(1 + \pi)^t$).

TABLE 2

Special Tax Incentives

	Canada	*France*	*Germany*	*Italy*	*Japan*	*UK*	*US*
Tax holidays	No except three provinces	Two years exempt, three years 50% tax holiday	No	Ten-year tax holiday	No	No	No
Investment tax credit or allowance	ITC — slow growth region, R&D	Incremental training / R&D	Yes	No	ITA — incremental R&D, import incentive, energy	ITC / grants	Incremental R&D
Tax-free zones	No	No	Yes	No	No	Yes	Partial exemption for US possessions
Reduced rates of tax	Manufactures Small business	Yes	No	No	No	No	Exempt earnings for qualifying export activities
Accelerated depreciation	Yes	Yes	Yes	No	No	100% in zones	Pollution equipment

value than the economic depreciation cost. This will happen when tax depreciation allowances are not indexed for inflation (so the real value after the holiday is eroded by inflation) or when governments provide fast write-offs. For example, under a cash- flow tax, the company loses the value of expensing during the holiday and will pay taxes on income generated by holiday investments when the holiday is complete. In some circumstances, holiday investments can be taxed more highly than normal investments if inflation or tax depreciation rates are sufficiently high that the firm's real value of tax depreciation after the holiday is insignificant.

3. Other Taxes

Governments are very innovative in assessing all sorts of taxes on corporate investments besides the corporate income tax. In Canada, corporate taxes are assessed on the gross assets of companies. In Mexico, the gross assets tax is a minimum tax whereby it is creditable against corporate income taxes. For Mexican companies established in the Maquilidoran region where they are exempt from corporate income tax, the gross assets tax is a final tax. Other minimum taxes can be found in the US (on profits), and on the net worth of companies (Colombia), turnover (Morocco) and dividends (UK, France and Germany for integration purposes). Taxes on property (structures and buildings) may be found in many countries.[31]

Some studies have also tried to incorporate non-capital taxes such as sales and payroll taxes in the user cost of capital to calculate the overall impact of the tax system on firms' decisions. However, it is unclear that this is appropriate methodology to follow. Payroll taxes affect labour decisions, not capital decisions. Sales taxes are neutral with respect to capital as long as they are levied on consumption goods, not capital goods. Thus to correct the user cost of capital to calculate the impact of non-capital taxes on investment is incorrect. Instead, taxes such as capital, payroll and motor fuel taxes might impact on the cost of producing a product. Therefore it would be more appropriate to calculate the effective tax rates on the marginal cost of production which is increased by taxes on various inputs (subject to the incidence of the taxes). In McKenzie, Mintz and Scharf (1993), a measure is derived for the impact of taxes on the marginal cost of production which aggregates taxes according to a cost structure for the firm. One can then think of taxes as affecting the production decision of the firm rather than a particular input such as capital.

[31] To incorporate these various special provisions in the user cost of capital, see Estache (1995) and Chen and Mintz (1995) on minimum taxes and Chen and Mintz (1993) on capital and property taxes.

4. The Effective Tax Rate on Capital

To capture the effect of all the different provisions of the corporate tax system on capital investments, it has now become popular to measure the *effective corporate tax rate* on capital (Auerbach, 1983; Boadway, Bruce and Mintz, 1984).[32] The effective tax rate is the amount of tax paid as a percentage of the rate of return on capital held at the margin. It is measured by the following formula:

$$(8) \qquad T^c = \frac{r^g - r^n}{r^g}$$

with r^g and r^n being the rate of return gross and net of taxes, respectively. For example, in the case of depreciable capital, the gross rate of return on capital is equal to the expression for the income net of economic depreciation (F'/q - (δ - x)). The net rate of return on capital is the case when all tax terms are zero (r^n is therefore equal to the weighted average cost of finance, $\beta i + (1 - \beta)\rho - \pi$).

In Table 3, a comparison of effective corporate income tax rates for the G7 countries is provided for 1994. Machinery (with relatively low depreciation rates compared with economic depreciation) and inventories (valued on a FIFO basis) tend to be highly taxed while land and inventories (LIFO basis) are more lightly taxed due to interest expense deductions in the presence of inflation.

5. Personal Taxation and the Cost of Capital

As emphasised by King (1977), personal taxation may be an important element in assessing the cost of capital and effective tax rate. To incorporate personal taxes in the effective tax rate, we need to account for personal tax rates on nominal interest income (denoted by m), the accrual equivalent tax rate on nominal capital gains (c)[33] and the dividend tax rate (ν). After personal taxes are paid, investors earn interest income at the rate $i(1 - m)$, capital gain income equal to $\rho(1 - c)$ and dividend income equal to $\rho(1 - \nu)$. Let β be the proportion of assets held as bonds, $1 - \beta$ be the proportion of assets held as equity, a be the proportion of equity income derived as capital gains and $1– a$ be the proportion of equity income derived as dividends. Therefore the after-tax rate of return on capital, after correcting for personal taxes and inflation, is equal to the following:

[32] King and Fullerton (1984) estimate effective tax rates on capital but include both corporate and personal income tax provisions. This is discussed below.

[33] Recall that capital gains taxes are assessed only when assets are sold. An accrual equivalent capital gains tax rate is calculated by discounting payable capital gains taxes to reflect the amount of tax paid had an accrual basis been used instead. See Davies and Glenday (1990) for a discussion of different methods of measuring the accrual equivalent capital gains tax rate.

TABLE 3

Marginal Effective Corporate Tax Rates: G7 Countries, Manufacturing, 1994

Per cent

	Machinery	*Buildings*	*Inventories*	*Land*	*Aggregate*
Canada	19.4	20.4	34.4	19.4	23.8
France	28.6	25.1	31.4	25.8	28.3
Germany	37.8	27.7	26.2	26.2	31.2
Italy	49.2	38.4	26.9	26.9	38.9
Japan	41.6	32.2	29.4	29.4	35.0
UK	36.9	24.9	41.8	20.3	34.1
US	21.2	28.4	30.2	16.8	25.4

Source: Author's own calculations based on capital stock, economic depreciation and interest rate parameters developed in McKenzie and Mintz (1992).

$$(9) \qquad r_n = \beta i\,(1 - m) + (1 - \beta)\,\rho\,(1 - \theta) - \pi$$

with θ denoting the average tax rate on equity income ($\theta = ac + (1 - a)\nu$).

One can measure the effective capital tax rate, T, that incorporates both corporate and personal taxes by using expression (9) for r_n in the right-hand side of equation (8) above. This approach is used in King and Fullerton (1984) and OECD (1991) who measure the effective tax on capital taking into account both corporate and personal taxes.

The inclusion of personal taxes as part of the effective tax rate measure clearly confronts analysts with the thorniest issue that has to be dealt with when analysing tax systems. This issue is related to the choice of personal tax rates that are relevant in assessing the effective tax rate on capital. Investors could face different tax rates for several reasons:

- *Progressivity of the tax rate schedule at the personal level.* This implies some investors face lower tax rates on capital income than others.
- *Tax exemptions for certain forms of savings.* Some sources of savings, such as pension plan savings, are exempt from taxation.
- *Financial intermediaries*. Banks, insurance companies, mutual funds and other financial institutions have their own special tax considerations.
- *Foreign investors*. Companies are owned not only by domestic investors but also by foreigners who are subject to a country's withholding and income taxes levied by government where the investor resides.

To deal with all these potential types of investors who can own companies, one requires a financial model that explains the determination of financial policies and rates of return on assets. This issue will be discussed in more detail in the next section, on corporate taxation and financing, although it would be useful to discuss now one particularly relevant point related to financial markets in open economies.

In earlier work on effective tax rates (King and Fullerton (1984), for example), it was assumed that economies were closed to international capital movements. Under this assumption, it is best to measure an aggregate effective tax rate on capital incorporating both the corporate and personal income provisions of a country to evaluate how investment is affected by the tax system. If either corporate tax rates or personal tax rates are increased, both domestic investment and savings, which are equal to each other in equilibrium, would be affected simultaneously.

However, in an open economy, whereby savings are obtained from international sources as well, it is no longer clear what impact personal taxes in a particular country might have on investment and corporate taxes on savings. In a small open economy (Boadway, Bruce and Mintz (1984) and see also Bovenberg, Andersson, Aramhi and Chand (1990)), rates of return received by investors are determined by international markets. This implies that domestic investment and savings decisions may not influence international interest rates and yields on financial instruments. Thus personal taxes on domestic savings may reduce the return earned by savers but this would simply reduce capital outflows of savings or increase capital inflows from abroad without affecting the interest rate that governs a firm's investment decision. Similarly, corporate tax provisions reduce investment, increasing (reducing) capital outflows (inflows) without affecting domestic savings decisions that depend on international yields on assets. Given these conclusions, one should *disaggregate* domestic corporate and personal effective tax rates for a small open economy to determine how investment and savings are affected.

These two extreme cases, the closed and open economies, raise important perspectives for policy. For example, in a closed economy, personal taxation reduces both domestic savings and corporate investment. In a small open economy, savings would be reduced, capital outflows would decline but investment would not be affected since firms finance capital at the internationally determined interest rate. Thus policies such as reducing tax rates at the personal level could be largely ineffective in increasing corporate investment in a small open economy.

How open are economies to capital movements? Feldstein and Horioka (1981) and Summers (1986) argue that national capital markets are closed since domestic investment and savings are highly correlated, in part due to government policies that interfere with capital flows. French and Poterba (1991) suggest that most equity of corporations is owned by domestic investors (although this does

not suggest that foreign savings could be the primary determinant of *marginal* savings). On the other hand, interest rates across countries seem to be closely related through financial arbitrage (Frenkel and Razin, 1987). Recent evidence suggests as well that cross- border financial transactions have increased substantially, from 64 per cent of GDP in 1990 compared with 9.6 per cent in 1980 for the G7 countries (Edey and Hviding, 1995).

This discussion of open versus closed economies becomes relevant in evaluating the impact of integrating corporate and personal taxes on capital income (see Boadway and Bruce (1992) and Devereux and Freeman (1995)). One view is that integration of personal taxes that results in relief for resident shareholders only is not effective in integrating corporate and personal taxes since foreign investors do not obtain the same benefit. The reduction in dividend or capital gains taxes only increases domestic savings without affecting the cost of capital of the company. Thus integration is not necessary. Alternatively, economies may be sufficiently large or distinct (Gordon and Varian, 1989; Burgess, 1988) that domestic savings influence interest rates faced by a country. Under these conditions, a reduction in dividend and capital gains taxes will increase the international supply of savings to an economy and reduce interest rates faced by the economy. In this case, integration is of benefit to investment. Moreover, integration may still be necessary to simplify a tax system and to minimise tax planning opportunities.

6. Do Taxes Affect Investment Decisions?

A large number of models have been estimated using econometric methods to determine how taxes impact on investment decisions. There are generally three approaches used in the literature.[34]

- *The accelerator model.* The first approach, due to Clark (1917), is to link investment simply to changes in aggregate demand. The accelerator model is based on an assumption that relative prices of labour and capital do not affect the demand for capital. Only output affects investment so the impact of taxes on investment would only be through the impact on aggregate demand for capital. The model was extended to allow for lags by assuming that output of current and past periods affects current investment.
- *The neo-classical model.* The neo-classical model assumes that profit-maximising firms will use capital and other inputs in production until the marginal product is equal to the price of the factor used in production. In terms of the microeconomic theory, the demand for capital will therefore depend on both output and the rental price of capital and other factors of production. The neo-classical model (Jorgenson, 1963) is based on an

[34] A comprehensive review of the literature may be found in Chirinko (1992), who discusses more fully the various approaches used to model investment behaviour. Only the primary ones are considered here.

underlying production function with a given measure of substitutability of factors in production. As it is assumed that investment responds slowly to changes in output and the user cost of capital, an adjustment is made so that current investment depends on both current and past changes in capital stock. Under the neo-classical model, taxes affect capital output as in the accelerator model, as well as the user cost of capital.

Later versions of the neo-classical model allowed for different formulations. One approach is to avoid specifying a production function, such as one with a given degree of substitutability of factors, but instead to assume a particular profit or cost function and derive the demand for investment using duality (see Bernstein and Nadiri (1987) for an explicit formulation using the dual approach). Feldstein (1982) outlined two other models. The *return over cost* model allows for net investment per unit of output to be correlated with the excess of the marginal return to capital (net of taxes and depreciation) over the cost of finance. The *effective tax rate* model assumes net increases in capital stock as a percentage of output are positively related to the net rate of return of capital, once correcting for both depreciation and taxes.

A recent neo-classical approach is to use the investment demand function derived from the firm's maximisation decision (the 'Euler equation') which depends on future investment, the difference between current and future costs or prices of capital and the return on capital (with the error term depending on both technological shocks and expectation errors). Taxes play an interesting role by affecting both current and future variables. One can thus more easily accommodate anticipated shifts in tax policy.

- *The Q model.* The Q model, due to Brainard and Tobin (1968) but originally conceived by Keynes (1936), is based on the notion that firms will invest in capital if the market value of projects is at least as great as the cost of purchasing capital. *Q* is measured as the ratio of the market value of a firm's equity and debt liabilities (the present value of its future returns) to its replacement cost of capital. If *Q* is greater than 1, then the firm invests in capital, while if *Q* is less than 1, the firm will divest. In principle, the market value of the firm embodies information used by investors to evaluate discounted earnings of the firm. Moreover, keeping in mind that investment is determined up to the point whereby the market value of the marginal unit of capital is equal to its purchase price, *marginal* Q would be the best indicator for investment decisions. However, the marginal *Q* is difficult to measure since it requires one to measure the market value of an incremental project decision. Instead, one must measure the *average* Q, which is the total market value of the firm divided by the replacement cost of its capital (see Hayashi (1982) who shows how average and marginal *Q* are related).

  In Q models, it is hypothesised that investment is adjusted but at a cost that increases by the amount of investment (a quadratic function is usually

assumed so that investment is simply a linear function of *Q*). The *Q* variable is corrected by reducing the replacement cost of capital by the present value of tax depreciation allowances as well as correcting the market value of equity and debt by personal and corporate income taxes that influence the financing of capital (see Summers (1981)).

Examples of empirical work that employ various approaches to modelling investment behaviour are provided in Table 4. Estimates of the impact of taxes on investment are also provided in terms of price and, where appropriate, output effects. Older studies of investment behaviour have primarily relied on aggregate time-series data. Newer studies have been using firm-level data (therefore both cross-section and time-series) with much better results given better information.

The overall conclusion one derives from recent studies is that taxes affect investment decisions, although the size of the effect is less clear. The firm-level studies find somewhat larger effects but there is still considerable controversy. For example, in Devereux, Keen and Schiantarelli (1994), the existence of tax losses in the UK did not affect the estimated impact of taxes on investment even though one would expect differences between taxpaying and non-taxpaying companies in terms of their reaction. Investment studies require future effort to incorporate several issues.

First, investment is modelled under the assumption that financing of capital is independent of investment. Yet one would expect a simultaneity between financial and investment decisions for several reasons. Some firms may be constrained in terms of liquidity, so investment projects may only be adopted if sufficient internal sources of funds are available. Also, some types of capital, such as structures and land, may be more easily financed by debt that can use the capital as collateral.

Second, the incorporation of expectations about the future has always plagued investment studies. Although the *Q* and Euler equation approaches have achieved some success at incorporating the expectations about future variables in the models, they still rely on specific *ad hoc* assumptions such as quadratic adjustment costs for investment.

Third, government decision-making is assumed to be exogenous in most investment models. However, in principle, governments react to changes in the economy such as providing temporary investment tax credits during recessionary periods. If firms anticipate changes in government decisions, then one should model not only investment behaviour but also government behaviour to obtain a better understanding of investment and taxes.

Finally, the analysis of taxation requires good data. The most difficult problem often faced by researchers is that specific tax data on firms, such as the composition of depreciation allowances (by type of asset), the use of tax loss carry-forward and carry-back provisions, and information on more intricate aspects of tax law (such as capitalised expenses in construction or local

TABLE 4

Selected Investment Studies

Study	*Period covered*	*Methodology*	*Results*
Hall and Jorgenson, 1967	1929–63	Neo-classical; time series of US manufacturing and non-manufacturing investments in structures and equipment.	Elasticity of capital to output varies from 0.04 to 0.13.
Summers, 1981	1931–78	Q model with time-series investment.	Doubling investment tax credit raises investment 5.5 per cent in first year and 17.3 per cent in the long run.
Feldstein, 1982	1953–78	Time-series study based on return over cost, effective tax rate model.	Elasticity of investment to return on capital is 0.58 and to output is 0.62.
Chirinko and Eisner, 1983	1973–79	Use of six macroeconomic quarterly models; structures and machinery.	Elasticity of investment to user cost is –0.52.
Poterba and Summers, 1983	1950–80	Annual time series of UK firms using a Q model with personal and corporate tax rates.	Dividend taxes impact on investment.
Chirinko, 1987	1951–81	Similar to Feldstein study except that return on capital is lagged.	Elasticity of investment to return on capital is 0.17 and to output is 1.76.
Devereux, 1989	1974–84	Pooled data at firm level using accelerator, neo-classical and Q models.	Decrease of 10 percentage points in cost of capital causes investment to rise 20 per cent per annum.
Blundell, Bond, Devereux and Schiantarelli, 1992	1975–86	Pooled firm-level data using Q model.	Increase of 10 per cent in market value of equity increases investment by 2.5 per cent in the short run.
Auerbach and Hassett, 1992	1953–88	Use of both the Euler and Q model approaches and allowance for changes in tax rates.	Tax policy plays a significant but not necessarily stabilising role in affecting investment.
Devereux, Keen and Schiantarelli, 1994	1976–86	Pooled firm-level data using neo-classical and Q models allowing for tax losses.	Allowing for tax losses does not improve measured impacts of tax system on investment.

continues

TABLE 4 *contd.*

Selected Investment Studies

Study	*Period covered*	*Methodology*	*Results*
Bernstein and Shah, 1994	1966–84	Industry-level dataset for companies operating in Pakistan based on a model of the user cost of capital.	Short- and long-run impacts allowing for various policy changes. Elasticities are small but investment tax credits have the largest impact per dollar of revenue loss.

government taxes), probably result in biased estimates of coefficients (perhaps towards smaller values) for tax variable terms.

IV. TAXES AND FINANCING

Corporate taxes are expected to affect financial decisions of firms as investment can be funded by bonds, new equity issues, financial leases, accounts payable or undistributed profits (retained earnings). Given the deductibility of interest as an expense under the corporate income tax, the tax system may be expected to encourage companies to finance investment with debt. However, corporate financial decisions also depend on the other parts of the tax system that might influence financing, such as personal taxes on capital income and financial transaction taxes. As pointed out in Section III, the effect of corporate taxation on investment in part depends on how financial decisions are determined.

This area of research is highly controversial since both theoretical and empirical research have had contradictory conclusions. One of the most important contributions to the theory of finance was due to Modigliani and Miller (1958). Using a model without taxes, they argued that firms are indifferent with respect to the use of debt and equity to finance their capital expenditure. The argument is based on the notion that investors and firms face the same opportunity costs or interest rate when financing assets. If a firm issues £1 of debt in replacement of equity finance, the firm incurs additional interest costs equal to the interest for £1 of debt. Investors, however, reduce their savings in equity assets by £1, which allows them to buy £1 of bonds (and thereby earn interest income equal to the rate of interest). Thus investors are no better or worse off when the firm changes its debt policy. The Modigliani–Miller theorem suggests that a firm's value is independent of financial decisions. In a later addendum to their paper (Modigliani and Miller, 1963), the authors consider the fact that interest payments on debt are deductible under the corporate income tax. This fact led Modigliani and Miller to a conclusion that taxes might affect

financial policy of firms, although they did not consider the role of personal taxes in influencing financial policy.

To see the importance of financial decisions to investment decisions as well as the role of both corporate and personal income taxes, let us consider a simple situation in which the firm can issue either bonds or equity.[35] Suppose that the firm earns a (risk-adjusted) rate of return of Y on capital that is distributed as either equity or bond income. An investor pays corporate taxes at the rate u and personal taxes at the rate θ,[36] with an after-tax income of $Y(1 - u)(1 - \theta)$. If, instead, the income is paid out as interest, which is not taxed at the corporate level given its deductibility as an expense, then the after-tax earnings of the investor are $Y(1 - m)$. Assuming that the investor is indifferent between bonds and equity, it is therefore necessary for after-tax returns on assets to be the same, which implies that the tax rate on interest income should be equal to the combined corporate and personal tax on equity income: $m = u + \theta (1 - u)$. Otherwise, investors will prefer bonds if the tax rate on bonds is less than that on equity, or prefer equity if the converse is true.

If tax rates are not equal, firms seek to use those sources of finance that minimise taxes for owners. For example, if the tax rate on bond income is less than the combined corporate and personal tax on equity income, then the firm will borrow as much money as possible and invest in both real and financial assets. Such financial arbitrage implies that firms would be 100 per cent debt financed. If the tax rate on equity is less than that on bonds, the firm will only issue equity and, if possible, sell equity short and lend the funds to investors who may deduct interest payments incurred for investments that are expected to earn a profit.

In the above discussion, it is assumed that financial arbitrage requires the gross- of-tax rate of return (i.e. Y) to be the same across the assets, and the net-of-tax rate of return (i.e. $Y(1 - m) = Y(1 - \theta)$) to be the same across the assets. The former case is referred to as 'firm-level arbitrage' and the latter as 'household arbitrage'.[37] There is even a third arbitrage which is that firms are indifferent

[35] The financing decision is even more complicated since there are a number of sources of finance to firms including retained earnings, new equity issues, collateral debt, unsubordinated debt, leasing and accounts payable, most of which have different tax implications for firms. As pointed out, interest deductibility favours debt. Leasing may be favourable when the lessor is in a better position than the lessee to use write-offs for capital (Edwards and Mayer, 1991).

[36] As Poterba and Summers (1985) show, the effective tax rate on equity income is an average of the capital gains and dividend tax rates when firms are signalling their attributes to investors in a market. Alternatively, the effective tax rate on equity is the capital gains tax rate if retained earnings are used to finance investment, or the dividend tax rate if new equity is used to finance investment. When firms only finance capital with retained earnings, dividends are simply a payment in excess of the financial needs of the company. Dividend taxes therefore have no impact on the firm since the dividends are effectively lump-sum payments to investors and the taxes are capitalised in the value of the firm.

[37] King and Fullerton (1984) refer to firm-level arbitrage as the 'fixed p' case and household arbitrage as the 'fixed s' case.

between the net-of- corporate-tax cost of debt and equity finance. Using equation (5), the tax cost for debt is $i(1 - u)$ and for equity finance it is ρ. If the firm is indifferent between these two costs, then $i(1 - u) = \rho$.

Which investor tax rates are relevant to measuring the cost of capital and the effective tax rate is difficult to determine. As discussed above, given the progressivity of the income tax system, investor tax rates depend on income. Thus low-income investors may prefer to hold bonds since they may face a low rate of personal tax on interest relative to the combined corporate and personal tax rate on equity ($m < u + \theta(1 - u)$). High-income investors may prefer equity (if $m > u + \theta(1 - u)$).

All this is further complicated by the presence of multiple corporate tax rates within a country (some types of industries might be taxed at lower statutory tax rates than others), the operation of financial intermediaries (financial institutions, insurance companies and tax-exempt pension plans) and, as already mentioned in Section III, the openness of markets to foreign investors. Thus the tax rates on investors (m and θ) and the corporate tax rate (u) may all differ for each type of firm, depending on the location of the firm and its ownership.

To sort out how taxes might influence financial decisions, models have been developed to explain the behaviour of financial and investment markets. Models can be grouped into three types (Myers, 1984):

- *Tax arbitrage models.* One set of models that deal with taxes and finance assume that investors and firms determine financial decisions so as to eliminate any differences in tax rates across investors or types of investment, so that the Modigliani–Miller theorem is restored. For example, in Miller (1977), firms are able to issue as much debt or equity as they wish. Individual investors are constrained from borrowing or selling assets short. Under Miller's equilibrium, some marginal investor is indifferent between holding equity and debt (for this investor, $m = u + \theta(1 - u)$) while other individuals, who are constrained, seek to own as much of an asset as possible. Thus low-income individuals or tax-exempt entities such as pension plans would invest only in bonds while upper-income individuals would only own equity. Firms, however, would seek marginal sources of finance from unconstrained investors who would earn the same after- tax rate of return on investments. Moreover, individuals will trade assets affecting their taxable income so that differences in tax rates across investors can be reduced. Gordon (1986) shows how the Miller model can be applied at the international level, which requires one to consider the determination of international exchange rates in the presence of taxes.
- *Static trade-off models.* Static trade-off models suggest firms will choose an optimal mix of debt and equity finance but will trade off tax benefits with other costs that affect financing. These costs might include bankruptcy costs and other transaction costs. In these models, the optimal mix

of debt and equity is determined where the tax benefit of issuing debt (when $m < u + \theta(1 - u)$) is offset by the incremental cost of issuing debt. The implication of these models is that the debt to asset ratio, β in equation (5), is optimally determined so that the marginal interest cost (net of corporate taxes), which reflects anticipated bankruptcy and other transaction costs, is equal to the cost of equity finance. Under the additional assumption that firms operate with constant returns to scale, one can show that the debt to asset ratio is independent of the firm's capital stock and that the firm's weighted average cost of finance (equation (5)) would be used to determine the cost of capital. Thus one can justify a two-stage procedure whereby, in the first stage, financing is chosen to minimise the cost of finance and, in the second stage, firms optimally choose their capital stock.

There are several different arguments given for the static trade-off models, two of the most important being related to tax losses and bankruptcy costs.

Tax losses. In DeAngelo and Masulis (1980), firms, facing uncertainty in future returns, trade off the tax benefit of issuing debt when the firm is taxpaying (due to the deductibility of interest expense) with the tax cost of losing corporate tax write-offs should the firm become non-taxpaying. Intuitively, firms issue debt until the personal tax rate on interest income, *m*, is equal to the expected corporate and personal tax rate on equity income (the expected corporate tax rate is the probability of the firm paying corporate taxes times the corporate tax).[38]

Bankruptcy costs. Several models with bankruptcy costs (Stiglitz, 1972; Stapleton, 1975) have shown that firms will choose an optimal debt policy, trading off the tax benefits of issuing debt with the bankruptcy costs of issuing debt. Bankruptcy costs are real costs such as legal and trustee fees and lost sales resulting from the reorganisation or selling-off of assets of a firm (Altman, 1984). However, as Webb (1983) has shown, investors also face bankruptcy costs. One can restore the Modigliani–Miller theorem by allowing for personal bankruptcy costs that offset the bankruptcy costs of firms.

In a number of empirical studies (for example, Kim (1978)), it was found that the variance of returns affects the financial policy of firms. This would be consistent with the explanations used by static trade-off models. It has also been found that firms that are taxpaying or are able to flow out tax losses to

[38] The usual interpretation of the DeAngelo and Masulis model is that the cost of issuing debt results from a firm losing the tax value of fast depreciation deductions or investment tax credits when it becomes non-taxpaying. This is actually the wrong interpretation. As long as there is some reason that corporate income can become negative for tax reasons (for example, when nominal interest expenses are deductible), the firm, when issuing more debt, increases the probability of becoming non-taxpaying so that the only tax on equity income is the personal tax rate on capital gains or dividends which is less than the tax rate on interest income. An optimal debt decision is achieved which trades off the excess tax cost on equity income in taxpaying situations with the excess personal tax costs of issuing bonds when the firm is not paying corporate taxes.

investors under partnership arrangements may be more highly debt financed (Mackie- Mason, 1990a; Gentry, 1994). Also, it was found by Bartholdy, Fisher and Mintz (1987) that a one-point increase in the statutory corporate income tax rate resulted in almost a three-quarter-point increase in the debt / asset ratio of Canadian-controlled companies.

- *Pecking-order models.* The pecking-order model, as discussed by Myers (1984), predicts that firms finance capital by exhausting the cheapest source of finance before going on to their next more costly source. The least-cost source of finance is retained earnings (cash) followed by risky debt and new equity issues. Thus the financial policy of the firm depends on the accumulated past earnings of the firm as well as its current investment needs: those firms with few reserves or large capital demands would require more finance in the form of debt and new equity than would those with `deep pockets' of cash reserves or less capital demand.

  What are the economic reasons for the pecking-order model? In the past number of years, theories related to informational problems have been developed to explain why firms may be reluctant to seek sources of finance from 'outside' investors who have less knowledge about a firm than 'inside' investors (important contributions include Myers and Majluf (1984) and Miller and Rock (1985)). The lack of knowledge may result from outside investors not being able to judge the quality of projects to be undertaken by the firm or adverse selection (Akerlof, 1970) or be due to moral hazard whereby entrepreneurial actions can affect the expected value of the firm's profits. In the case of lack of knowledge about inside investor opportunities, firms when selling securities to the market find that the security prices reflect the market's perception of the firm's investment opportunity. Due to the lack of information available to shareholders, share prices reflect the anticipated average quality of investments rather than the true quality of a firm. Unless high-quality firms can separate themselves from low-quality firms by using a signal for quality (for example, dividend policy or debt / equity ratios) or investors can screen firms so better managers reveal their true behaviour (for example, use of bond covenants), the high-quality firms will be reluctant to sell shares in the market since the prices of shares held by existing informed shareholders are bid down to a lower level. Thus the sale of equity and risky bonds by firms reduces the value of the firm in the market. This leads to 'bad' firms chasing out 'good' firms so that, in the extreme, the market believes only bad firms would ever issue equity or risky bonds.

  For general problems of informational imperfections, it is possible for good prospects to separate themselves from bad prospects by using a signal or for investors to use a screen as an indicator of quality that would be too costly for bad agents to duplicate. In the case of firms signalling quality about their projects, the amount of debt relative to equity may serve as a signal (Ross, 1977; Leland and Pyle, 1977). Since higher-quality firms are able to issue

debt incurring lower bankruptcy and agency costs than low-quality firms, one would observe higher- quality firms with greater debt to equity ratios. However, to the extent that high- quality firms must issue debt to finance investment, they would bid down their value, thereby giving up potentially worthwhile investments or, in other words, underinvest in capital compared with a situation with no informational asymmetries. The problem with this theory is that firms may not issue dividends since it forces firms to borrow more at a higher cost from markets. Yet dividend policy itself can be a signal about the value of the firm.[39] If dividends serve as a costly signal (due to dividends being more highly taxed than capital gains arising from retentions at the personal level), then higher-quality firms should issue more dividends than lower-quality firms, implying that they finance capital with more capital raised from the market. Brennan and Kraus (1987) and Constantinides and Grundy (1989) use signalling arguments to question the 'pecking-order hypothesis' by suggesting that a richer set of financial choices, rather than simply debt and equity, would result in firms overcoming informational problems in markets.

In a model with informational asymmetries between inside and outside investors, corporate tax policy has two effects. The first is the standard one: taxes, through the cost of capital, discourage investment and, given the deductibility of interest expense, may encourage debt financing. The second effect is through the current cash position of the firm. If taxes reduce the cash flow that is available to firms to finance investment, then investment will be ultimately affected as firms must rely on other sources of finance that are more costly to raise from the market. The implication of the pecking-order models is that personal taxes play little role in affecting investment decisions. Moreover, a rent tax on firms that reduce their cash may affect investment.

Several studies have successfully incorporated cash-flow constraints in explaining investment decisions (Fazarri, Hubbard and Petersen (1988), Hubbard (1990) and, for other references, Chirinko (1992)). It is suggested by these studies that upfront incentives, such as the investment tax credit, are more successful in encouraging investments than downstream incentives, such as lower corporate tax rates or accelerated depreciation.

V. CORPORATE TAXATION AND RISK

Investment is an inherently risky decision. When firms commit themselves to new capital projects, they must predict the after-tax returns on investment. These returns are uncertain, so risk, which is the aversion that investors have towards

[39] See Battacharya (1979), Miller and Rock (1985) and Bernheim and Wantz (1995) for models that deal with dividend signalling. The literature has not made clear which signals are preferred by firms for signalling (dividends, debt policy, new security issues, etc.).

uncertainty, plays an important role in affecting capital decisions. Taxes affect the perception that investors have towards risk, so it is clearly important to determine the degree to which taxes affect the evaluation of risky investments.

When uncertainty is present, investors will balance future gains with potential losses. For example, suppose that an investor can choose a safe asset (for example, a government treasury bill) with a rate of return of 6 per cent per annum or a risky investment with an expected rate of return of 10 per cent per annum. If the investor is just as happy to invest in either asset, then the excess rate of return on the risky asset, 4 per cent, which is the difference between the expected rate of return of 10 per cent and the safe rate of return of 6 per cent, is the monetary return or *risk premium* needed to compensate the investor for risk.

Risky investment arises for a number of reasons. These include the following:

- *Income risk.* This arises from uncertainty with respect to operating income or revenues net of current costs.
- *Capital risk.* This arises from uncertain economic depreciation costs due to unknown wear and tear of capital assets or obsolescence (as future innovations that replace capital are uncertain).
- *Financial risk.* This arises from uncertainty with respect to future interest expenses incurred for borrowed funds. Financial bonds held by investors may be risky since firms may be unable to repay the principal and interest on loans. Investors therefore demand a higher rate of interest on bonds taking into account the risk of non-repayment of loans and interest and any associated bankruptcy costs.
- *Inflation risk.* This arises from uncertainty with respect to future inflation rates that will affect future earnings as well as the cost of replacing assets.
- *Irreversibility risk.* As capital may be irreversible (once sunk, it cannot be used for another purpose), uncertainty is increased for investors who have to be concerned about the timing of a project.
- *Political risk.* This arises from uncertainty with respect to uncertain public policies, such as tax rates.

Below, we consider how taxes influence investment in the presence of each type of risk. However, the discussion is best understood by considering some theoretical aspects of how taxes and risk interact.

1. Taxation and Risk: Theory

To understand how taxes may interact with different types of risk, it would be useful to provide an example similar to the one provided at the beginning of this section. Suppose an investment of £100 can earn a return of either 30 per cent or –10 per cent in the following period. Assuming that there is an equal chance of either return being earned, the expected return is 10 per cent. The standard

deviation of returns[40] is equal to 20 per cent. If investors are willing to accept £1 in expected income for every £5 in the standard deviation of returns, then the monetary cost of the risk is 4 per cent in terms of the rate of return on the asset. The *risk-adjusted* return in assets is therefore equal to 6 per cent (10 per cent less 4 per cent for risk). Once adjusting for risk, an investor would be willing to hold either risky or riskless assets earning a return of 6 per cent.

Now consider income taxes levied at the rate of 25 per cent on investment returns. An important aspect of tax policy when considering risk is how the government treats losses when incurred by investors. If the income tax provides for *full refundability* or a *full loss offset* when losses are incurred, the government issues a cheque equal to its share of losses determined by the rate of tax (in this example, a 25 per cent refund of any losses incurred by the investor). Anything less would be an imperfect loss offset or partial refundability.

At the tax rate of 25 per cent and full refundability, the after-tax rate of return for the investment is 22.5 per cent (when profitable) and –7.5 per cent (when unprofitable). The expected after-tax rate of return on the investment, given that each return is equally possible, is 7.5 per cent and the standard deviation of returns is 15 per cent. One may note that both the expected return and standard deviation are reduced by 25 per cent, which is equal to the tax rate on income. The cost of risk is now 3 per cent (assuming that the investor still likes to have £1 of income to compensate him for £5 in the standard deviation),[41] so the after-tax risk-adjusted rate of return on the investment is 4.5 per cent. Note that if the return on a safe asset that earns a before-tax rate of return of 6 per cent is also taxed at rate of 25 per cent, then its after-tax rate of return is 4.5 per cent as well. Thus the rates of return on both the risky and riskless assets remain equal to each other so that the income tax with a full loss offset has no direct impact on relative rates of return. In this sense, a tax system with full refundability is neutral with respect to risk. Implicitly, full refundability of losses allows investors to fully deduct the cost of risk from the tax base so that neutrality is maintained (Mintz, 1982; Gordon, 1985; Gordon and Wilson, 1991).

When governments do not fully refund losses, the tax system can dramatically increase the cost of risk associated with investment. When there is no loss offset at all, the investor earns an after-tax rate of return of either 22.5 per cent or –10 per cent. The expected rate of return on the investment is 6.25 per cent and the standard deviation is 16.25 per cent. Thus the income tax at a

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[40] The standard deviation is the square root of the probability-weighted sum of squared deviations around the mean $(\sigma = [\, p_1(x_1 - \bar{x})^2 + p_2(x_2 - \bar{x})^2 \,]^{½}$ where p_i and x_i are the probability and return in the ith state respectively).

[41] We assume that income or wealth does not affect the investor's evaluation of the cost of uncertainty relative to expected returns. As stressed in the literature, taxes that reduce income or wealth could make individuals more averse to risk by requiring a greater amount of income to compensate for risk (Domar and Musgrave, 1944; Mossin, 1968; Stiglitz, 1969).

rate of 25 per cent and with no refundability reduces the expected rate of return by a rate of 37.5 per cent and the standard deviation by only 18.75 per cent. Assuming again that the investor needs £1 in expected income to offset £5 in standard deviation, the risk-adjusted after-tax rate of return on the investment is only 2.5 per cent. This rate of return is far less than the after-tax rate of return of 4.5 per cent on the riskless investment. When there is no full refundability, the tax system clearly discourages risky investment.

Under current corporate income tax systems, losses are only partly refundable. Governments may allow losses to be carried back or carried forward for a limited period (in the case of the UK, losses are carried forward indefinitely). When a current year's losses are carried back, the loss is applied against profits earned in qualifying past years, resulting in a refund of corporate taxes. Alternatively, when losses are carried forward, the losses are applied against profits of qualifying future years, resulting in a reduction in future corporate income taxes. However, the losses are not carried forward at a rate of interest, so that the present value of losses is subsequently reduced by the number of years needed to use them against future profits. If losses cannot be used within the qualifying number of years, they then expire without refundability.

At best, therefore, governments only permit a partial refundability of losses. Given the dynamic nature of investment, the presence of carry-backs and carry-forwards complicates considerably the analysis used to model the impact of taxes on risky investments (see Auerbach (1986) and Mayer (1986)). For example, accumulated losses in current years can help shelter taxes on future investments, thereby reducing the amount of tax to be paid on future income generated by marginal investment decisions. Similarly, current taxable profits may be used to absorb future losses, thereby reducing the amount of tax to be paid on current losses (Altshuler and Auerbach, 1990). Thus at each point of time, the effective tax paid on an investment will vary according to the history of the company.

2. Taxation, Risk and the Cost of Investment

As discussed above, there are several sources of risk that affect investment decisions. The effect of taxes in the presence of each type of risk on investment decisions largely depends on the degree to which losses are refundable. As shown above, when losses are not refundable, the impact of taxes is to discriminate against risky investments.

- *Income risk.* When losses are fully refundable, taxes do not impact on the cost of capital in the presence of income risk.[42] However, when losses are not refundable, risky investments are discouraged, as shown in the example

[42] It is assumed that capital is reversible, a point that we turn to later.

above. Tax rates vary depending on the history of the firm — effective tax rates are lowest when firms have past losses that shelter income taxation and are highest when firms are starting up or future profits are highly uncertain (Mintz, 1988).

- *Capital risk.* When firms face capital risk, the tax system could penalise risky investments since governments do not share the gains and losses arising from uncertain economic depreciation (Bulow and Summers, 1984). Under most tax systems, depreciation allowances are based on the historical rather than the replacement cost of investment. Thus the tax depreciation allowances will be too little (generous) when economic depreciation is more (less) costly than expected. Taxes will generally increase the cost of risky capital investments unless tax depreciation allowances and other write-offs (such as investment tax credits) are so generous that the tax system subsidises the replacement cost of investment (McKenzie and Mintz, 1992).
- *Financial risk.* As financial risk increases the cost of borrowed funds for firms, such costs are deductible from corporate income for tax purposes. Thus the tax system provides an implicit deduction for such risks. However, certain costs upon bankruptcy may not be deductible since no income is available to absorb tax losses. Thus the existing asset holders may find that some expenses associated with bankruptcy will not be deductible which, if anticipated, will result in higher interest payments demanded for loans.
- *Inflation risk.* When a tax is fully indexed for inflation as found in a number of Latin American countries, taxes will not affect the risk associated with uncertain inflation rates. However, without indexation, taxes will affect inflation risk faced by firms. Conceptually, the effect of taxes in the presence of inflation risk is similar to the results arising from the lack of inflation accounting for tax purposes. Uncertain inflation affects the future income of businesses, the replacement cost of assets and inflation-adjusted interest expenses. For example, when inflation is higher than expected, the firm will earn greater profits (which are taxed unless the firm is in a loss position), incur higher replacement cost for assets (which are not accounted for by historical tax depreciation allowances) and incur a capital gain resulting from a lower real value of debt liabilities. The first two impacts of inflation on income and capital costs would increase the tax penalty on capital, while the latter impact on real debt liabilities would lower the effect of inflation on capital costs. The net effect depends on the degree to which firms finance capital with debt.

- *Irreversibility risk.* When capital investments are irreversible, firms face an additional cost associated with the inflexibility of capital (Nickell, 1978; Dixit and Pindyck, 1993). Similarly to the case of capital risk, taxes can increase the cost of irreversible investment since the cost of inflexibility is

not deductible from the corporate income tax base (see Mackie-Mason (1990b) and McKenzie (1994)).

This point can be illustrated as follows. Using our previous example, suppose that an investment could either[43] (i) be undertaken immediately, thereby earning either a 30 per cent or –10 per cent rate of return with equal chance in the future, or a risk-adjusted return of 6 per cent (the expected return is 10 per cent), or (ii) be delayed one year so that the investment is made knowing a certain 8 per cent rate of return is realised, otherwise no investment is made as the return will be negative.

Given that capital, once invested, is irreversible, there is a clear gain to the firm to delay implementing the project. The *option* value of delaying the project is the difference between the return on capital by postponing the investment by one period compared with the risk-adjusted return on capital by immediately investing in capital. In other words, a firm would be willing to pay a price to be given the option of rejecting a project in the future should it not be profitable. In this example, the option value of the project is 2 per cent of the investment cost, which reflects the difference between the certain rate of return of 8 per cent after delaying the investment and the risk-adjusted rate of return of 6 per cent if the investment is immediately made. One can think of the option value as a cost in addition to the depreciation and financing costs for irreversible investments.

With irreversible capital, the effect of taxes will depend on the degree of refundability. With full refundability, and as we determined earlier, the risky investment subject to a 25 per cent tax rate on returns would earn a risk-adjusted return of 4.5 per cent. By delaying one year to resolve uncertainty, the after-tax return would be 6 per cent. Thus, in the presence of taxes, the option value of delaying investment is 1.5 per cent of the cost of investment compared with the 2 per cent option value without taxes.

When there is no refundability, the risk-adjusted return on investment made immediately would be 2.5 per cent, as determined earlier. Given that delaying the investment would allow the firm to earn a 6 per cent return, then the option value of flexible investments is equal to 3.5 per cent of the investment cost in the presence of taxes rather than 2 per cent without taxes. Thus the option cost of irreversible investment is higher in the presence of non-refundable taxes.

In recent work (McKenzie, 1994), the effective tax rate on irreversible capital has been estimated. In the presence of risk, the effective tax rate is calculated by subtracting the riskless net-of-tax return on capital from the gross rate of return on capital (and dividing the difference by either the risk-adjusted gross or net rate of return on capital). To adjust the gross rate of return on capital for risk, the cost of risk in addition to economic depreciation

[43] Returns are expressed by taking into account timing differences.

must be subtracted from the cost of capital. McKenzie estimates effective tax rates for Canada and finds that, in aggregate, the 1992 effective tax rate on riskless reversible investments is 32 per cent, on reversible risky investments is 42 per cent and on risky irreversible investments is 48 per cent when the variability in future income is as high as 10 per cent. Thus the incorporation of risk can significantly affect the effective tax rate. Without more precise estimates of risk, it is difficult to determine the total impact of the tax system on investment (Shoven and Topper, 1992).

- *Political risk.* Policy decisions made by governments can affect the riskiness of investments in three ways.

  First, when firms anticipate tax changes, the cost of capital is affected by both current and future tax policy variables. For example, if corporate tax rates are reduced, firms are better off purchasing capital in the current period (when the deductions for expenses are at a high rate of tax) and delaying the earning of income until after the tax rate is lowered. As discussed above, the tax holiday is an example in which tax policies are anticipated to change. The incorporation of changes in tax rates or depreciation rates requires one to consider the time variation in the present value of depreciation allowances.[44]

  Second, uncertainty about government policy implies that tax rates and allowances will add to the riskiness of investment. Political risk in terms of future tax policies generally increases the cost of capital.

  Third, in the case of irreversible investment, uncertainty of tax policy adds to the option cost of undertaking projects that require capital to be sunk. In addition, the presence of irreversibility adds another dimension to tax policy considerations. When capital is sunk, governments may have the irresistible urge to tax such capital at a high rate in the future.

  This endogeneity of government decisions results in a problem of *time consistency* in tax policy whereby governments may wish to take actions in the future that would be different from what would be originally planned (see Kehoe (1989) and Persson and Tabellini (1992)). Once capital is sunk, taxation in future years has no effect on the use of capital. However, investors would anticipate governments taxing such capital heavily and so would fail to undertake investment currently to avoid excessive taxation in the future. Thus, to encourage investment, governments would need to commit themselves *credibly* to not increasing rates of tax on sunk capital in the future. The desire of a government to develop a reputation for not excessively taxing capital in future years may be sufficient in ensuring a commitment. Indeed, one finds that many governments often 'grandfather' old capital from changes in depreciation schedules or increases in excise tax rates. However, some governments may not last for ever, so, without worrying about

[44] See Auerbach and Hassett (1992), who provide explicit formulas for the cost of capital when tax rates change.

reputational effects, there is an incentive to shirk from a commitment not to tax old capital unless there is some cost associated with breaking the commitment. Some of the costs that might encourage governments to commit to tax rates that are not excessive on sunk capital include increased tax competition for foreign investment, tax evasion and concern for particular groups in society (for example, labour). If there is uncertainty about such commitments, tax policy variables will affect the risk cost faced by firms.

VI. WHO PAYS THE CORPORATE TAX?

An old but important question in public finance is the following: 'who pays for the corporate tax?'. As discussed in the introduction to this survey, corporations are only institutions but they are favourite subjects for taxation. Yet corporations do not pay taxes — people do! So who pays the corporate tax? Are corporate taxes shifted forward through higher consumer prices or backwards onto workers and shareholders in terms of lower factor incomes? Is the corporate tax progressive (falling more heavily on the rich) or regressive (falling more heavily on the poor)? Below, several arguments are only considered briefly.

The original contribution of Kryzaniuk and Musgrave (1963) argues that corporations shift forward taxes to consumers as higher prices (thereby lowering the real income of consumers). Their empirical work suggested that corporate after- tax rates of return on capital remain unaffected, suggesting that corporate taxes have no impact on the returns earned by shareholders. Depending on how prices are affected, the shifting forward of the corporate tax can be progressive or regressive. If necessity industries such as housing and food are more highly taxed than luxury good industries, then the corporate tax will fall more heavily on lower-income than higher-income individuals. Otherwise, the converse may be true.

In the seminal work of Harberger (1962), the corporate tax was found to fall largely on shareholders. Harberger considered an economy with labour and capital used in the production of goods offered by a capital-intensive corporate and a labour-intensive non-corporate sector. Capital and labour were freely mobile between the two sectors, although fixed in aggregate. The corporate tax was seen as an additional levy on the corporate sector (where in the US there is no integration of corporate and personal taxes). In Harberger's model, the corporate income tax has two impacts. First, the corporate tax increases the cost of using capital in the corporate sector, thereby discouraging the use of capital and increasing the demand for labour (this is referred to as the *substitution effect*). Second, the corporate tax increases the cost of goods produced by the taxed sector relative to the untaxed sector, thereby causing the relative price of corporate goods to increase and demand to shift from the corporate to non-corporate sectors (this is referred to as the *output effect*). Given that the corporate sector is more capital-intensive, the shift in demand results in more

capital relative to labour being released from the corporate sector than the labour-intensive non-corporate sector would demand. Given that these impacts reinforce each other, the corporate income tax is largely borne by shareholders and is therefore progressive.

The Harberger model is appropriate for closed economies with a fixed capital supply. In dynamic models with variable savings, corporate taxes would reduce capital demands and the amount of savings available. If savings are perfectly elastic with respect to the interest rate, the after-tax return on savings cannot adjust downwards, so corporate taxes would have to be shifted forward. Domestic savings, however, are not perfectly elastic with respect to the interest rate, so a model with dynamic considerations would suggest that the corporate tax would fall in part on shareholders.

In open economies, particularly small ones, the above conclusions are subject to revision. If the interest rate faced by firms is determined by international markets and is not influenced by the domestic demand or supply of capital, the corporate tax cannot affect after-tax returns earned by shareholders. Instead, given the relative immobility of labour, especially unskilled labour, at the international level, the corporate tax will be shifted back on fixed factors (labour and land). For a small open economy, this implies that the corporate tax could be regressive, especially if lower-paid unskilled workers must bear the brunt of the corporate tax.

There is little economic evidence that can be used to answer the question, 'who pays the corporate tax?'. Economic studies on the incidence of taxes will use various assumptions to analyse the impact of the corporate tax on the distribution of income (Whalley, 1984) ranging from full forward shifting to backward shifting. This lack of empirical work on the distributive effects of the corporate tax is rather troubling since the degree to which corporations are taxed is one of the most important political issues to be found in many industrialised countries.

VII. CONCLUSIONS

This survey provides an extensive discussion of several topics related to corporate taxation. The topics include: (i) policy objectives, (ii) investment effects, (iii) financing of firms, (iv) risk and (v) distributive effects.

Yet this survey is not nearly exhaustive enough, since several important topics have not been considered. There has been little discussion of the impact of corporate taxation on inbound and outbound investment, and recent work on the taxation of international capital flows has not received attention here. Questions regarding competition for capital flows and policy harmonisation in an international framework have also not been considered. Nor have the efficiency effects of the corporate tax been considered, especially in an open economy, as well as compliance costs associated with the corporate tax.

Economists, however, have come a long way in the past several decades in understanding the function and effects of the corporate tax. As indicated by the many issues raised by this survey, the corporate tax will remain an exciting topic for analysts for some time to come.

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