Chapter 4 Corporate Taxation

4.1 Introduction

The corporation is treated as a separate entity for tax purposes in all developed countries. It has been subject of numerous tax instruments with a variety of different motivations. The transfers between the corporation and its stock-holders result in the behavior of the corporation also being influenced by the structure of the personal tax system, most notably through the favorable tax treatment of capital gains.

There are two rationales for corporate taxation:

1. If the corporation is seen merely as earning income and transmitting this to its ultimate owners, then there is no reason why the corporation should be taxed. Instead, the tax liability should be placed upon its owners alone. This argument reflects the view that the corporation does not have a personality or existence of its own other than that given to it in law.

   In simple setting where shareholders exercise direct control, the corporation cannot be identified as an entity distinct from its owners. A coherent tax structure would then involve a comprehensive income tax on owners, covering all sources of earnings, with no need for separate taxation of the corporation.
2. The alternative perspective is that incorporation carries legal and economic privileges and that the corporation tax is a tax upon the gains enjoyed from the benefit of these privileges, in particular that of *limited liability*. Another privilege is that the tax falls primarily on *pure profits* and hence is less distortionary than taxes on other kinds of income. Perhaps most important in political terms is the belief that it is borne by corporations rather than individuals and is therefore relatively painless.

Ultimately (practically), the effect of a tax depends upon how it affects the individuals in the economy and the correctness, or otherwise, of taxing the corporation depends upon the *final incidence of the tax*. If the tax can achieve objectives that other taxes cannot, and so raise social welfare, then there is a justification for its existence.

4.2 Types of Taxes

There are many different types of tax that are imposed on firms.

1. Taxes on individual factors

The most common kind of tax on labor is a *payroll tax*, usually levied as a fixed percentage of the wage bills (e.g. the social security tax). The converse of a payroll tax is where the government provides *wage subsidies*.

The corporate profit tax is sometimes viewed as a tax on *the return to capital* in the corporate sector. But *the interest deductibility* implies that the tax falls primarily on *pure profits*, not on the return to capital. As there are wage subsidies, there are subsidies for investment: investment tax *credits or grants*.

Taxes on factors may be general taxes or confined to particular forms of *input* or to particular activities. Thus payments to bond holders are generally exempt from corporate profits tax and returns in the form of an increase in the value of an asset (*capital gains*) are treated differently from other returns. Dividends are taxed.

2. Taxes on total output or total input.

The Value Added Tax (VAT), a proportionate tax on the value added by the firm.

On *an income base*, value added is defined as wage payment plus the return to capital (net of depreciation) (equivalent to a uniform payroll tax plus an equal rate profits tax).

There are *the product base* and *the consumption base*, which is equivalent to a uniform payroll tax plus an equal rate profits tax with free depreciation.

Production and turnover taxes are levied on the value of *gross output* of a firm (e.g. The impact on the degree of integration in the economy needs to be considered. Gross turnover taxes may provide an incentive for vertical integration).

4.3 Changing Views of Corporate Income Tax[1]

In Table 1 I have tried to summarize the most well-known competing theories of corporate income taxation[2]. The statements regarding the cost of capital assume that taxable profits are equal to the true economic profits, *i.e.*, that depreciation for tax purposes corresponds to the true economic depreciation of the firm's assets[3]. The following sections provide some explanatory remarks to the table.

[1] This part is drawn from Sørensen (1999)
[2] For more detailed surveys, see Auerbach (1983), Poterba and Summers (1985), Sinn (1991a), or Sørensen (1995).
[3] In the next part of the paper, we shall consider the complications arising from deviations between taxable profits and true economic profits.

Table 1 Alternative Views of the "Classical" Corporate Tax System

Theory		Influence of Nontax Factors on Corporate Financing Decisions	Marginal Source of Finance	Marginal Use of Profits	Cost of Corporate Capital [a]	Effect of Dividend Tax Relief
"Old" view [b]		Important	New equity important	Dividend payments	High above market interest rate	Significant stimulus to corporate investment
Neutrality view [c]		Unimportant	Debt	Financial investment in capital market	Equal to market interest rate	No stimulus to investment
"New" view [d]		Unimportant	Retained earnings	Dividend payments	Slightly above market interest rate	Windfall gains to existing shareholders; no investment stimulus
"Nucleus" theory of the firm [e]	Growth phase	Unimportant	At time of establishment: new equity after time of establishment: retained earnings	Reinvestment in real capital	Starting very high above market interest rate, but falling over time	Significant stimulus to the establishment and growth of new corporations
	Maturity phase	Unimportant	Retained earnings	Dividend payments	Slightly above market interest rate	Windfall gains to existing shareholders; no investment stimulus

[a] The statements in this column assume true economic depreciation.
[b] Elaborated by numerous writers over the years, but heavily influenced by Harberger (1962, 1966).
[c] Reaching its most developed form in Stiglitz (1973).
[d] Developed and elaborated by King (1974a, b, 1977), Auerbach (1979), Bradford (1980, 1981) and Sinn (1985).
[e] Developed by Sinn (1991b).

The "Old" View of the Corporation Tax

According to the traditional view – also referred to as the "old" view – a classical corporate tax system will distort the financing as well as the real investment decisions of corporations. Since interest payments are deductible from the corporate income tax base, hence escaping double taxation, there is a tendency for debt finance to be substituted for equity finance. Moreover, since the shareholder's personal tax on capital gains is deferred until the time of realization, whereas his dividend income is taxed immediately, corporations are induced to generate capital gains to shareholders by retaining part of their profits rather than paying them out as dividends. To some extent, the substitution of debt finance for equity finance and the replacement of new equity by retained profits will reduce the impact of taxation on the cost of corporate capital. However, according to the old view, corporations will still wish to rely on some amount of equity finance at the margin, including some amount of new equity. The double taxation of corporate equity income will therefore reduce the overall level of saving and investment and drive the required pretax rate of return on corporate investment above the pretax rate of return required in the noncorporate sector. As a result, too little capital is allocated to the corporate sector, and too much is allocated to the noncorporate sector, as seen from society's viewpoint.

To explain why corporations would want to use some amount of equity finance at the margin despite the tax-preferred status of debt finance, the holders of the old view typically argue that high debt equity ratios generate certain invisible costs stemming from the risks of

financial distress and bankruptcy. At some leverage ratio well below a hundred percent the rise in these costs will outweigh the tax benefits of increased reliance on debt finance.

The old view also assumes that shareholders have a nontax preference for dividends over capital gains on shares. Other things equal, shareholders will thus require a lower after-tax return on shares in corporations with higher dividend pay-out ratios. Up to a point, the corporation is therefore able to reduce its cost of equity finance by raising its pay-out ratio. Since new share issues increase the ability of the corporation to pay dividends to existing shareholders, it becomes optimal for the value-maximizing corporation to rely to some extent on new equity rather than using only retained profits as the source of equity finance. In principle, the corporation will raise its dividend pay-out ratio to the point where the marginal nontax benefits from increased dividend payments are just offset by the tax penalty on dividends, with the tax penalty being equal to the difference between the personal tax rate on dividends and the effective personal tax rate on (accrued) capital gains on shares.

Proponents of the old view do not always make very clear why shareholders would require lower net returns on shares with higher dividend pay-out ratios. The most popular hypothesis is that dividends serve as a signal to the stock market that the corporation is financially healthy and faces bright earnings prospects. Critics have found this theory rather unconvincing, arguing that a corporation faced with profitable investment opportunities should retain and reinvest its profits rather than paying them out.

The Neutrality Hypothesis

The critics of the old view tend to downgrade the importance of nontax factors for corporate financing decisions. The point of departure for these skeptics is the so-called Modigliani-Miller theorem, according to which shareholders would be indifferent to the corporation's financial policy in a world without taxes, since investors would always be able to neutralize the effects of the firm's borrowing and dividend policy on the risk-return profiles of their personal portfolios by selling from or borrowing against their portfolios. If the various modes of finance are in fact equally attractive from a nontax point of view, it follows that the corporation should rely exclusively on the source of finance that is most favored by the tax system.

In most countries, the mode of finance would be debt, because equity-financed investment tends to be subject to double taxation. If debt is used as the marginal source of finance, and taxable profits coincide with actual profits, it will be profitable for the corporation to carry its real investment to the point where the risk-adjusted marginal pretax rate of return is just equal to the (deductible) market rate of interest before tax. In other words, the optimal investment policy of the corporation would be identical to the optimal policy in a hypothetical world of

zero taxes, and the corporation tax would be neutral, falling only on the inframarginal profits exceeding the market interest rate.

Stiglitz (1973) argued that the corporate income tax will also be neutral if the total corporate and personal tax burden on retained earnings is lower than the personal tax on interest income so that finance by retentions is tax-preferred to debt finance. In this situation – which Stiglitz believed to prevail in the U.S. before the 1981 tax reform – the corporation should undertake retentions-financed real investment until the marginal rate of return becomes equal to the market interest rate, and the remaining profits (if any) should be used for financial investment in the capital market. In the absence of nontax benefits from dividend payments, it is not rational to pay out any dividends if distributions are penalized by the tax system, and if financial investment undertaken through the corporation is taxed more lightly than financial investment undertaken directly by the shareholders themselves[4]. Furthermore, it would obviously not be rational for the corporation to carry out real investment with a return below the market interest rate when it could alternatively invest in financial assets. It should be clear that such a tax regime is really equivalent to a regime of debt finance: to increase its real investment by one dollar, the corporation will have to reduce its financial investment by one dollar, so the opportunity cost of real investment is the interest rate that might have been earned in the capital market. In short, the cost of corporate capital equals the going interest rate, and again the corporation tax falls only on the inframarginal investments with returns above the market rate of interest.

The "New" View

The neutrality hypothesis does not square with the observations that most corporations do tend to pay dividends on a regular basis and that they rarely rely exclusively on debt finance at the margin. The so-called "new" view of the corporation tax assumes that corporations pay dividends and accepts the fact that firms will typically wish to use some amount of equity finance at the margin. However, according to the new view there is no convincing reason why shareholders should prefer a dollar of net dividend to a dollar of net capital gain on shares. Instead, it is argued that a mature corporation earning sufficient profits should meet all of its need for equity finance through retentions and should pay out only the remaining profit as dividends. A mature corporation operating under a classical corporate tax system should never substitute new share issues for retained earnings, since this would transform lightly taxed capital gains on shares into more heavily taxed dividends.

Since the new view assumes that retained profits are the marginal source of corporate

[4] For the corporation to have a positive market value, it must ultimately return cash to its shareholders. Stiglitz (1973) assumed that this would be done by liquidating the firm at some point.

finance, it implies that the corporation's marginal investment will generate an additional capital gains liability for shareholders, because increased retentions will tend to raise the market value of outstanding shares. If the combined corporate and personal tax burden on retentions (i.e., the sum of the corporate income tax on retentions and the personal tax on capital gains on shares) exceeds the shareholder's personal tax on interest income, the required rate of return on corporate investment will exceed the market interest rate.

On the other hand, the new view has the striking implication that taxes on *distributed profits are neutral*. While it is true that dividend taxes reduce the shareholder's income from additional investment, they also reduce his opportunity cost of allowing the firm to retain profits for further investment. Thus, if the total corporate and personal tax burden on a dollar of distributed profits is 50 cents, the shareholder only has to give up a net income of 50 cents for each dollar retained for investment by the corporation. This 50 percent reduction of the opportunity cost of investment fully compensates for the 50 percent dividend tax levied when the profits on the extra investment are ultimately paid out, leaving the shareholder's net return unaffected by the tax burden on distributions. Hence, taxes on dividends have no influence on the cost of corporate capital, but are merely capitalized in share prices in order to ensure that investment in shares is just as attractive as investment in interest-bearing assets, despite the double taxation of dividends. One may also say that equity is "trapped" within the corporation in the sense that the funds accumulated within the firm will inevitably have to bear the dividend tax, whether distributions are made now or later. For a constant dividend tax rate, an investment policy that maximizes the present value of distributions before dividend tax will therefore also maximize the present value of dividends after tax. Hence the neutrality of the dividend tax.

The new view thus implies that measures to alleviate the double taxation of dividends will not stimulate corporate investment, leading only to a windfall gain to existing shareholders and a corresponding loss of government revenue. According to the new view, policymakers should focus instead on the double taxation of *retained earnings* resulting from the coexistence of the corporate income tax and the personal tax on capital gains on shares. However, since the effective tax rate on accrued capital gains is typically rather low because the tax is deferred until the time of realization of the gain, the new view also suggests that the problem of double taxation is not very serious and that the cost of corporate capital is probably not very far above the market interest rate, even in countries like the United States where realized long-term capital gains on shares are included in the personal income tax base[5].

[5] Critics have argued that the surge in share repurchases observed in the United States during the last decade undermines the assumption underlying the new view that cash distributions to shareholders take the form of dividends. However, as Sinn (1991a, sec. 7.1) has demonstrated, a corporation financing its marginal investment by new share issues (or, equivalently, by a reduction in share repurchases) and using its marginal profits to

Reconciling the Old and the New View: The "Nucleus" Theory of the Firm

If revenue-generating dividend taxes are neutral, one might be tempted to conclude that policy makers should *increase* the tax burden on dividends rather than worry about measures to alleviate the existing double taxation. This conclusion would be too hasty, however, since the new view explained above applies only to mature firms earning sufficient profits to be able to meet their need for equity finance through retained earnings. Holders of the new view do not deny that newly established firms or rapidly growing firms that have to rely on new share issues will face a higher cost of capital when dividends are subject to double taxation. Since shareholders are not entitled to a tax deduction for their purchase of shares, their opportunity cost of investment will not be reduced by the dividend tax rate, as is the case when the firm finances investment by with-holding dividends. The net return to investment will therefore be reduced by the full amount of the dividend tax, and the cost of capital will be correspondingly higher, when new equity is the marginal source of finance and marginal profits are paid out as dividends.

It would thus seem that the old view may be relevant for immature or rapidly growing firms even if the new view provides a correct description of mature firms. Yet, it has been argued by Sinn (1991b) that the cost of capital for an immature firm will be even *higher* than predicted by the old view. The old view suggests that a corporation that is about to be set up should immediately issue the amount of shares necessary to carry investment to the point where the marginal return just compensates for the extra tax on dividends relative to interest income. However, Sinn (1991b) points out that if retentions are taxed more lightly than distributions, it may be optimal for a corporation in the start-up phase to issue a smaller amount of shares than this investment rule would suggest. The reason is that the tax system provides an incentive to postpone investment until the firm begins to make profits so that it can finance investment out of tax-preferred retentions. If it only has a limited number of investment projects with above-normal rates of return, the new firm foregoes the possibility of financing these investments by "cheaper" capital (retentions) at a later date if it raises new equity today in order to implement all projects at once. The loss of the opportunity to use a cheaper mode of finance at a later stage represents an additional opportunity cost of current investment for the immature firm that must be added to the cost of capital.

According to Sinn (1991b), a new corporation should therefore issue only a limited amount of new shares at the time of foundation – *i.e.*, it should start only with a small "nucleus" of equity – in order to carry out only the most profitable of its planned investment projects. The remaining projects with relatively high returns should be financed exclusively out of retained

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repurchase shares would in fact have exactly the same cost of capital as implied by the new view.

earnings in the subsequent growth phase of the firm, and no dividends should be paid during this phase, since this would transform lightly taxed capital gains into heavily taxed dividends. The greater the tax discrimination against distributions relative to retentions, the lower should be the initial injection of equity, and the greater should be the volume of investment financed by retentions in the subsequent growth phase. The growth phase comes to an end when the capital stock has expanded to the point where additional investment no longer yields above-normal rates of return. The corporation then enters the stage of maturity, where net investment becomes zero and where profits are paid out as dividends. In this phase, the "trapped-equity" argument applies, *i.e.*, the dividend tax becomes neutral, and the cost of capital becomes equal to the value implied by the new view. The point is, however, that under very mild conditions the initial cost of capital is even *higher* than suggested by the *old* view at the time the firm is set up. Moreover, the cost of capital remains above the value predicted by the new view during the drive to maturity. The reason is that the gradual fall in the marginal productivity of capital during the growth phase will generate a gradual capital loss to shareholders for which they must be compensated by an above normal rate of return on the corporation's real investment.

Notice the paradoxical implication of this dynamic theory of the corporate firm: the double taxation of dividends will drive up the cost of capital during the growth phase where the firm does *not* pay dividends and no dividend tax is collected, whereas the dividend tax will be neutral in the maturity phase where dividends are actually paid and the tax begins to yield revenue!

Table 2 Effects of the Corporate Tax System under Alternative Accounting Regimes[a]

Accounting Regime	**Role of Monitoring Costs**		
	Unimportant	Significant monitoring cost savings from debt finance	Significant monitoring cost savings from external finance
Uniform reporting ("One-book" system)	Corporate income tax rate neutral Dividend taxation neutral Investment stimulated by accelerated depreciation	Corporate income tax rate neutral Dividend taxation neutral Accelerated depreciation ineffective	Corporate income tax rate non-neutral Dividend taxation non-neutral Accelerated depreciation ineffective
Separate reporting ("Two-book" system)	Corporate income tax rate non-neutral ("taxation paradox") dividend taxation neutral Investment stimulated by accelerated depreciation		Corporate income tax rate non-neutral Dividend taxation non-neutral Investment stimulated by accelerated depreciation

[a] The table summarizes the finding of Kanniainen and Södersten (1994a, b) and Sørensen (1994, 1995). All results reported in the table are based on the assumption that marginal profits are paid out as dividends.

The recent theories stressing the importance of accounting conventions for the cost of

corporate capital are summarized in Table 2. As stated in the table, the presence of monitoring cost savings from debt finance does not eliminate the firm's incentive to take full advantage of allowances for accelerated depreciation under separate reporting (see Sørensen, 1994, Appendix). The reason is that this accounting regime does not constrain the use of debt finance to the same extent as the regime of uniform reporting.

It should be added that the monitoring-cost theory sketched here is not the only possible explanation why corporations in "one-book" (uniform-reporting) countries may not wish to exploit all available depreciation allowances. As Cummings, Harris, and Hassett (1994) has pointed out, firms in one-book countries may also be reluctant to claim all potential tax benefits if reductions in taxable income may be misinterpreted by financial markets as signals of lower profitability. Indeed, these authors find empirical evidence that investment in one-book countries is less sensitive to tax-law changes than investment in "two-book" countries allowing separate reporting. This underscores the importance of analyzing a country's accounting regime when evaluating the incentive effects of the corporation tax.

Profit tax

With full allowance for capital expenditure, the firm will optimize, by choice of capital and labor, the level of after-tax profits are given by

$$\pi = (1 - t_c)\left[pF(K, L) - wL - rK \right] \tag{1}$$

As the first-order conditions for profit maximization,

$$p\frac{\partial F}{\partial k} = r \qquad\qquad p\frac{\partial F}{\partial L} = w$$

the firm's optimal choice of inputs is unaffected by the imposition of the tax.

The results are modified if *payments to capital* can not be deducted before tax.

$$\pi = (1 - t_c)\left[pF(K, L) - wL \right] - rK \tag{2}$$

rK can be interpreted as *the cost of capital*,

The definition of tax base is the key. There are difficulties in depreciation, depletion, inventory accumulation, capital gains and losses, and intercorporate dividends.

4.4 Financial Structure

The analysis focuses on the fundamental financial identity of the firm.

1. gross profits $\pi = pF - wL$
2. New bond issues $B_{t+1} - B_t$
3. New equity issues $\theta_{t+1} - \theta_t$

We can identify the following disbursements:

1. dividends D_t
2. interest payments to bondholders rB_t
3. investment I_t

The fundamental relationship is that revenues equal disbursements are period *t*.

$$\pi_t + B_{t+1} - B_t + \theta_{t+1} - \theta_t = D_t + I_t + rB_t \tag{3}$$

Retained earnings,

$$RE_t = \pi_t - rB_t - D_t \tag{4}$$

Then (3) becomes

$$I_t = RE_t + (B_{t+1} - B_t) + (\theta_{t+1} - \theta_t) \tag{5}$$

Investment is financed by retained earnings, borrowing or new equity issues.

In the absence of taxation, the net financial flow from the corporation to the personal sector is

$$Y_t = D_t + rB_t - (B_{t+1} - B_t) - (\theta_{t+1} - \theta_t) \tag{6}$$

This is equal to $Y_t = \pi_t - I_t$.

The net flow is determined by the real variables and does not depend at all on the financial structure. It is formally stated in the following:

The Modigliani-Miller Theorem: in the absence of taxation and bankruptcy, corporate financial policy is irrelevant and has no effect on the value of the firm.

We introduce the tax system (*the classical system*)

1. corporate profits tax t_c
2. interest payments by corporations are deductible.
3. interest payments by individuals are deductible at the personal tax rate, t_p.
4. dividends and interest received are taxable at t_p.
5. capital gains are taxable at $t_g < t_p$.

One problem with the classical system is the double taxation of dividends: they are taxed once as corporate profit and then again as personal income.

The imputation system attempts to avoid this double taxation by integrating the corporate and personal tax systems. It does this by giving each shareholder a credit for the tax paid by the company on the profit out of which dividends are paid. In essence, any profits distributed as dividends are deemed to have already been subject to personal tax at what is known as *the rate of imputation*. The shareholder receiving the dividend is then only liable for the difference between the rate of imputation and their personal tax rate.

With this tax system, the corporate tax liability is $t_c(\pi_t - rB_t)$ and the financial identity is,

$$\pi_t(1-t_c) + (B_{t+1} - B_t) + (\theta_{t+1} - \theta_t) = D_t + I_t + r(1-t_c)B_t \qquad (7)$$

For the personal sector, there is liability to income tax and capital gains tax, so that the net financial flow after tax is

$$Y_t = (D_t + rB_t)(1-t_p) - (B_{t+1} - B_t) - (\theta_{t+1} - \theta_t) \qquad (8)$$

A further alternative system that has been employed in U.K., Germany and Japan is *the two-rate (split-rate) system*. Under this system, different tax rates apply to distributed and undistributed profits with the latter being taxed at a higher rate.

The main reason for this system is not to alleviate the double taxation of dividends in view of integration, but to improve the working of the securities markets and encourage saving and investment.

Table 3 Types of Corporate Taxation in OECD, 1987

Type of Taxation	Country
Separate Corporate Tax (X)	
Pure Classical system	Australia
Slight alleviation at company level (X1)	Sweden
Slight alleviation at shareholder level (X2)	USA (Japan)
Partial Integration (Y)	
At company level (split rate) (Y1)	Japan (Germany)
At shareholder level (imputation) (Y2)	
Credit for company tax actually withheld (Y2(a))	UK
Credit for domestic tax deemed to have been paid (Y2(b))	Canada
Full Assimilation (Z)	
At company level (Z1)	Greece
At shareholder level (Z2)	Germany

Source: OECD (1987) p.86.

Table 3 illustrates many ways of avoiding the double taxation of dividends in 1987. As we discussed above, there are three broad types of the corporate tax system: the separate system (X), the split rate system (Y1), and the imputation system (Y2). The full assimilation (full integration) does not seem to be a practical method of integration.

According to Ishi (1993, pp.187-8), Japan is characterized by a hybrid type of integration system combining X2 and Y1. Under the X2 method the shareholder can receive a credit for part of the corporate tax paid on dividends, while the Y1 method admits to tax distributed profits at a lower rate than retained profits. It is often explained that the double taxation of dividends is partially alleviated at both the shareholder and the company level.

In 1990, this hybrid system was partially changed into the present form, i.e., the Y1 method was abandoned and the X2 method alone was retained to lighten the double taxation of dividends.

For details in relative advantages in means of finance under the different tax systems and the different rates (see Atkinson and Stiglitz (1980), pp.132-142).

Taxation and Corporate Finance[6]

Debt financing has one important advantage under the corporate income tax system in many countries. The interest that the company pays is a tax-deductible expense. Dividends and retained earnings are not. Thus the return to bondholders escapes taxation at the corporate level.

Table 4 shows simple income statements for firm U, which has no debt, and firm L, which has borrowed $1,000 at 8 percent. The tax bill of L is $28 less than that of U. This is the *tax shield* provided by the debt of L. In effect the government pays 35 percent of the interest

[6] This section draws heavily from Brealey and Myers (1996, Chapter 18).

expense of L. The total income that L can pay out to its bondholders and stockholders increases by that amount.

Tax shields can be valuable assets. Suppose that the debt of L is fixed and permanent (that is, the company commits to refinance its present debt obligations when they mature and to keep "rolling over" its debt obligations indefinitely). It looks forward to a permanent stream of cash flows of $28 per year. The risk of these flows is likely to be less than the risk of the operating assets of L. The tax shields depend only on the corporate tax rate[7] and on the ability of L to earn enough to cover interest payments. The corporate tax rate has been pretty stable (it did fall from 46 to 34 percent after the Tax Reform Act of 1986, but that was the first material change since the 1950s). And the ability of L to earn its interest payments must be reasonably sure – otherwise it could not have borrowed at 8 percent[8]. Therefore we should discount the interest tax shields at a relatively low rate.

Table 4

The tax deductibility of interest increases the total income that can be paid out to bondholders and stockholders.

	Income Statement of Firm U	Income Statement of Firm L
Earnings before interest and taxes	$1,000	$1,000
Interest paid to bondholders	0	80
Pretax income	1,000	920
Tax at 35%	350	322
Net income to stockholders	$650	$598
Total income to both bondholders and stockholders	$0+650=$650	$80+598=$678
Interest tax shield (.35 x interest)	$0	$28

But what rate? The most common assumption is that the risk of the tax shields is the same as that of the interest payments generating them. Thus we discount at 8 percent, the expected rate of return demanded by investors who are holding the firm's debt:

$$\text{PV (tax shield)} = \frac{28}{.08} = \$350$$

In effect the government itself assumes 35 percent of the $1,000 debt obligation of L.

Under these assumptions, the present value of the tax shield is independent of the return on the debt r_D. It equals the corporate tax rate T_c times the amount borrowed *D*:

[7] Always use the marginal corporate tax rate, not the average rate. Average rates were often much less than that because of accelerated depreciation and various other adjustments.

[8] If the income of L does not cover interest in some future year, the tax shield is not necessarily lost. L can "carry back" the loss and receive a tax refund up to the amount of taxes paid in the previous 3 years. If L has a string of losses, and thus no prior tax payments that can be refunded, then losses can be "carried forward" and used to shield income in subsequent years.

$$\text{Interest payment} = \text{return on debt} \times \text{amount borrowed}$$
$$= r_D \times D$$
$$\text{PV (tax shield)} = \frac{\text{corporate tax rate} \times \text{expected interest payment}}{r_D}$$
$$= \frac{T_c(r_D D)}{r_D} = T_c D$$

Of course, PV (tax shield) is less if the firm does not plan to borrow permanently, or if it may not be able to use the tax shields in the future.

Modigliani and Miller (MM)'s theorem I amounts to saying that "the value of a pie does not depend on how it is sliced." The pie is the firm's assets, and the slices are the debt and equity claims. If we hold the pie constant, then a dollar more of debt means a dollar less of equity value.

But there is really a third slice, the government's. Look at Table 4. It shows an *expanded* balance sheet with *pretax* asset value on the left and the value of the government's tax claim recognized as a liability on the right. MM would still say that the value of the pie – in this case *pretax* asset value – is not changed by slicing. But anything the firm can do to reduce the size of the government's slice obviously makes stockholders better off. One thing it can do is borrow money, which reduces its tax bill and, as we saw in Table 4, increases the cash flows to debt and equity investors. The *after-tax* value of the firm (the sum of its debt and equity values as shown in a normal market value balance sheet) goes up by PV (tax shield).

MM and Taxes

We have just developed a version of MM's theorem I as "corrected" by them to reflect corporate income taxes[9]. The new proposition is

$$\text{Value of firm} = \text{value if all-equity-financed} + \text{PV (tax shield)}$$

In the special case of permanent debt,

$$\text{Value of firm} = \text{value if all-equity-financed} + T_c D$$

MM were not that fanatical about it. No one would expect the formula to apply at extreme debt ratios. But that does not explain why firms not only exist but thrive with no debt at all. It is hard to believe that the management is simply missing the boat.

Therefore we have argued ourselves into a corner. There are just two ways out:

1. Perhaps a fuller examination of corporate *and personal* taxation will uncover a tax disadvantage of corporate borrowing, offsetting the present value of the corporate tax

[9] MM's original article Modigliani F. and M.H. Miller (1958), recognized interest tax shields but did not value them properly. They put things right in their 1963 article Modigliani F. and M.H. Miller (1963).

shield.

2. Perhaps firms that borrow incur other costs – bankruptcy costs, for example – offsetting the present value of the tax shield.

We will now explore these two escape routes.

Corporate and Personal Taxes

When personal taxes are introduce, the firm's objective is no longer to minimize the *corporate* tax bill; the firm should try to minimize the present value of *all* taxes paid on corporate income. "All taxes" include *personal* taxes paid by bondholders and stockholders.

Figure 1 illustrates how corporate and personal taxes are affected by *leverage*. Depending on the firm's capital structure, a dollar of operating income will accrue to investors either as debt interest or equity income (dividends or capital gains). That is, the dollar can go down either branch of Figure 1.

Notice that Figure 1 distinguishes between T_p, the personal tax rate on interest, and T_{pE}, the effective personal rate on equity income. The two rates are equal if equity income comes entirely as dividends. But T_{pE} can be less than T_p if equity income comes as capital gains. After 2004, the top rate on ordinary income, including interest and dividends, was 35 percent. The rate on *realized* capital gains was 15 percent[10]. However, capital gains taxes can be deferred until shares are sold, so the top *effective* capital gains rate can be less than 15 percent.

The firm's objective should be to arrange its capital structure so as to maximize after-tax income. You can see from Figure 1 that corporate borrowing is better if $1-T_p$ is more than $(1-T_{pE})\times(1-T_c)$; otherwise, it is worse. The relative tax advantage of debt over equity is

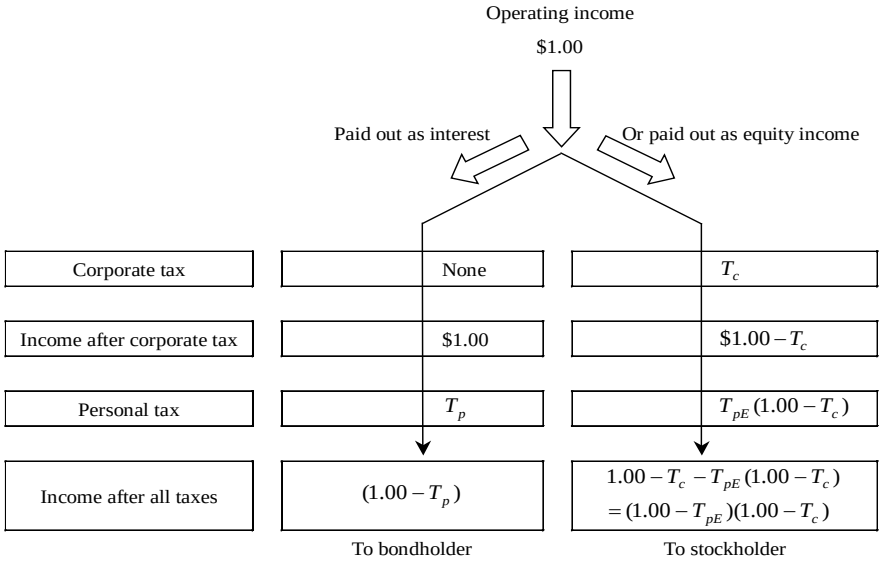
$$\text{Relative tax advantage of debt} = \frac{1-T_p}{(1-T_{pE})(1-T_c)}$$

This suggests two special cases. First, suppose all equity income comes as dividends. Then debt and equity income are taxed at the same effective personal rate. But with $T_{pE}=T_p$, the relative advantage depends only on the *corporate* rate:

[10] Note that we are simplifying by ignoring *corporate* investors, for example, banks, that pay top rates of 35 percent. Of course, banks shield their interest income by paying interest to lenders and depositors.

Figure 1

The firm's capital structure determines whether operating income is paid out as interest or equity income. Interest is taxed only at the personal level. Equity income is taxed at both the corporate and the personal levels. However, T_{pE}, the personal tax rate on equity income, can be less than T_p, the personal tax rate on interest income.



$$\text{Relative advantage} = \frac{1-T_p}{(1-T_{pE})(1-T_c)} = \frac{1}{1-T_c}$$

In this case, we can forget about personal taxes. The tax advantage of corporate borrowing is exactly as MM calculated it[11]. They do not have to assume away personal taxes. Their theory of debt and taxes requires only that debt and equity be taxed at the same rate.

This case can happen only if T_c, the corporate rate, is less than the personal rate T_p *and* if T_{pE}, the effective rate on equity income, is small.

Merton Miller's "Debt and Taxes"

How does capital structure affect firm value investors have different tax rates? There is one model that may help us think through that question. It was put forward in "Debt and

[11] Of course, personal taxes reduce the dollar amount of corporate interest tax shields, but the appropriate discount rate for cash flows after personal tax is also lower. If investors are willing to lend at a prospective return *before* personal taxes of r_D, then they must also be willing to accept a return *after* personal taxes of $r_D(1-T_p)$, where T_p is the marginal rate of personal tax. Thus we can compute the value after personal taxes of the tax shield on permanent debt: $\text{PV(taxshield)} = \frac{T_c \times (r_D D) \times (1-T_p)}{rD \times (1-T_p)} = T_c D$. This brings us back to our previous formula for firm value: Value of firm = value if all-equity-financed + $T_c D$.

Taxes" Merton Miller's 1976 presidential address to the American Finance Association[12].

Miller was considering debt policy before the 1986 Tax Reform Act. He started by assuming that all equity income comes as unrealized capital gains and nobody pays any tax on equity income; T_{pE} is zero for all investors. But the rate of tax on interest depends on the investor's tax bracket. Tax-exempt institutions do not pay any tax on interest; for them T_p is zero. At the other extreme, millionaires paid tax at a rate of 50 percent on bond interest; for them T_p was .50. Most investors fell somewhere between these two extremes.

Consider a simple world with these tax rates. Suppose that companies are initially financed entirely by equity. If financial managers are on their toes, this cannot represent a stable situation. Think of it in terms of Figure 1. If every dollar goes down the equity branch, there are no taxes paid at the personal level (remember $T_{pE} = 0$). Thus the financial manager need consider only corporate taxes, which we know create a strong incentive for corporate borrowing.

As companies begin to borrow, some investors have to be persuaded to hold corporate debt rather than common stock. There should be no problem in persuading tax-exempt investors to hold debt. They do not pay any personal taxes on bonds or stocks. Thus, the initial impact of borrowing is to save corporate taxes and to leave personal taxes unchanged.

But as companies borrow more, they need to persuade taxpaying investors to migrate from stocks to bonds. Therefore they have to offer an incentive in the form of a higher interest rate on their bonds. Companies can afford to incentive investors to migrate as long as the corporate tax saving is greater than the personal tax loss. But there is no way that companies can give millionaires an incentive to hold their bonds. The corporate tax saving cannot compensate for the extra personal tax that those millionaires would need to pay. Thus the migrations stop when the corporate tax saving *equals* the personal tax loss. This point occurs when T_p, the personal tax rate of the migrating investor, equals the corporate tax rate T_c.

Let us put some numbers on this. The corporate tax rate T_c was 46 percent. We continue to assume that T_{pE}, the effective rate of tax on equity income, is zero for all investors. In this case, companies will incentivize investors with tax rates below 46 percent to hold bonds. But there is nothing to be gained (or lost) by persuading investors with tax rates *equal* to 46 percent to hold bonds. In the case of these investors $1 of operating income will produce income after all taxes of $.54, regardless of whether the dollar is interest or equity income:

	Income Remaining after All Taxes
Income paid out as interest	$1 - T_p = 1 - .46 = \$.54$
Income paid out as equity income	$(1 - T_{pE})(1 - T_c) = (1 - 0)(1 - .46) = \$.54$

[12] See Miller (1977).

In this equilibrium taxes determine the aggregate amount of corporate debt but not the amount issued by any particular firm. The debt-equity ratio for corporations as a whole depends on the corporate tax rate and the funds available to individual investors in the various tax brackets. If the corporate tax rate is increased, migration starts again, leading to a higher debt-equity ratio for companies as a whole. If personal tax rates are increased, the migration reverses, leading to a lower debt-equity ratio. If *both* personal and corporate tax rates are increased by the same amount – 10 percentage points, say – there is no migration and no change. That could explain why there was no substantial increase in the debt-equity ratio when the corporate income tax rose drastically at the start of World War II. Personal tax rates were simultaneously increased by about the same amount.

The companies in our example that first sold bonds to tax-exempt investors may have gained an advantage. But once the "low-tax" investors have bought bonds and the migrations have stopped, no single firm can gain an advantage by borrowing more or suffer any penalty by borrowing less. Therefore there is no such thing as an optimal debt-equity ratio *for any single firm*. The market is interested only in the *total* amount of debt. No single firm can influence that.

One final point about Miller's tax equilibrium: Because he assumes equity returns escape personal tax ($T_{pE} = 0$), investors are willing to accept lower rates of return on low-risk common stock than on debt. Consider a safe (zero-beta) stock. The standard capital asset pricing model would give an expected return of $r = r_f$, the risk-free interest rate. But the investor migrating from equity to debt gives up *r* and earns $r_f(1 - T_p)$, the *after-tax* interest rate. In equilibrium, the migrating investor is content with either debt or equity, so $r = r_f(1 - T_p)$. Moreover, that investor's T_p equals the corporate rate T_c. Therefore, $r = r_f(1 - T_c)$. If we accept Miller's argument lock, stock, and barrel, the security market line should pass through the after-tax risk-free interest rate.

The Bottom Line on Debt and Taxes

Miller's model was intended not as a detailed description of the United States tax system but as a way of illustrating how corporate and personal taxes could cancel out and leave firm value independent of capital structure. Nevertheless, the model's predictions are plausible only if the effective tax rate on equity income is substantially lower than that on interest, enough lower to offset the corporate interest tax shield. Under today's tax system, it's hard to see how Miller's model could work out as he originally intended. Even if there were no tax advantage to borrowing before the 1986 tax low changes, there ought to be one now.

The majority of financial managers and economists believe our tax system favors corporate

borrowing. But it's easy to overestimate the advantage. Analyses which calculate the present value of a safe, perpetual stream of corporate interest tax shields, must overestimate debt's net value added. As Miller's paper shows, the aggregate supplies of corporate debt and equity should adjust to minimize the sum of corporate and personal taxes; at the resulting equilibrium the higher personal tax rate on debt income should partially offset the tax deductibility of interest at the corporate level.

We should also reconsider the assumption that the corporate tax shield on debt is a constant 35 percent regardless of the amount borrowed. In practice few firms can be *sure* they will show a taxable profit in the future. If a firm shows a loss and cannot carry the loss back against past taxes, its interest tax shield must be carried forward with the hope of using it later. The firm loses the time value of money while it waits. If its difficulties are deep enough, the wait may be permanent and the interest tax shield lost forever.

Notice also that borrowing is not the only way to shield income against tax. Firms have accelerated write-offs for plant and equipment. Investment in many intangible assets can be expensed immediately. So can contributions to the firm's pension fund. The more that firms shield income in these other ways, the lower the expected tax shield from borrowing[13].

Thus corporate tax shields are worth more to some firms than to others. Firms with plenty of noninterest tax shields and uncertain future prospects should borrow less than consistently profitable forms with lots of taxable profits to shield. Firms with large accumulated tax-loss carry-forwards shouldn't borrow at all. Why should such a firm "incentivize" taxpaying investors to hold debt when it can't use interest tax shields?

We believe there is a moderate tax advantage to corporate borrowing, at least for companies that are reasonably sure they can use the corporate tax shields. For companies that do not expect to be able to use the corporate tax shields we believe there is a moderate tax disadvantage.

Cost of Financial Distress

Financial distress occurs when promises to creditors are broken or honored with difficulty. Sometimes financial distress leads to bankruptcy. Sometimes it only means skating on this ice.

As we will see, financial distress is costly. Investors know that levered firms may fall into financial distress, and they worry about it. That worry is reflected in the current market value of the levered firm's securities. Thus, the value of the firm can be broken down into three

[13] For a discussion of the effect of these other tax shields on company borrowing, see DeAngelo and Masulis (1980). For some evidence on the average marginal tax rate of United States firms, see Cordes and Sheffrin (1981).

parts:

$$\text{Value of firm} = \text{Value if all-equity-financed} + \text{PV (tax shield)} - \text{PV (costs of financial distress)}$$

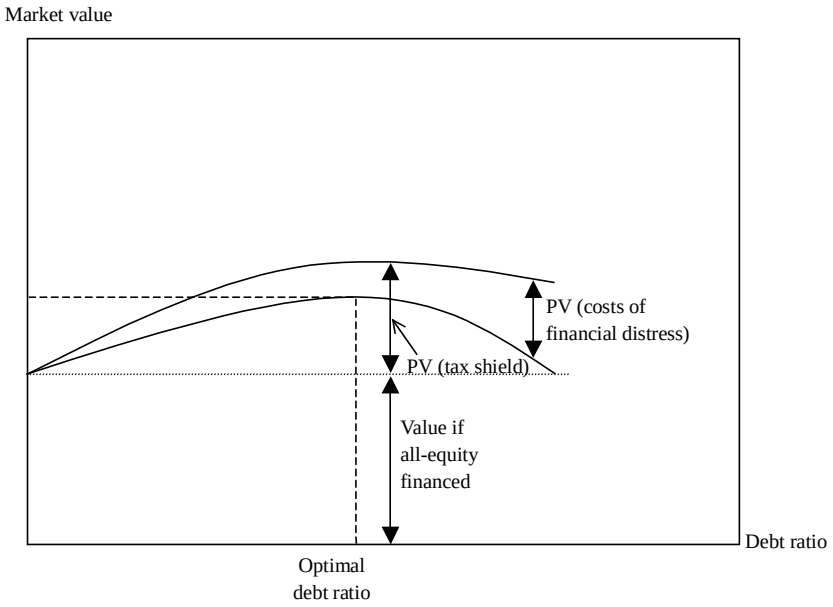
The costs of financial distress depend on the probability of distress and the magnitude of costs encountered if distress occurs.

Figure 2 shows how the trade-off between the tax benefits and the costs of distress determines optimal capital structure. PV (tax shield) initially increases as the firm borrows more. At moderate debt levels the probability of financial distress is trivial, and so PV (cost of financial distress) is small and tax advantages dominate. But at some point the probability of financial distress increases rapidly with additional borrowing; the costs of distress begin to take a substantial bite out of firm value. Also, if the firm can't be sure of profiting from the corporate tax shield, the tax advantage of debt is likely to dwindle and eventually disappear. The theoretical optimum is reached when the present value of tax savings due to additional borrowing is just offset by increases in the present value of costs of distress.

Costs of financial distress cover several specific items. Now we identify these costs and try to understand what causes them.

Figure 2

The value of the firm is equal to its value if all-equity-financed plus PV (tax shield) minus PV (costs of financial distress). The manager should choose the debt ratio that maximizes firm value.



Bankruptcy Costs

You rarely hear anything nice said about corporate bankruptcy. But there is some good in almost everything. Corporate bankruptcies occur when stockholders exercise their *right to default*. That right is valuable; when a firm gets into trouble, limited liability allows stockholders simply to walk away from it, leaving all its troubles to its creditors. The former creditors become the new stockholders, and the old stockholders are left with nothing.

Financial Distress without Bankruptcy

Not every firm which gets into trouble goes bankrupt. As long as the firm can scrape up enough cash to pay the interest on its debt, it may be able to postpone bankruptcy for many years. Eventually the firm may recover, pay off its debt, and escape bankruptcy altogether.

When a firm is in trouble, both bondholders and stockholders want it to recover, but in other respects their interests may be in conflict. In times of financial distress the security holders are like many political parties –untied on generalities but threatened by squabbling on any specific issue.

Financial distress is costly when these conflicts of interest get in the way of proper operating, investment, and financing decisions. Stockholders are tempted to forsake the usual objective of maximizing the overall market value of the firm and to pursue narrower self-interest instead. They are tempted to play games at the expense of their creditors. We will now illustrate how such games can lead to costs of financial distress.

Here is the Circular File Company's book balance sheet:

Circular File Company (Book Values)

Net working capital	$20	$50	Bond outstanding
Fixed assets	80	50	Common stock
Total assets	$100	$100	Total liabilities

We will assume there are only one share and one bond outstanding. The stockholder is also the manager. The bondholder is somebody else.

Here is its balance sheet in market values – a clear case of financial distress, since the face value of Circular's debt ($50) exceeds the firm's total market value ($30):

Circular File Company (Market Values)

Net working capital	$20	$25	Bond outstanding
Fixed assets	10	5	Common stock
Total assets	$30	$30	Total liabilities

If the debt matured today, Circular's owner would default, leaving the firm bankrupt. But suppose that the bond actually matures 1 year hence, that there is enough cash for Circular to limp along for 1 year, and that the bondholder cannot "call the question" and force bankruptcy before then.

The 1-year grace period explains why the Circular share still has value. Its owner is betting

on a stroke of luck that will rescue the firm, allowing it to pay off the debt with something left over. The bet is a long shot – the owner wins only if firm value increases from $30 to more than $50[14]. But the owner has a secret weapon: he controls investment and operating strategy.

Risk Shifting: The First Game

Suppose that Circular has $10 cash. The following investment opportunity comes up:

Now	Possible Payoffs Next Year
Invest $10	$120 (10% probability) $0 (90% probability)

This is a wild gamble and probably a lousy project. But you can see why the owner would be tempted to take it anyway. Why not go for broke? Circular will probably go under anyway, and so the owner is essentially betting with the bondholder's money. But the owner gets most of the loot if the project pays off.

Suppose that the project's NPV is -- $2 but that it is undertaken anyway, thus depressing firm value by $2. Circular's new balance sheet might look like this:

Circular File Company (Market Values)

Net working capital	$10	$20	Bond outstanding
Fixed assets	18	8	Common stock
Total assets	$28	$28	Total liabilities

Firm value falls by $2, but the owner is $3 ahead because the bond's value has fallen by $5[15]. The $10 cash that used to stand behind the bond has been replaced by a very risky asset worth only $8.

Thus a game has been played at the expense of Circular's bondholder. The game illustrates the following general point: Stockholders of levered firms gain when business risk increases. Financial managers who act strictly in their shareholders' interests (and *against* the interests of creditors) will favor risky projects over safe ones. They may even take risky projects with negative NPVs.

This warped strategy for capital budgeting clearly is costly to the firm and to the economy as a whole. Why do we associate the costs with financial distress? Because the temptation to play is strongest when the odds of default are high. Exxon Mobil would never invest in our negative-NPV gamble. Its creditors are not vulnerable to this type of game.

Refusing to Contribute Equity Capital: The Second Game

[14] We are not concerned here with how to work out whether $5 is a fair price for stockholders to pay for the bet.

[15] We are not calculating this $5 drop. We are simply using it as a plausible assumption.

We have seen how stockholders, acting in their immediate, narrow self-interest, may take projects which reduce the overall market value of their firm. These are errors of commission. Conflicts of interest may also lead to errors of omission.

Assume that Circular cannot scrape up any cash, and therefore cannot take that wild gamble. Instead a *good* opportunity comes up: a relatively safe asset costing $10 with a present value of $15 and NPV = +$5.

This project will not in itself rescue Circular, but it is a step in the right direction. We might therefore expect Circular to issue $10 of new stock and to go ahead with the investment. Suppose that two new shares are issued to the original owner for $10 cash. The project is taken. The new balance sheet might look like this:

Circular File Company (Market Values)

Net working capital	$20	$33	Bond outstanding
Fixed assets	25	12	Common stock
Total assets	$45	$45	Total liabilities

The total value of the firm goes up by $15 ($10 of new capital and $5 NPV). Notice that the Circular bond is no longer worth $25, but $33. The bondholder receives a capital gain of $8 because the firm's assets include a new, safe asset worth $15. The probability of default is less, and the payoff to the bondholder if default occurs is larger.

The stockholder loses what the bondholder gains. Equity value goes up not by $15 but by $15−$8 = $7. The owner puts in $10 of fresh equity capital but gains only $7 in market value. Going ahead is in the firm's interest but not the owner's.

Again, our example illustrates a general point. If we hold business risk constant, any increase in firm value is shared among bondholders and stockholders. The value of any investment opportunity *to the firm's stockholders* is reduced because project benefits must be shared with bondholders. Thus it may not be in the stockholders' self interest to contribute fresh equity capital even if that means forgoing positive-NPV investment opportunities.

This problem theoretically affects all levered firms, but it is most serious when firms land in financial distress. The greater the probability of default, the more bondholders have to gain from investments which increase firm value.

And Three More Games, Briefly

As with other games, the temptation to play the next three games is particularly strong in financial distress.

1. ***Cash In and Run:*** Stockholders may be reluctant to put money into a firm in financial distress, but they are happy to take the money out – in the form of a cash dividend, for example. The market value of the firm's stock goes down by less than the amount of the

dividend paid, because the decline in *firm* value is shared with creditors. This game is just "refusing to contribute equity capital" run in reverse.

2. ***Playing for Time:*** When the firm is in financial distress, creditors would like to salvage what they can by forcing the firm to settle up. Naturally, stockholders want to delay this as long as they can. There are various devious ways of doing this, for example, through accounting changes designed to conceal the true extent of trouble, by encouraging false hopes of spontaneous recovery, or by cutting corners on maintenance, research and development, etc., in order to make this year's operating performance look better.
3. ***Bait and Switch:*** This game is not always played in financial distress, but it is a quick way to get *into* distress. You start with a conservative policy, issuing a limited amount of relatively safe debt. Then you suddenly switch and issue a lot more. That makes all your debt risky, imposing a capital loss on the "old" bondholders. Their capital loss is the stockholders' gain.

What the Games Cost

Why should anyone object to these games so long as they are played by consenting adults? Because playing them means poor decisions about investments and operations. These poor decisions are *agency costs* of borrowing.

The more the firm borrows, the greater the temptation to play the games (assuming the financial manager acts in the stockholders' interest). The increased odds of poor decisions in the future prompt investors to mark down the present market value of the firm. The fall in value comes out of stockholders' pockets. Potential lenders, realizing that games may be played at their expense, protect themselves by demanding better terms.

Therefore it is ultimately in the stockholders' interest to avoid temptation. The easiest way to do this is to limit borrowing to levels at which the firm's debt is safe or close to it.

But suppose that the tax advantages of debt spur the firm on to a high debt ratio and a significant probability of default or financial distress. Is there any way to convince potential lenders that games will not be played? The obvious answer is to give lenders veto power over potentially dangerous decisions.

There we have the ultimate economic rationale for all that fine print backing up corporate debt. Debt contracts almost always limit dividends or equivalent transfers of wealth to stockholders; the firm may not be allowed to pay out more than it earns, for example. Additional borrowing is almost always limited. For example, may companies are prevented by existing bond indentures from issuing any additional long-term debt unless their ratio of earnings to interest charges exceeds 2.0[16].

[16] RJR Nabisco bondholders might have done better if they had effective covenants to protect tem against drastic

Sometimes firms are restricted from selling assets or making major investment outlays except with the lenders' consent. The risks of "playing for time" are reduced by specifying accounting procedures and by giving lenders access to the firm's books and its financial forecasts.

Of course, fine print cannot be a complete solution for firms that insist on issuing risky debt. The fine print has its own costs; you have to spend money to save money. Obviously a complex debt contract costs more to negotiate than a simple one. Afterward it costs the lender more to monitor the firm's performance. Lenders anticipate monitoring costs and demand compensation in the form of higher interest rates; thus the monitoring costs – another agency cost of debt – are ultimately paid by stockholders.

Perhaps the most severe costs of the fine print stem from the constraints it places on operating and investment decisions. For example, an attempt to prevent the "riskshifting" game may also prevent the firm from pursuing *good* investment opportunities. At the minimum there are delays in clearing major investments with lenders. In some cases lenders may veto high-risk investments even if net present value is positive. Lenders can lose from risk shifting even when the firm's overall market value increases. In fact, the lenders may try to play a game of their own, forcing the firm to stay in cash or low-risk assets even if good projects are forgone.

Thus, debt contracts cannot cover every possible manifestation of the games we have just discussed. Any attempt to do so would be hopelessly expensive and doomed to failure in any event. Human imagination is insufficient to conceive of all the possible things that could go wrong. We will always find surprises coming at us on dimensions we never thought to think about.

We hope we have not left the impression that managers and stockholders always succumb to temptation unless restrained. Usually they refrain voluntarily, not only from a sense of fair play but also on pragmatic grounds: A firm or individual that makes a killing today at the expense of a creditor will be coldly received when the time comes to borrow again. Aggressive game playing is done only by out-and-out crooks and by firms in extreme financial distress. Firms limit borrowing precisely because they don't wish to land in distress and be exposed to the temptation to play.

The Trade-off Theory of Capital Structure

Financial managers often think of the firm's debt-equity decision as a trade-off between interest tax shields and the costs of financial distress. Of course, there is controversy about how valuable interest tax shields are and what kinds of financial trouble are most threatening,

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increases in financial leverage.

but these disagreements are only variations on a theme. Thus, Figure 2 illustrates the debt-equity trade-off.

This *trade-off theory* of capital structure recognizes that target debt ratios may vary from firm to firm. Companies with safe, tangible assets and plenty of taxable income to shield ought to have high target ratios. Unprofitable companies with risky, intangible assets ought to rely primarily on equity financing.

If there were no costs of adjusting capital structure, then each firm should always be at its target debt ratio. However, there are costs, and therefore delays, in adjusting to the optimum. Firms cannot immediately offset the random events that bump them away from their capital structure targets, so we should see random differences in actual debt ratios among firms having the same target debt ratio.

All in all, this trade-off theory of capital structure choice tells a comforting story. Unlike MM's theory, which seemed to say that firms should take on as much debt as possible, it avoids extreme predictions and rationalizes moderate debt ratios.

But what are the facts? Can the trade-off theory of capital structure explain how companies actually behave?

The answer is "yes and no". On the "yes" side, the trade-off theory successfully explains many industry differences in capital structure. High-tech growth companies, for example, whose assets are risky and mostly intangible, normally use relatively little debt. Airlines can and do borrow heavily because their assets are tangible and relatively safe[17].

The trade-off theory also helps explain what kinds of companies "go private" in leveraged buy-outs (LBOs). LBOs are acquisitions of public companies by private investors who finance a large fraction of the purchase price with debt. The target companies for LBO takeovers are usually mature "cash cow" businesses with established markets for their products but little in the way of high-NPV growth opportunities. That makes sense by the trade-off theory, because these are exactly the kind of companies that *ought* to have high debt ratios.

The trade-off theory also says that companies saddled with extra heavy debt – too much to pay down with a couple of years' internally generated cash – should issue stock, constrain dividends, or sell off assets to raise cash to rebalance capital structure. Here again, we can find plenty of confirming examples. When Texaco bought Getty Petroleum in January 1984, it borrowed $8 billion from a consortium of banks to help finance the acquisition (The loan was arranged and paid over to Texaco within 2 weeks!). By the end of 1984, it had raised about $1.8 billion to pay down this debt, mostly by selling assets and forgoing dividend

[17] We are not suggesting that all airline *companies* are safe; many are not. But air*craft* can support debt where air*lines* cannot. If Fly-by-Night Airlines fails, its planes retain their value in another airline's operations. There's a good secondary market in used aircraft, so a loan secured by aircraft can be well protected even if made to an airline flying on thin ice (and in the dark).

increases. Chrysler, when it emerged from near-bankruptcy in 1983, sold $432 million of new common stock to help regain a conservative capital structure[18]. In 1991, after a second brush with bankruptcy, it again sold shares to replenish equity, this time for $350 million[19].

On the "no" side, there are a few things the trade-off theory cannot explain. It cannot explain why some of the most successful companies thrive with little debt, thereby giving up valuable interest tax shields. Think of Merck, it is basically all-equity-financed. Granted, Merck's most valuable assets are intangible, the fruits of its pharmaceutical research and development. We know that intangible assets and conservative capital structures tend to go together. But Merck also has a very large corporate income tax bill ($1.4 billion in 1994) and the highest possible credit rating. It could borrow enough to save tens of millions of tax dollars without raising a whisker of concern about possible financial distress[20].

Merck illustrates an odd fact about real-life capital structures: Within an industry, the most profitable companies generally borrow the least[21]. Here the trade-off theory fails, for it predicts exactly the reverse: Under the trade-off theory, high profits should mean more debt-servicing capacity and more taxable income to shield and should give a *higher* target debt ratio[22].

A final point on the "no" side for the trade-off theory: Debt ratios in the early 1900s, when income tax rates were low (or zero), were just as high as those in the 1990s. Debt ratios in other industrialized countries are equal to or higher than those in the United States. Many of these countries have imputation tax systems, which should eliminate the value of the interest tax shields[23].

None of this disproves the trade-off theory. As George Stigler emphasized, theories are not rejected by circumstantial evidence; it takes a theory to beat a theory. So we now turn to a

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[18] Note that Chrysler issued stock after it emerged from financial distress. It did not prevent financial distress by raising equity money when trouble loomed on its horizon. Why not? Refer back to "Refusing to Contribute Equity Capital: The Second Game" or forward to the analysis of asymmetric information.

[19] Chrysler simultaneously contributed $300 million of newly issued shares to its underfunded pension plans.

[20] Research by Graham and Mackie-Mason has detected a tendency for taxpaying firms to prefer debt financing. See J.R. Graham, "Debt and the Marginal Tax Rate", Journal of Financial Economics, forthcoming; and J. Mackie-Mason, "Do Taxes Affect Corporate Financing Decisions?" Journal of Finance, 45: 1471-1493 (December 1990). However, it seems clear that public companies rarely make major shifts in debt ratios just because of taxes.

[21] For example, Carl Kester, in a study of the financing policies of firms in the United States and in Japan, found that in each country, high book profitability was the most statistically significant variable distinguishing low-from high-debt companies. See "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Corporations", *Financial Management*, 15:5-16 (Spring 1986).

[22] Here we mean debt as a fraction of the book or replacement value of the company's assets. Profitable companies might not borrow a greater fraction of their market value. Higher profits imply higher market value as well as stronger incentives to borrow.

[23] We described the Australian imputation tax system. Look again at Table 16-4, supposing that an Australian corporation pays $A10 of interest. This reduces the corporate tax by $A3.30; it also reduces the tax credit taken by the shareholders by $A3.30. The final tax does not depend on whether the corporation or the shareholder borrows.

You can check this by redrawing Figure 1 for the Australian system. The corporate tax rate T_c will cancel out. Since income after all taxes depends only on investors' tax rates, there is no special advantage to corporate borrowing.

completely different theory of financing.

The Pecking Order of Financing Choices

The pecking-order theory starts with *asymmetric information* – a fancy term indicating that managers know more about their companies" prospects, risks, and values than do outside investors.

Managers obviously know more than investors. We can prove that by observing stock price changes caused by announcements by managers. When a company announces an increased regular dividend, stock price typically rises, because investors interpret the increase as a sign of management's confidence in future earnings. In other words, the dividend increase transfers information from managers to investors. This can happen only if managers know more in the first place.

Asymmetric information affects the choice between internal and external financing and between new issues of debt and equity securities. This leads to a *pecking order*, in which investment is financed first with internal funds, reinvested earnings primarily; then by new issues of debt; and finally with new issues of equity. New equity issues are a last resort when the company runs out of debt capacity, that is, when the threat of costs of financial distress brings regular insomnia to existing creditors and to the financial manager.

Implications of the Pecking Order

The pecking-order theory of corporate financing goes like this[24].

1) Firms prefer internal finance.
2) They adapt their target dividend payout ratios to their investment opportunities, while trying to avoid sudden changes in dividends.
3) Sticky dividend policies, plus unpredictable fluctuations in profitability and investment opportunities, mean that internally generated cash flow is sometimes more than capital expenditures and other times less. If it is more, the firm pays off debt or invests in marketable securities. If it is less, the firm first draws down its cash balance or sells its marketable securities.
4) If external finance is required, firms issue the safest security first. That is, they start with debt, then possibly hybrid securities such as convertible bonds, then perhaps equity as a last resort.

In this theory, there is no well-defined target debt-equity mix, because there are two kinds of

[24] The description is paraphrased form S.C. Myers, "The Capital Structure Puzzle", *Journal of Finance*, 39: 581-2 (July 1984). For the most part, this section follows Myers's arguments.

equity, internal and external, one at the top of the pecking order and one at the bottom. Each firm's observed debt ratio reflects its cumulative requirements for external finance.

The pecking order explains why the most profitable firms generally borrow less – not because they have low target debt ratios but because they don't need outside money. Less profitable firms issue debt because they do not have internal funds sufficient for their capital investment program and because debt financing is first on the pecking order of *external* financing.

In the pecking-order theory, the attraction of interest tax shields is assumed to be a second-order effect. Debt ratios changes when there is an imbalance of internal cash flow, net of dividends, and real investment opportunities. Highly profitable firms with limited investment opportunities work down to a low debt ratio. Firms whose investment opportunities outrun internally generated funds are driven to borrow more and more.

This theory explains the inverse intraindustry relationship between profitability and financial leverage. Suppose firms generally invest to keep up with the growth of their industries. Then rates of investment will be similar within an industry. Given sticky dividend payouts, the least profitable firms will have less internal funds and will end up borrowing more.

The pecking order seems to predict changes in many mature firms' debt ratios to a T. These companies' debt ratios increase when the firms have financial deficits and decline when they have surpluses. If asymmetric information makes major equity issues or retirements[25] rare, this behavior is nearly inevitable.

The pecking order is less successful in explaining *inter*industry differences in debt ratios. For example, debt ratios tend to be low in high-tech, high-growth industries, even when the need for external capital is great. There are also mature, stable industries – electric utilities, for example – in which ample cash flow is not used to pay down debt. High dividend payout ratios give the cash flow back to investors instead.

Financial Slack

Other things equal, it's better to be at the top of the pecking order than at the bottom. Firms that have worked down the pecking order and need external equity may end up living with excessive debt or passing by good investments because shares can't be sold at what managers consider a fair price.

In other words, *financial slack* is valuable. Having financial slack means having cash, marketable securities, readily saleable real assets, and ready access to the debt markets or to bank financing. Ready access basically requires conservative financing, so that potential

[25] Companies with low debt ratios and surplus cash often repurchase stock, but ordinary repurchases rarely cause material increases in debt ratios.

lenders see the company's debt as a safe investment.

In the long run, a company's value rests more on its capital investment and operating decisions than on financing. Therefore, you want to make sure your firm has sufficient financial slack, so that financing is quickly available for good investments. Financial slack is most valuable to firms with plenty of positive-NPV growth opportunities. That is another reason why growth companies usually aspire to conservative capital structures.

Free Cash Flow and the Dark Side of Financial Slack[26]

There is also a dark side to financial slack. Too much of it may encourage managers to take it easy, expand their perks, or empire-build with cash that should be paid back to stockholders. Michael Jensen has stressed the tendency of managers with ample free cash flow (or unnecessary financial slack) to plow too much cash into mature businesses or ill-advised acquisitions. "The problem", Jensen says, "is how to motivate managers to disgorge the cash rather than investing it below the cost of capital or wasting it in organizational inefficiencies."[27]

If that's the problem, then maybe debt is an answer. Scheduled interest and principal payments are contractual obligations of the firm. Debt forces the firm to pay out cash. Perhaps the best debt level would leave just enough cash in the bank, after debt service, to finance all positive-NPV projects, with not a penny left over.

4.5 Taxation and Investment

A typical analysis of the effect of taxation on capital stock is to consider a neoclassical 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 (e.g. input and output prices) and tax regimes (e.g. corporate tax rates and depreciation rate). 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 modeled, such as investment tax credits and allowances, accelerated depreciation, and tax holidays.

The firm maximizes 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 chooses the optimal path of investment, taking into account relevant economic and taxes variables. The firm invests in

[26] Some of the following is drawn from S.C. Myers, "Still Searching for Optimal Capital Structure", *Journal of Applied Corporate Finance*, 6: 4-14 (Spring 1993).
[27] M.C. Jensen, "Agency Costs of Free Cash Flow, Corporate Finance and Takeovers", *American Economic Review*, 26: 323 (May 1986).

capital until the value of marginal product (less adjustment costs) is equal to *the user cost of capital*. 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 Depreciation

The cost of depreciation 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 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 equal to $q_0 - (1-\delta)q_1 - (\delta - x)q_1$ where $x = (q_1 - q_0)/q_1$ which is the rate of real capital gains. The term (δ-x) is *the economic depreciation rate*, which is equal to the rate of physical wear and tear less the rate of real capital gains accused from holding an asset (evaluated at the cost of replacement).

If there were perfect markets for all used assets, there would be no difficulty in calculating true economic depreciation, but used capital goods markets are notoriously imperfect. As a result, the government has to employ the rule of thumb depreciation formulae.

1. straight-line depreciation.
2. declining balance.
3. a fraction of the expenditure that declines linearly over the lifetime (e.g. 10/55, 9/55, 8/55, 1/55 for an asset with a life of ten years) is allowed.
4. free depreciation or investment tax credit.

Such formulae do not typically ensure true economic depreciation. Whether they are more or less generous depends in general on the relationship between the true life and that used for tax purposes.

With a choice of depreciation rate, financial policy and cost of capital (net of depreciation) can be related differently from the previous discussion (see Atkinson and Stiglitz (1980), pp.142-147).

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 (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 and π is the rate of inflation, the real cost of equity finance is ρ-π.

If *i* is the nominal bond interest rate, which is deductible from corporate taxable income at the corporate tax rate, t_c, then the real cost of debt finance is therefore $i(1-t_c)-\pi$.

Using the formulation of Auerbach (1979), the firm can be characterized as minimizing its cost of finance by choosing its optimal debt/equity ratio prior to making its investment decision.

Let the proportion of investment to be financed by debt be β and 1-β by equity, the cost of finance is equal to,

$$r = R - \pi = \beta i(1-t_c) + (1-\beta)\rho - \pi \qquad (9)$$

where *R* is the nominal cost of finance.

The User Cost of Capital

Taking into account the depreciation and financing costs, we can derive the user cost of capital which is the minimum return needed for investment to take place.

Suppose 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 of each capital good is reduced to $\$q(1-\varphi)$. 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*. The effective cost of buying an asset is equal to
$\$q(1-\varphi-t_cA)$.

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 dollar of investment equals gross income net of corporate taxes and is given by $\partial F/\partial k(1-t_c)$. The cost of holding capital is equal to the annual cost of depreciation and financing costs multiplied by the effective purchase price of capital, $(r+\delta-x)q(1-\varphi-t_cA)$, where *x* is the rate of real capital gains and δ is the depreciation rate.

For the optimal investment decision, the marginal return is equal to the marginal cost of holding capital, so this implies

$$(1-t_c)\frac{\partial F}{\partial k} = (r+\delta-x)q(1-\varphi-t_cA) \qquad (10)$$

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

$$p = \frac{\partial F / \partial k}{q} = \left(\frac{r + \delta - x}{1 - t_c} \right) \left(1 - \varphi - t_c A\right) \qquad (11)$$

The right-hand side of (11) multiplied by q (the price of capital) is interpreted as *the user cost of capital* for a firm that invests in depreciable assets such as machinery and structures.

(11) Suggests the corporate tax system affects the user cost of capital in the following ways.

1) The corporate tax reduces gross income and thus increases the user cost of capital.
2) The corporate tax reduces the effective purchase price of capital through depreciation allowances and investment tax credits.
3) The corporate tax reduces financing costs by allowing firms to write off nominal interest expenses.

Neutrality of the Corporate Tax

The corporate tax is neutral with respect to investment decisions of a firm under a rent or cash-flow tax, if investment is expensed (A=1), there is no investment tax credit (φ=0) and interest is not deductible $\left(r = \beta i + (1-\beta)\rho - \pi\right)$. That is, the user cost of capital becomes $q\left(r + \delta - x\right)$ which is independent of the corporate tax.

The government usually violates the neutrality and gives special investment incentives such as accelerated depreciation allowances for manufacturing investment, investment tax credits for machinery, and lower corporate tax rates for specific industries. The government may also provide tax holidays for firms. Note, however, that once the holiday is completed, the firm has to pay corporate income taxes, thus the government taxes affect the cost of capital during the holidays as well.

The Effective Tax Rate on Capital

To capture the effect of all the different provisions of the corporate tax system on capital investment, we can use a kind of summary *index* to measure *the effective corporate tax rate* on capital.

The effective tax rate is the amount of tax paid as a percentage of the rate of return or capital

held at the margin.

$$T = \frac{r_g - r_n}{r_g} \tag{12}$$

Where r_g and r_n are the rate of return gross and net taxes. 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, $r_g = \frac{\partial F / \partial k}{q}(\delta - x)$. The net rate of return on capital is the case when all taxes are zero, $r_n = \beta i + (1-\beta)\rho - \pi$. Then we can calculate the effective tax rate by using the formula (12).

Personal Taxation and the Cost of Capital

Personal tax 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 take account for personal taxes on nominal interest income (t_{pr}), the accrual equivalent tax on nominal capital gains (t_g) and the dividend tax (t_{pd}). After personal taxes are paid, investors earn interest income at the rate $i(1\text{-}t_{pr})$, capital gain income equals to $\rho(1\text{-}t_g)$ and the dividend income equals to $\rho(1\text{-}t_{pd})$.

Let α be the proportion of assets held as bonds, 1-α be that of equity, γ be the proportion of equity income derived as capital gains and 1-γ be that as dividends. Then the after-tax rate of return on capital, after correcting for personal taxes and inflation, can be expressed as,

$$r_n = \alpha i(1 - t_{pr}) + (1-\alpha)\rho(1-\theta) - \pi \tag{13}$$

Where θ = the average tax rate on equity income ($\theta = \gamma t_g + (1-\gamma)t_{pd}$).

We can use (13) to calculate the effective capital tax rate T defined in (12). This method is known as the King-Fullerton method (see King and Fullerton (1984) and Jorgenson and Landau (1993)).

The inclusion of personal taxes as part of the effective tax rate measure raises the following difficulties.

1) *Progressivity* of the tax rate schedule at the personal level.

This implies some investors face lower tax rates on capital income than others.

2) *Tax exemptions* for certain form of savings.
   Some sources of savings are exempt from taxation.
3) *Financial intermediaries*
   Banks, insurance companies, mutual funds, and other financial institutions have their own special tax considerations
4) *Foreign Investors*
   Firms are owned not only by domestic investors but also by foreigners who are subject to a country's withholding and income taxes levied by the government where the investor resides.

4.6 Empirical Studies of Corporate Tax

The empirical study of the effects of taxation on firm behavior has been one of the most active areas of applied research in public finance (e.g. the influence of the corporate tax on finance decision).

There are three major approaches in the literature.

(1) *The Accelerator Model*: The accelerator model is based on an assumption that relative prices of labor and capital do not affect the demand for capital. Only output affects investment, so that impact of taxes on investment would only be through the impact on aggregate demand.
   In functional form, this model can be expressed as,

$$I_t^N = K_t - K_{t-1} = v\left(Q_t - Q_{t-1}\right) \tag{14}$$

where I_t = net investment, K_t = capital stock, Q_t = output.

A slightly modified version of this model, known as *the flexible accelerator model* is given,

$$I_t^N = K_t - K_{t-1} = v\lambda\sum_{i=0}(1-\lambda)^i dQ_{t-i} \tag{15}$$

where $dQ_t = Q_t - Q_{t-1}$

For empirical modeling, we tend to consider gross investment (i.e. net investment (I^N) plus replacement investment I^R). That is,

$$
\begin{aligned}
I_t &= I_t^N + I_t^R \\
&= K_t - K_{t-1} + \delta K_{t-1}
\end{aligned}
\tag{16}
$$

Combining (24) and (25), the gross investment is given

$$
I_t = v\lambda \sum_{i=0}^{1} (1-\lambda)^i dQ_{t-i} + \delta K_{t-1}
$$

For empirical application, this model can further be simplified as,

$$
I_t = \alpha_t + \beta Q_t + \gamma Q_{t-1} + \delta K_{t-1} \tag{17}
$$

In case of Japan ,the following model is estimated by Zhu (1995).
Period: 1970.I-1992.IV, Estimation method: OLS, Standard error in parenthesis.

$$
\begin{aligned}
I_t = & \underset{(1110.75)}{-1917.11} + \underset{(0.02303)}{0.004213}\left[Q_t + Q_{t-1} + Q_{t-2} + Q_{t-3}\right] \\
& - \underset{(0.004423)}{0.005792}\, K_{t-1} + \underset{(0.044862)}{0.965675}\, I_{t-1} \\
& \overline{R}^2 = 0.9896, \quad \text{Dubins'h} = -1.6607
\end{aligned}
\tag{18}
$$

(2) *The Neoclassical model*: The neoclassical model assumes that profit-maximizing firms will use capital and other inputs in production until the marginal product is equal to the price of the factor used in production. The neoclassical model (e.g. Jorgenson (1963), Hall and Jorgenson (1967)) is based on an 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 neoclassical model, taxes affect capital output as in the accelerator model, as well as the user cost of capital.

We can state formally that the firm is trying to maximize its net revenue through time while subject to the constraints of (1) its technology, embodied in the production function and (2) the equation of motion of the capital stock describing how the capital stock changes as investment occurs, given that there is a constant rate of depreciation of capital, δ.

The problem can be set in dynamic optimization.

$$\max V_t = \int_t^{\infty} \{p_t Q_t - w_t L_t - q_t I_t\} e^{-rt} dt \tag{19}$$

subject to

$$Q_t = F(K_t, L_t) \tag{20}$$

and

$$K_t = I_t - \delta K_t \tag{21}$$

where Q=output, p=price of output, w=wage, L=labor, q=price of capital, I=investment, δ=rate of depreciation, K=capital stock, r=interest rate.

To solve this, we use the Hamiltonian function as

$$H = pQ - wL - qI + \lambda\{Q - F(K, L)\} + \mu\{I - \delta K\} \tag{22}$$

The first order conditions are as follows.

$$\begin{aligned}
&\frac{\partial H}{\partial Q} = 0 \;\Rightarrow\; p + \lambda = 0 \\
&\frac{\partial H}{\partial L} = 0 \;\Rightarrow\; \frac{\partial F}{\partial L} = \frac{w}{p} \\
&\frac{\partial H}{\partial Z} = 0 \;\Rightarrow\; \mu = q \\
&\frac{\partial(\mu e^{-rt})}{\partial t} = \frac{-\partial H e^{-rt}}{\partial K} \Rightarrow p\frac{\partial F}{\partial K} = q(r + \delta) - \dot{q} = c
\end{aligned} \tag{23}$$

where c=the user cost of capital

Compared with (20), for simplicity, (31) ignores tax factors. But we should include them in empirical modeling.

Jorgenson (1963) assumes the Cobb-Douglas production function, $Q = AK^{\alpha} L_{\beta}$ with

$\alpha + \beta < 1$ (decreasing returns to scale). With this production function, the marginal product of capital $\partial F / \partial K = \alpha(Q/K)$, so (23) becomes

$$p\frac{\partial F}{\partial K} = \alpha p\frac{Q}{K} = c \Rightarrow K^* = \frac{\alpha P_t Q_t}{c_t} \tag{24}$$

Thus $I = \Delta K^* = \alpha\Delta\left(\frac{PQ}{c}\right)_t$ (25)

Jorgenson further assumes that there are delivery lags for the new capital goods, with the result that only a fixed fraction λ_0 of the goods ordered this period are actually delivered, a fraction λ_1, of the orders of this period are delivered next periods, and so on. We can express this assumption such that

$$I_t = \Delta K_t = \lambda_0 \Delta K_t^* + \lambda_1 \Delta K_{t-1}^* + \lambda_2 \Delta K_{t-2}^* + \cdots \tag{26}$$

Combining (25) with (26),

$$\begin{aligned} I_t &= \lambda_0\alpha\Delta\left(\frac{PQ}{c}\right)_t + \lambda_1\alpha\Delta\left(\frac{PQ}{c}\right)_{t-1} + \lambda_2\alpha\Delta\left(\frac{PQ}{c}\right)_{t-2} + \cdots \\ &= \alpha\sum_{i=0}\lambda_i\Delta\left(\frac{PQ}{c}\right)_{t-i} \end{aligned} \tag{27}$$

In case of Japan, the following model is estimated by Zhu (1995).
Period: 1970.I-1992.IV, Estimation method: OLS, Standard error in parenthesis.

$$\begin{aligned} I_t = &-\underset{(0.0109)}{0.0399}\Delta\left[\frac{PQ}{c}\right]_t + \underset{(0.0178)}{0.0683}\Delta\left[\frac{PQ}{c}\right]_{t-1} + \underset{(0.0214)}{0.0841}\Delta\left[\frac{PQ}{c}\right]_{t-2} + \underset{(0.0219)}{0.0862}\Delta\left[\frac{PQ}{c}\right]_{t-3} \\ &+ \underset{(0.0190)}{0.0736}\Delta\left[\frac{PQ}{c}\right]_{t-4} + \underset{(0.0120)}{0.0452}\Delta\left[\frac{PQ}{c}\right]_{t-5} + \underset{(0.0016)}{0.0240}K_{t-1} \\ &\rho = 0.9370, \quad \bar{R}^2 = 0.9876, \quad \text{DW} = 1.9919 \end{aligned} \tag{28}$$

This is the basic functional form of empirical model in which tax factors are incorporated in the user cost of capital, *c*.

There are substantial objections to this model. Among many criticisms, the following are

important.

(a) The adjustment process of the firm: Jorgenson's theoretical work implies that the firm is always optimally adjusted, yet in his empirical work, he imposes an *ad hoc* delivery lag.

(b) Econometric objections to the empirical work: critics argue that the methods used by Jorgenson will lead to biased and inconsistent estimates because of autocorrelation and lagged dependent variables.

(c) The endogeneity of output: a perfectly competitive neoclassical firm chooses the output it wishes to supply. To have output as an explanatory variable is inconsistent with the use of OLS estimation.

(d) The treatment of tax policy: taxation, depreciation allowances, and tax credits affect the user cost of capital (c) and the desired capital stock (K^*). It is a maintained hypothesis that a change in taxation has the same effect as a change in other variables that enter the user cost of capital (e.g. the interest rate), but it is an empirical hypothesis, not a stylized fact.

A recent neoclassical approach is to use the investment demand function derived from the firm's maximization decision (the Euler equation approach), which depends on future investment, the difference between current and future costs or prices of capital, and the return on capital. Taxes play an interesting role by affecting both current and future variables.

(3) *The Q-theory Model*: The *Q* model 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 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, as 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.

In *Q* models, it is assumed that investment is adjusted with a quadratic cost function. 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)).

The real attraction of *Q*-theory is that the original formulation of *Q* in terms of stock market value relative to replacement cost of capital (i.e. average *Q*) seems to offer a solution to the problem surrounding the empirical testing of investment theories. It looks as if asset markets could be relied upon to digest all relevant expectations and reflect them in stock market prices. Empirical work could use an observable market variable to summarize all the information concerning expectations formation, market conditions, and technology which had divided previous formulations of the investment equation.

Hayashi (1982) gives a rigorous analysis of the relationship between average and marginal *Q* and establishes conditions under which marginal *Q* can be inferred from market data. He shows that it is appropriate to proxy marginal by average *Q* under conditions of a *putty-putty technology*, constant returns to scale, and perfect competition.

Edwards and Keen (1983) shows that, when account is taken of differential taxation, marginal *Q*, like the cost of capital, depends sensitively on the marginal source of finance.

Formally, we can define the average Q such that

$$Q_t^A = \frac{V_t}{q_t K_t} \tag{29}$$

where V_t=the market value of firm, q_t=price of capital, K_t=capital stock

The marginal *Q* with tax adjustment is defined as

$$Q_t^M = \frac{\lambda_t}{(1-\psi - t_c A)q_t}$$

where λ_t=shadow price of capital = the present discounted value of additional future profits resulting from an additional unit of capital. ψ =a share of investment tax credit, *A*= depreciation allowance, and t_c= corporate tax rate.

Empirical model of *Q*-theory is, in general, given as follows.

$$\ln\left[\frac{I_t}{K_t}\right] = \alpha + \beta Q_t^M + \varepsilon \tag{30}$$

Zhu (1995) obtains the following empirical estimate.

Period: 1970.I-1992.IV, Estimation method: OLS, Standard error in parenthesis

$$\ln\left[\frac{I_t}{K_t}\right] = \underset{(0.0601)}{-3.9609} + \underset{(0.1558)}{1.1361} Q_t^M$$

$$\overline{R}^2 = 0.3644, \quad \text{DW} = 0.1439$$

In practice, empirical fit for (30) is not so good as expected. It has empirical difficulty to capture all relevant information in a summary statistics of *Q* from market data. As shown in Hayashi (1982), actual market conditions may not satisfy the theoretical assumptions of perfect competition, constant returns to scale, and putty-putty technology. Note that, in reality, capital is not homogeneous, so that each capital has its own *Q*, we need to consider multiple *Q*, not a single *Q*.

Summary Table of past empirical works is given in Table 4. Older studies of investment behavior relied heavily on aggregate time-series data. Newer studies use the firm-level microeconomic data (after in panel data) with much richer information.

The overall conclusion 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.

Table 4 Selected investment studies

Study	Period covered	Methodology	Results
Hall and Jorgenson, 1967	1929-63	Neoclassical; 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% in first year and 17.3% in the long run.
Feldstein, 1982	1953-78	Time-series study based on return over cost, effective tax rate model.	Elasticity of investment to user cost is –0.52
Chirinko and Eisner, 1983	1973-79	Use of six macroeconomic quarterly models; structures and machinery	Elasticity of investment to return on capital is 0.58 and to output is 0.62.
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.
Blundell, Bond, Devereux, and Schiantarelli, 1992	1975-86	Pooled firm-level data using Q model	Increase of 10% in market value of equity increases investment by 2.5% 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 stabilizing role in affecting investment.
Devereux, Keen and Schiantarelli, 1994	1976-86	Pooled firm-level data using neoclassical and Q models allowing for tax losses	Allowing for tax losses does not improve measured impacts of tax system on investment.
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.

Source: Mintz (1996, p.164)

Investment studies require future effort to incorporate several issues.

First, investment is modeled under the assumption that financing of capital is independent of investment (the Modigliani-Miller theorem). Financial and investment decisions may not be independent in practice. Some firms may face a liquidity constraint, so investment projects may be adopted only if sufficient retained earnings are available. Some types of capital such as structures and land may be more easily financed by debt that can use these capitals 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. But, in practice, 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 behavior but also government behavior to obtain understanding of investment and taxes.

Finally, the analysis of taxation requires good data. The most difficult problem after faced by researchers is that specific tax data on firms, such as the composition of depreciation allowances, the use of tax loss carry-forward and carry-back provisions, and information on more intricate aspects of tax law, probably result in biased estimates of coefficients (perhaps towards smaller values) for tax variable terms.

As seen above, there are considerable difficulties in making the transition from the theoretical model to the empirical model, including the specification of the production function and of the lag structure, the incorporation of the tax variables, and the econometric problems.

Exercises

1. 《Brealy, Myers and Allen (2006, chap 18, Quiz 1)》
   Compute the present value of interest tax shields generated by these three debt issues. Consider corporate taxes only. The marginal tax rate is $T_c = .35$.
   a. A $1,000, one-year loan at 8 percent.
   b. A five-year loan of $1,000 at 8 percent. Assume no principal is repaid until maturity.
   c. A $1,000 perpetuity at 7 percent.
2. 《Brealy, Myers and Allen (2006, chap 18, Quiz 2)》
   Here are book and market value balance sheets of the United Frypan Company (UF):

Book			
Net working capital	$20	Debt	$40
Long-term assets	80	Equity	60
	$100		$100

Market			
Net working capital	$20	Debt	$40
Long-term assets	140	Equity	120
	$160		$160

   Assume that MM's theory holds with taxes. There is no growth, and the $40 of debt is expected to be permanent. Assume a 40 percent corporate tax rate.
   a. How much of the firm's value is accounted for by the debt-generated tax shield?
   b. How much better off will UF's shareholders be if the firm borrows $20 more and uses it to repurchase stock?
3. 《Brealy, Myers and Allen (2006, chap 18, Quiz 3)》
   What is the relative tax advantage of corporate debt if the corporate tax rate is $T_c = .35$, the persona tax rate is $T_p = .35$, but all equity income is received as capital gains and escapes tax entirely ($T_{pE} = 0$)? How does the relative tax advantage change if the company decides to pay out all equity income as cash dividends that are taxed at 15 percent?
4. 《Brealy, Myers and Allen (2006, chap 18, Practice Questions 1)》
   In the U.K., the top personal income tax rate is 40 percent. This rate applies to interest and dividends. Capital gains are tax free, providing that realized gains do not exceed an annual allowance of about £8,000.

   All the individual stock holders of John Peel Group are in the top U.K. tax bracket, but manage their portfolios so that realized capital gains never exceed their annual allowances. Suppose that the Group's effective corporate tax rate is 30 percent. How does the sum of corporate and personal taxes change if the Group:

a. Operates at a higher or lower debt ratio?
b. Increases or reduces cash dividend payout, holding capital investment and debt constant?

Given your answers to (a) and (b), how would you advice the Group about debt and dividend policy?

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