Corporate Income Taxation : (b) Neutrality of the Tax

How does the corporate income tax affect firms' investment decisions?

Suppose that a corporation is considering investing I dollars in some durable asset. The durable asset is expected to generate a stream of returns to the firm : $x_1, x_2, \ldots$, over time, where x_1 is the return in the first year the asset is owned, x_2 the return in the second year, and so on.

These returns are the expected additional profit that the firm would earn, in the various years, if it undertakes the investment.

In other words, undertaking the investment involves an immediate cost of I, and a stream of future increases in profits x_t in future years $t = 1, 2, \cdots$.

Should the firm undertake the investment?

In the absence of tax considerations, the firm should undertake the investment if the **present value** of the returns exceeds the cost of the investment, in other words if

$$\frac{x_1}{1+r} + \frac{x_2}{(1+r)^2} + \cdots \geq I \qquad (c1)$$

where r is the (annual) rate at which it **discounts** future income.

What is this rate r here? If the firm has to raise the money for the investment from outside sources, then r is the rate of return which it must offer, in order to raise the money. In other words, it would be the interest rate it must pay on its debt, if it financed the investment by issuing debt. Or it would be the return to equity which it must offer on its shares, if it financed the investment by issuing new equity.

If the firm already had the money needed for the investment on hand, through retained earnings from previous years, then r would be the opportunity cost of investing the money internally. Since it has the retained earnings, an alternative use of the money (rather than to use it for this investment) would be to invest it externally, in bonds, or in the equity of another company, or in some other project.

In the absence of uncertainty, and in the absence of tax complications, the source of the funding for the investment does not matter. The appropriate rate at which to discount the returns from the investment is r, which is the rate of return in must offer outside investors (through debt or equity), and is also the opportunity cost of investing retained earnings.

An alternative way of expressing the firm's decision criterion, is to calculate the **internal rate of return** on the project. The internal rate of return i is the solution to the equation

$$\frac{x_1}{1+i} + \frac{x_2}{(1+i)^2} + \cdots = I \qquad (c2)$$

That is, the internal rate of return i to the investment project is the rate i which makes the present value of the returns exactly equal to the cost of the project. The firm should then undertake the investment if and only if the internal rate of return i is at least as large as the cost of capital r.

Thus if r is the firm's cost of capital, the return which it must offer investors, then — in the absence of any tax considerations — the firm's decision whether or not to invest can be described by the following two rules, which are just two ways of describing the same rule :

undertake the investment project if and only if the present value of the future returns, discounted using the cost of capital r as discount rate, is at least as large as the cost of the project ; that is undertake the investment if and only if inequality ($c1$) holds

undertake the investment project if and only if the internal rate of return i to the project, defined by equation ($c2$), exceeds the cost of capital r

Now, what about the corporate income tax? Suppose that the firm's earnings are subject to corporate income taxation at the rate τ. How will this affect the firm's investment decisions? The corporate income tax will be said to be **neutral** with respect to investment, if the firm's decision rule does not change : that is, if it undertakes exactly the investment projects which it would undertake in the absence of any corporate income tax (in other words, the projects satisfying the criterion listed above). The corporate income tax will be said to **discourage** investment if it reduces the set of investment projects which the firm is willing to undertake, and it will be said to **encourage** investment if it makes the firm willing to undertake investment projects which it would not undertake in the absence of tax considerations.

Throughout this section, taxes other than the corporate income tax will be ignored. In particular, the required rate of return r will be taken as given. This makes sense if the firm is raising money from outside Canada (so that investors are not affected by the Canadian personal income tax system), or if it is raising money from Canadian entities which are not subject to personal income tax. [Both pension funds, and life insurance companies, are effectively exempt from personal income taxation on the return to their investments. And these two groups supply a good fraction of the capital raised domestically by Canadian corporations.] The interaction between personal and corporate income tax will be discussed briefly in section c.

What are the key features of the corporate income tax, which might affect the investment decision? There are three :

1 The annual return to the investment, x_t is part of corporate income, and so is taxed at the rate τ.

2 The firm's borrowing costs are deductible from its annual income, in computing its corporate tax liabilities.

3 The firm can deduct a capital cost allowance (a.k.a. depreciation allowance), according to some depreciation schedule, from annual taxable income, to reflect depreciation on the asset

The previous section a discussed some aspects of depreciation allowances — so they will be

ignored here at first. So assume, for simplicity, that a project does not depreciate (and that depreciation for the project cannot be claimed on the corporate tax return). Suppose that an investment of I buys an annual return of x each year, the same amount x in each future year, lasting forever.

That means that the internal rate of return to the project is just x/I, and that the firm's investment criterion, in the absence of tax considerations, is to undertake the project if and only if condition $(c3)$ below holds :

$$\frac{x}{I} \geq r \tag{c3}$$

If the return to the investment is subject to the corporate income tax, then the after–tax return becomes $(1-\tau)x$. If the investment is financed by issuing new equity, or from retained earnings, then the firm does not incur any borrowing costs. Only point (1) above is relevant, so that the firm's criterion becomes to invest if and only if

$$\frac{(1-\tau)x}{I} \geq r \tag{c4}$$

$(c4)$ is a more difficult criterion to satisfy than $(c3)$; in this case the corporate income tax would discourage investment. From criterion $(c4)$, and from the fact that the internal rate of return i is

$$i = \frac{x}{I} \tag{c5}$$

in this case (with a constant annual return x), then $(c4)$ says that the firm should invest if and only if the internal rate of return on the project is $r/(1-\tau)$ or more. Since $r/(1-\tau) > r$, the tax raises the required rate of return on an investment (in order for it to be worth undertaking) ; any projects with internal rates of return between r and $r/(1-\tau)$ would be worth undertaking in the absence of the corporate income tax, but not worth undertaking when the return is subject to taxation.

But what if the project is financed by debt, rather than equity? The cost of the project is I, which means that the firm would have annual interest costs of rI if it borrowed the money to finance the project. Those costs can be deducted from income in the computation of the firm's corporate tax liabilities. So if the firm invested, then each year it would get a net return of

$$(1-\tau)x + \tau r I$$

where the second term is the reduction in taxes payable due to the interest it is paying on its new debt. The firm's criterion to invest is to invest if and only if

$$\frac{(1-\tau)x + \tau r I}{I} \geq r \tag{c6}$$

where the term on the left side of equation $(c6)$ is the project's internal rate of return, taking into account all the tax consequences. But condition $(c6)$ can be written as

$$(1-\tau)\frac{x}{I} \geq (1-\tau)r \tag{c7}$$

by subtracting $\tau rI/I$ from both sides of $(c6)$. And $(c7)$ is exactly the same as $(c3)$: the corporate tax is **neutral** if the investment is financed entirely by borrowing.

What if the firm financed some **fraction** β of the cost of the investment by borrowing, and the remaining fraction $1-\beta$ by new equity issue. Then the firm's investment criterion would be to undertake the project if and only if

$$\frac{(1-\tau)x+\beta\tau rI}{I} \geq r \tag{c8}$$

which can be written (by subtracting $\beta\tau I$ from both sides of $(c8)$)

$$(1-\tau)\frac{x}{I} \geq r(1-\beta\tau) \tag{c9}$$

Expression $(c9)$ can be interpreted two ways. One, the firm requires that the internal rate of return x/I must be at least as great as the **user cost of capital**

$$R_u \equiv r\frac{1-\beta\tau}{1-\tau} \tag{c10}$$

Second, the **net of tax** return per dollar invested $(1-\tau)x/I$ must be at least as much as the discount rate

$$r_d \equiv (1-\beta\tau)r \tag{c11}$$

So, if not all of the investment is financed by borrowing (so that $\beta < 1$), then investment is discouraged, either because the user cost of capital is increased (expression $(c10)$, or because the discount rate decreases less than the net return per dollar invested.

To complicate matters considerably, now suppose that the asset does not last forever, but depreciates at a constant rate. That is, the annual returns from the asset are x in the first year, $(1-\alpha)x$ in the second year, $(1-\alpha)^2x$ in the third year, and so on.

If there were no taxation, the firm would invest if and only if

$$\frac{x}{1+r}+\frac{(1-\alpha)x}{(1+r)^2}+\frac{(1-\alpha)^2x}{(1+r)^3}+\cdots \geq I \tag{c12}$$

which is equivalent to

$$\frac{x}{I} \geq r+\alpha \tag{c13}$$

So the corporate tax will discourage investment if — in the presence of the tax — the firm will only invest if

$$\frac{x}{I} \geq R+\alpha$$

for some $R > r$.

So here α is the **actual** (constant) rate of depreciation. What might be different is the rate of depreciation which may be claimed in the tax schedule. So let δ denote the rate allowed in the tax schedule for depreciation claims. For many assets, the tax schedule allows the firm to claim

for depreciation at a faster rate than it actually occurs. This is called **accelerated depreciation**, and it provides a benefit to the firm, since it wants to claim its tax deductions sooner, rather than later. With declining balance depreciation allowances at the rate δ, the firm could deduct a depreciation allowance of δI from taxable income in the first year it owned the asset, $\delta(1-\delta)I$ in the second year, $\delta(1-\delta)^2 I$ in the third year, and so on.

So here is the whole, pretty complicated, decision the firm has. It is considering undertaking an investment project which costs I. If it does undertake the project, it would finance a fraction β of the costs through borrowing, and a fraction $1-\beta$ through equity issue. That means that the discount rate that the firm should use to evaluate the profitability of the project is

$$r_d = (1-\beta\tau)r$$

In year t, the project will yield a net–of–tax return to the firm of

$$(1-\tau)(1-\alpha)^{t-1}x + \tau\delta(1-\delta)^{t-1}I \qquad (c14)$$

The first term in expression ($c12$) is the value of the return to the investment in year t, after tax. The second term is the value of the depreciation allowance. The firm should undertake the investment if the present value of annual returns ($c14$), discounted at the discount rate r_d, is at least as large as the cost I, or

$$\frac{(1-\tau)x+\tau\delta I}{1+r_d} + \frac{(1-\tau)(1-\alpha)x+\tau\delta(1-\delta)I}{(1+r_d)^2} + \frac{(1-\alpha)^2(1-\tau)x+\delta(1-\delta)^2\tau I}{(1+r_d)^3} + \cdots \geq I \quad (c15)$$

Using the mathematical fact that

$$a + a^2 + a^3 + \cdots = \frac{1}{1-a} \qquad (c16)$$

for any $a < 1$, expression ($c15$) can be written [use ($c16$) with $a = (1-\alpha)/(1+r_d)$, and with $a = (1-\delta)/(1+r_d)$]

$$\frac{(1-\tau)x}{\alpha+r_d} + \frac{\tau\delta I}{\delta+r_d} \geq I \qquad (c17)$$

or

$$\frac{x}{I} \geq (\alpha+r_d)\frac{(1-\tau)\delta+r_d}{(1-\tau)(\delta+r_d)} \qquad (c18)$$

The corporate tax discourages investment whenever the right–hand side of expression ($c18$) exceeds $r+\alpha$. For example, suppose that the firm financed its investment entirely through borrowing, so that $\beta = 1$. Suppose as well that the tax code provided "true" economic depreciation, so that $\delta = \alpha$. Then $r_d = (1-\tau)r$, and the right hand side of expression ($c18$) exactly equals $r+\alpha$. If $r_d = r(1-\tau)$, and if $\delta > \alpha$, then the right–hand side of ($c18$) would be **less** than $r+\alpha$. [Differentiate the right side of ($c18$) with respect to δ to see that it does decrease with δ.] So

if all investment is to be financed by borrowing, then using "true" economic depreciation ($\delta = \alpha$) makes the corporate tax neutral with regard to investment, whatever is the tax rate τ ; if

all investment is to be financed by borrowing, and there is accelerated depreciation ($\delta > \alpha$), then the corporate income tax **encourages** investment, and an increase in the corporate tax rate would lead to more investment

At the opposite extreme, suppose that all corporate investment were financed by equity, so that $\beta = 0$, and $r_d = r$. Then the right side of expression ($c18$) is

$$(\alpha + r)(1 + \frac{r}{\delta + r}\frac{\tau}{1+\tau}) > \alpha + r \qquad (c19)$$

for any depreciation rate $\delta < 1$ in the tax schedule. Therefore

if all investment is to be financed by new equity issue, then the corporate income tax **discourages** investment, no matter what the depreciation rate allowed for tax purposes ; increases in the corporate tax rate τ or decreases in the allowable depreciation rate δ would both lead to a reduction in investment

Could the corporate income tax be neutral if the costs of investment were not tax deductible? Suppose that we had no taxable depreciation allowances at all, but that all investment costs could be **expensed**. That is, investment costs were deductible in the year in which they were incurred. In that case, the firm would undertake the investment if and only if

$$\frac{(1-\tau)x}{1+r_d} + \frac{(1-\tau)(1-\alpha)x}{(1+r_d)^2} + \cdots \geq (1-\tau)I \qquad (c20)$$

or if and only if

$$\frac{x}{I} \geq (\alpha + r_d) \qquad (c21)$$

If no finance costs were deductible, then $r_d = r$, and the right hand side of expression ($c21$) just equals $\alpha + r$. Hence

if all of the firm's expenses, current or capital, were deductible in the year in which they were incurred, then the corporate income tax would be neutral if costs of financing investment were not tax–deductible ; if any costs of finance were tax deductible (and if all current and capital costs could be deducted immediately), then the corporate income tax would **encourage** investment

A corporate income tax in which there are no deductions for borrowing costs or depreciation, and in which all capital expenditures can be deducted from taxable income, is sometimes called a **cash flow** tax.

In summary, then, there are two relatively easy ways to make the corporate income tax neutral : a cash flow tax, and a tax in which all finance costs are tax deductible, and in which depreciation allowances equal true economic depreciation.

In practice, we do not have immediate deductibility of capital expenditures. But we do have accelerated depreciation. Whether the current tax encourages or discourages corporate investment, compared to no tax at all, depends on how much firms rely on borrowing to finance capital expenditures (and on how generous are capital consumption allowances).