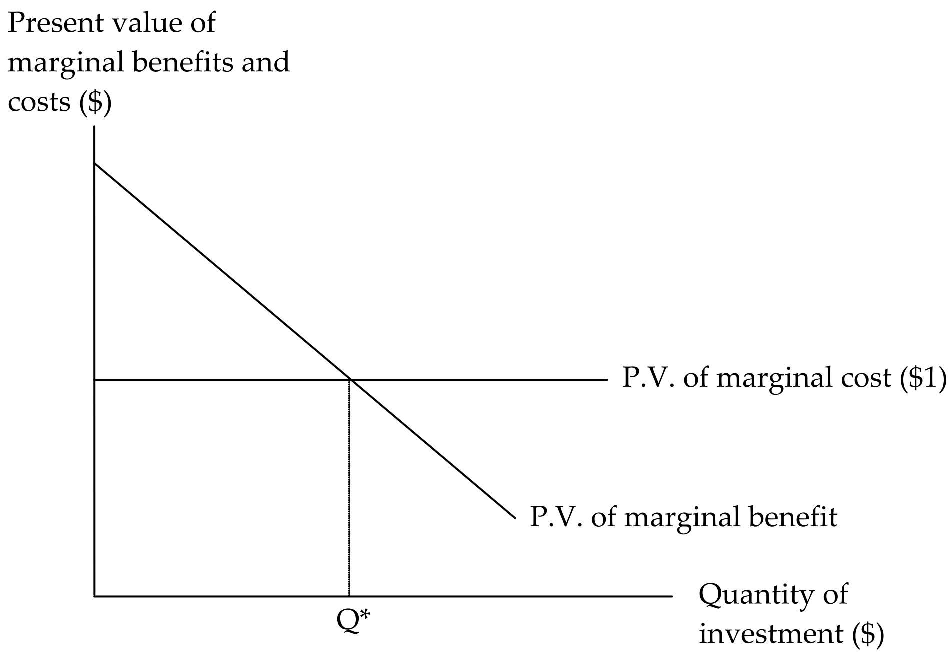
How taxes affect incentives to invest

Jon Bakija, Williams College
Original version: March, 2011
Minor revisions to improve clarity: April 2014

The effect of taxation on incentives to undertake investment is one of the more technically difficult subjects in the economics of taxation, but most of the key insights can be understood with simple examples. In this short document, I will illustrate how incentives to invest are affected by various approaches to business level taxation; for example, what are the consequences for incentives to invest of allowing deductions for economic depreciation, accelerated depreciation, expensing, or an "allowance for corporate equity?" To keep things simple, we'll focus entirely on business-level taxation and ignore personal level taxation. Personal level taxation certainly matters too – for example, if interest on corporate bonds or dividends on corporate equities are taxable at the personal level, this will affect the incentive to invest too. Both business-level and personal-level taxes can affect the size of the "wedge" that taxes may insert between the marginal benefit of investment and the marginal cost of saving. Here, we'll just focus on the effects of business-level taxes.

When a firm invests in physical capital (e.g., factories, productive machinery, buildings), it incurs costs today, and receives benefits that may be spread out over the course of many future years. In order to compare benefits and costs that occur at different points in time, we need to convert them to present values. Think of a firm's decision about how much investment to undertake this year. The decision rule a firm will follow is to make any particular investment for which the present value of marginal benefits is greater than or equal to the present value of marginal costs. If the present value of marginal benefits is less than the present value of marginal costs, then the firm would be better off forgoing the investment, because it could earn a higher return by saving or lending out the funds at the going rate of interest. To simplify things, let's measure the quantity of investment in dollars, and assume that all of the costs of the investment are laid out immediately, so that the present value of the cost of $1 of investment is $1. We can imagine a continuum of possible investments, each with a certain present value of anticipated marginal benefits. The firm will undertake the investments with the highest present value marginal benefits first, and then will keep making investments up to the point where the present value of the benefits of the last, marginal, investment is just equal to the cost. So the firm's investment decision can be shown on a diagram like the one below. In the diagram, Q* is the optimal, or economically efficient, quantity of investment.

Figure 1



To think through how different approaches to business taxation affect the incentive to invest, let's consider an extremely simple example of a "marginal investment" -- that is, the investment right at Q*, where, in the absence of taxes, the present value of marginal benefits just equals the present value of marginal costs. Suppose the marginal investment is a machine that costs $100 immediately, produces $110 of benefits (e.g., sales revenue) exactly one year from now, and then experiences $100 of depreciation exactly one year from now (that is, the machine dies and becomes worthless after one year). We will assume that the discount rate (that is, the opportunity cost of investing in the absence of taxes) is 10% -- this is not meant to be empirically realistic, it's just chosen to keep the math simple. In the absence of taxes, the present value of costs = $100, and the present value of benefits = $110 / 1.1 = $100. So in the absence of taxes, the firm would just break even on this investment. In each of the following examples, we will consider how the decision to undertake this investment affects the present value of tax burden compared to not undertaking the investment, and will also calculate the effect on the after-tax rate of return to the investment (which would be 10% in the absence of taxes). In each case, we consider a 30% business-level tax, and show how things differ depending on the design of the business-level tax, the source of financing, etc.

Corporate income tax, equity financed investment, deductions for economic depreciation

First, suppose this is an equity-financed investment undertaken under a standard corporate income tax regime with a 30% rate, and suppose that the tax law allows a deduction for depreciation which exactly equals economic depreciation (which in this case is simply $100 one year from now). Consider how the decision to invest the $100 affects the present value of tax burdens. Under the income tax, the decision to spend the $100 on the investment has no consequences for taxes today, because no sales revenue has yet been produced by the investment, and no depreciation deductions are yet allowed. One year from now, the choice to make the investment will increase the firm's tax base by:

$110 increased sales revenue - $100 depreciation deduction = $10.

The tax paid next year is 30%*$10 = $3. The decision to undertake the investment thus increases the present value of the firm's tax burden by $3/1.1 = $2.73.

We can also think through how the tax affects the after-tax rate of return to the investment, which can be thought of as the percentage by which the benefits of the investment exceed the costs (or in a more complicated setting, it's like the interest rate you are earning by making the investment). In the absence of taxes, the rate of return to the investment is ($110-$100)/$100 = 10%. The 30% corporate income tax imposes a $3 tax burden next year, reducing the rate of return to the investment to ($110-$3-$100)/$100 = 7%. So in other words, the corporate income tax reduces the incentive to invest by the tax rate times the rate of return, from 10% to 7%. The "effective tax rate" on the return to the investment is:

$(r_{\text{before tax}} - r_{\text{after tax}})/r_{\text{before tax}}$

In this example the effective tax rate equals (10%-7%)/10% = 30%, which is the same as the statutory tax rate. In general, a corporate income tax with deductions for economic depreciation imposes a tax equal to the statutory tax rate on the return to equity-financed investment.

Expensing ("Cash Flow Taxation")

The key economic distinction between an income tax and a consumption tax is that an income tax reduces the incentive to save and invest, and a consumption tax does not. At the business level, one way to achieve consumption tax treatment would be to allow investment to be "expensed" – that is, the firm gets to deduct the full cost of the investment immediately when the investment is made, rather than gradually getting deductions for depreciation over time. This approach to business taxation is also sometimes known as "cash flow taxation." Let's consider the consequences of expensing for the decision to undertake a marginal investment. Today, when the firm makes the investment, it gets a $100 tax deduction. This reduces the firm's tax bill by 30%*$100 = $30, and since the deduction happens immediately, the present value of the tax saving is also $30. Next year, the decision to undertake the investment increases the firm's sales revenue by $110, and there are no deductions available next year, so tax next year increases by 30%*$110 = $33. However, the present value of next year's tax increase is just $33/1.1 = $30. So the net effect of the decision to invest on the present value of tax burdens in this example is +$30 - $30 = $0. When we allow expensing, then the decision to invest incurs no present value tax burden on a marginal investment, because the present value of the tax savings from the expensing deduction just offsets the present value of the tax burden imposed in the future on the proceeds from the investment. Thus, a business tax that allows expensing creates no distortion in the incentive to undertake investment, and we will still get investment equal to Q*.

When we allow expensing, the tax similarly has no impact on the rate of return from the investment. You can think of the opportunity cost of undertaking the investment today as $70 – the $100 cost of the investment, less the $30 tax savings from expensing. The benefit of undertaking the investment is the $110 increase in sales proceeds next year, less the $33 tax bill next year, for a net gain of $77. The rate of return to undertaking the investment is ($77 - $70)/$70 = 10%, the same as it would be without taxation. So the effective tax rate on the return to investment is zero.

Corporate income tax, equity financed investment, deductions for accelerated depreciation

Let's return to the corporate income tax again. In practice, deductions for depreciation are only rough approximations of economic depreciation, and sometimes the tax law is written to intentionally allow "accelerated" depreciation – that is, allowing deductions for some depreciation before it actually occurs. This is often intended to increase the incentive for investment. Accelerated depreciation gives us something part way between economic depreciation and expensing. Suppose, for example, that we modify our corporate income tax example above to allow $50 of depreciation deduction immediately, and $50 of depreciation deduction next year, despite the fact that economically speaking, all $100 of the depreciation actually happens next year. First, consider the consequences of the investment for the present value of tax burdens. The decision to invest allows the firm to take a $50 deduction today, which reduces the firm's tax burden today by 30%*$50 = $15. Next year, the firm receives $110 in sales revenue from the investment, and only gets to deduct the remaining $50 of depreciation deductions, leaving a tax base of ($110-$50) = $60, and incurring a tax burden of 30%*$60 = $18. The present value of next year's tax burden is $18/1.1 = $16.36. So the net present value of the increase in tax liability caused by the decision to invest is -$15 + $16.36 = $1.36. This is roughly half of the $2.73 present value tax burden imposed by an income tax that only allows deductions for economic depreciation.

The effect of the corporate income tax with accelerated depreciation on the rate of return to investing can be determined as follows. The opportunity cost of investing today is the $100 cost of the investment less the $15 tax saving, which equals $85. The after-tax benefit next year from choosing to undertake the investment is the $110 sales revenue less the $18 tax payment next year, which equals $92. So the rate of return on the investment is ($92-$85)/$85 = 8.235%. The effective tax rate on the return to investment is (10%-8.235%)/10% = 17.65%. So in this case, accelerated depreciation has reduced the effective tax rate on the returns to investment from the 30% statutory tax rate to an effective tax rate of 17.65%.

Corporate income tax, debt financed investment, deductions for economic depreciation

Now consider what happens if we have a corporate income tax with deductions for economic depreciation, but we finance the investment by selling a $100 bond that pays a 10% interest rate (the interest is paid next year). The decision to invest today has no tax consequences, because there are no sales revenues or depreciation deductions today. Next year, the decision to invest increases sales revenue by $110, and the firm is allowed a $100 depreciation deduction, and a $10 deduction for interest paid out on the bonds. So next year's tax base =

$110 sales revenue - $100 depreciation deduction - $10 interest deduction = $0.

As a result, the decision to invest leads to no additional tax liability next year. In a corporate income tax, the deduction for interest on a debt-financed investment effectively wipes out the tax on the normal rate of return on a marginal investment. So the decision to invest has no effect on the present value of tax burden. The rate of return on the investment is still ($110-$100)/$100 = 10%. In an income tax, the interest on the bonds may be taxed at the personal level, so that will affect the incentive to save and invest, but the corporate income tax is imposing no tax on the normal return to the debt-financed investment, and is not distorting incentives to invest.

Corporate income tax, debt-financed investment, accelerated depreciation

As noted above, the interest deduction in a corporate income tax with deductions for economic depreciation wipes out the business-level tax on the normal return to debt-financed investments. In many real-world corporate income taxes, however, deductibility of interest is coupled with accelerated depreciation. In that case, debt-financed investments actually face a *negative* effective tax rate at the business level. For example, consider a debt-financed investment when we allow accelerated depreciation, say $50 depreciation deduction today and $50 next year. If we make the investment, then today we get a deduction of $50, which reduces our tax burden by 30%*$50 = $15. Next year, our tax base is:

$110 sales revenue - $50 depreciation deduction - $10 interest deduction = $50.

Next year, our increase in tax burden relative to not making the investment, is 30%*$50 = $15, which in present value is worth $15/1.1 = $13.64. So the effect of investing on the net present value of tax burdens is +$15 - $13.64 = -$1.36. The decision to invest has actually *reduced* the present value of tax payments. In other words, the corporate income tax is subsidizing investment in this case. The after-tax rate of return can be found as follows. The opportunity cost of investing today is the $100 cost of the investment less the $15 tax savings = $85. The benefit next year is $110 sales revenue - $15 tax = $95. So the rate of return to investing is ($95-$85)/$85 = 11.76%. The effective tax rate is (10%-11.76%)/10% = *negative* 17.6%. So the combination of interest deductibility and accelerated depreciation in this example amounts to a 17.6% *subsidy* to investment. This can be thought of as yet another example of tax arbitrage; we're borrowing money and deducting the interest at the statutory tax rate, in order to invest in an asset whose returns are taxed at an effective rate that is well below the statutory tax rate. This provides an opportunity for firms to reduce their tax burdens by making investments that are economically inefficient. If we were to allow interest deductions and expensing at the same time, this problem would be even worse. The problem is also exacerbated during periods of high inflation, since during those times nominal interest rates will be high, so the tax savings from deducting interest will be very large. All of these problems are offset to some extent if the interest paid out on the bonds is taxed at the personal level, which we are ignoring here.

The "allowance for corporate equity" (ACE)

The "allowance for corporate equity" (ACE) approach to business taxation is discussed in Keen and King (2002). In the context of an income tax, the purpose of an ACE is to treat debt-financed and equity-financed investments equally, and to get rid of the problem of subsidies for investment when interest deductions are coupled with accelerated depreciation. The ACE could also be used to implement a consumption tax; as we will see, if the ACE is allowed at the business level, and at the personal level we only tax labor income and impose no tax on personal capital income, then we have a consumption tax that does not distort the incentive to save or invest (this is how it worked in Croatia between 1994 and 2001).

The ACE works like a corporate income tax, with the following modification. There is an additional deduction equal to:

*a**(book value of firm's equity at the end of last year for tax purposes)

where *a* is an interest rate chosen by the tax authorities to approximate the "normal" rate of return to investment (for example, it might be the interest rate on low-risk bonds), and:

Book value of firm's equity for tax purposes =
original cost of all capital owned by the firm
- depreciation deductions already taken
- debt

For example, suppose we buy a $100 machine, pay for $40 of it with debt, are allowed $25 of accelerated depreciation deductions on the machine in its first year, and *a* is set to 10%. In that case, the decision to make the investment increases the book value of the firm's equity for tax purposes by $100 - $40 - $25 = $35, and the investment increases the allowance for corporate equity that the firm can deduct next year by 10%*$35 = $3.50.

The idea here is to provide a deduction for the normal return to equity-financed investment, in a manner parallel to what the corporate income tax normally does for debt-financed investments. An important difference, though, is that as long as a is set equal to the rate of return on a marginal investment, the design of the ACE makes the effective tax rate on a marginal investment precisely zero, regardless of whether the investment is financed with equity or debt, and regardless of whether depreciation deductions reflect true economic depreciation.

ACE, equity financed investment, economic depreciation

First, consider an equity-financed investment in an ACE tax that allows deductions for economic depreciation. Making the investment today has no tax consequences, because it does not affect sales revenue or yield depreciation deductions immediately. This year's decision to invest will increase next year's "ACE" deduction by normal rate of return (10%) times the value of the investment ($100) less depreciation deductions already taken ($0); so the ACE deduction will be 10%*$100 = $10. The effect of the investment on the firm's tax base next year will be:

$110 sales revenue - $100 depreciation deduction - $10 ACE deduction = $0.

As a result, the decision to invest will not affect tax liability next year. This basically replicates the corporate income tax's treatment of debt-financed investment. The opportunity cost of investment today is $100, the benefit next year is $110, so the rate of return is ($110-$100)/$100 = 10%, and the effective tax rate on the return to a marginal investment are zero.

ACE, equity financed investment, accelerated depreciation

A particularly clever feature of the ACE is that, if we have accelerated depreciation, the extra tax saving from the accelerated depreciation is exactly offset by a reduction in tax savings from the ACE deduction. So even if our depreciation deductions do not match economic depreciation (either intentionally or because economic depreciation is too hard to measure), the business-level ACE tax will still impose an effective tax rate of exactly 0% on the normal return to a marginal investment, and will neither tax it nor subsidize it. To see how this works, consider an ACE tax where we allow accelerated depreciation, granting a $50 depreciation deduction today and a $50 depreciation deduction next year. The decision to invest gives us a $50 deduction today, which reduces our tax bill by 30%*$50 = $15. Next year, our ACE deduction will only be 10%*($100 cost of investment - $50 depreciation deductions already taken) = $5. So the effect of choosing to invest on our tax base next year will be:

$110 sales revenue - $50 depreciation deduction - $5 ACE deduction = $55.

Our tax next year will be 30%*$55 = $16.5. In present value, that's $16.5/1.1 = $15. So the net effect of the investment on the present value of tax burden is +$15 - $15 = $0. The opportunity cost of the investment today is $100 less the $15 tax saving = $85, and the benefit from the investment next year is $110 - $16.50 tax = $93.5, so our rate of return is ($93.5-$85)/$85 = 10%. The effective tax rate is again 0%.

ACE, debt-financed investment, accelerated depreciation

Here is how the ACE fixes the problem of subsidies for investment when interest deductions for debt are coupled with accelerated depreciation. Suppose accelerated depreciation allows us a $50 deduction today and a $50 deduction next year. Further suppose we borrow $100 at a 10% interest rate to finance our investment. The consequence for taxes today will be to reduce taxes by 30%*$50 = $15. Next year, we'll have $110 in sales revenue, and will get a $50 depreciation deduction and a $10 deduction for interest paid on our bonds. The tricky thing is that this combination of events will actually reduce the ACE deduction we can get on our other investments. The effect of this debt-financed investment on the aggregate amount of ACE deductions we can take is 10%*(effect on equity-financed investment – effect depreciation deductions already taken) = 10%*($0 - $50) = -$5. In other words, the debt-financed investment didn't increase the value of our equity-financed investments, but the accelerated depreciation reduced the base used to calculate our ACE deduction, so we are reducing the ACE deduction that is available to be taken on other investments. So the effect of the debt-financed investment on next year's tax base is:

$110 sales revenue - $50 depreciation deduction - $10 interest deduction + $5 reduction in ACE deductions = $55.

Thus, tax next year is 30%*$55 = $16.5, which is $16.5/1.1 = $15 in present value. So the net effect of the decision to invest on the present value of tax burden is: -$15 + $15 = $0. The effective tax rate on the normal return to this marginal investment is still 0%, and the after-tax rate of return on the investment is still 10%.

The bottom line: effects of different approaches to taxation and methods of financing on incentives to invest

All of the examples above illustrated the effects of various approaches to taxation and methods of financing on the tax burden for a *marginal* investment, an investment where the rate of return is just equal to the "normal" rate of return (the discount rate used to compute present values). The bottom line findings were as follows:

- A corporate income tax with deductions for economic depreciation taxes the return to an equity financed investment at the statutory tax rate.

- A business-level tax that allows expensing imposes no present value tax burden on a marginal investment, and imposes a 0% effective tax rate on the normal rate of return to investment. So the quantity of investment will be efficient under such a tax.

- A corporate income tax with accelerated depreciation taxes the return to an equity financed investment at less than the statutory rate.

- A corporate income tax with deductions for economic depreciation imposes no tax on the normal rate of return to a debt-financed investment.

- A corporate income tax with accelerated depreciation *subsidizes* debt-financed investment.

- An ACE imposes an effective tax rate of exactly 0% at the business level on the normal rate of return to investment, regardless of whether it is financed by debt or equity.

ABOVE NORMAL RETURNS

Some investments in the economy earn a return higher than the "normal" rate of return. For example, refer back to Figure 1. In that diagram, the marginal investment at Q* pays a rate of return just equal to the "normal" rate of return (the discount rate), which is why the present value of marginal benefits for that investment just equals the present value of marginal costs. But all of the investments to the left of Q* (the "infra-marginal" investments) pay rates of return higher than the normal rate of return. These are called "above normal returns," "supernormal returns," or "rents." In the context of our simple examples above, they are investments that pay a rate of return above our assumed normal rate of return of 10%. Above-normal returns may also arise for other reasons besides infra-marginal investment -- see Slemrod and Bakija (forthcoming, Ch. 6) for discussion of these other sources of above-normal return.

A key point is that although cash flow taxation (expensing) and the ACE impose no tax burden on a marginal investment that earns a normal rate of return, they do impose a tax burden on above-normal returns. As a result, these approaches to taxation will raise revenue in present value terms, but will not distort investment decisions. A standard corporate income tax also imposes tax on above-normal returns; the difference is that it also imposes tax on the normal return to marginal investments, so it will distort the quantity of investment that takes place.

To illustrate how some of these approaches to taxation raise revenue from investments with above-normal returns, let's modify our simple example in the following way. A firm is considering an investment in a machine that costs $100 today, and produces $121 in benefits one year from now. Next year, the machine dies, so there is depreciation of $100 one year from now. The rate of return on the investment is ($121-$100)/$100 = 21%. But let's continue to suppose the normal rate of return (the discount rate) is 10%. The business tax rate is still 30%.

Expensing (Cash flow taxation) with above-normal returns

If we choose to invest, we reduce our tax base today by $100, which saves us 30%*$100 = $30 in taxes today. Next year, we have $121 in sales revenue, and no deductions, so we pay 30%*$121 = $36.3 in taxes. That's $36.3/1.1 = $33 in present value. So the net effect of the decision to invest on the net present value of our tax payments is -$30 + $33 = +$3. So the government is gaining revenue in present value. To find the after-tax rate of return, note that the opportunity cost of investing today is the $100 cost less the $30 tax savings = $70. The benefit next year is $121 - $36.3 = $84.7. The rate of return to the investment is ($84.7-$70)/$70 = 21%. So the tax system is still not distorting the incentive to invest, but it is raising revenue in present value.

ACE, equity financed investment, economic depreciation, above-normal returns

Now suppose we are considering the same investment (financed by equity) under an ACE business tax with deductions for economic depreciation. If we make the investment, it has no tax consequences today. Next year, we'll have $121 of sales revenue, a $100 depreciation deduction, and an ACE deduction of 10%*($100) = $10. So the effect of investment on next year's tax base is:

$121 sales revenue - $100 depreciation deduction - $10 ACE deduction = $11.

Our tax next year is $3.3, which in present value is $3.3/1.1 = $3, the same as under the cash flow tax. So the ACE tax is also raising revenue in present value terms by taxing above normal returns, but as noted above does not distort how much investment occurs, because it imposes no tax on a marginal investment.

Corporate income tax, equity-financed investment, economic depreciation, above normal returns

Now consider how a corporate income tax treats an investment with above normal returns. There's no tax consequence today. Next year, the effect on the tax base is to increase sales revenue by $121, and to increase depreciation deductions by $100. So next year's tax base increases by ($121-$100) = $21, producing a tax bill at that time of 30%*$21 = $6.3. In present value, that's $5.73. On page 4, we found that this tax put a $2.73 present value tax burden on a marginal investment that just earns a normal return. The $5.73 present value tax burden on this investment with an above normal return is equal to the $2.73 present value tax on the normal return, plus the same $3 present value tax that a cash-flow tax or an ACE would place on the above-normal part of the return. So an income tax is equal to a cash-flow tax or an ACE plus a tax on the normal rate of return.

Diagrammatic illustration

The diagrams below illustrate how the present value of tax revenue collected from an investment varies depending on the rate of return. In Figure 2, because the corporate income tax imposes present value tax burden on a marginal investment, at the margin it places a "wedge" between the present value of benefits from the investment and the present value of the costs. As a result, it leads firms to reduce their quantity of investment from the efficient level Q* to the lower level Q_{tax}. The present value of tax revenue raised by the tax is equal to the light gray shaded area in Figure 2. As we saw in the example above, the present value of tax revenue raised by the corporate income tax on $1 of investment increases as the rate of return rises, which is why the present value of revenue from the first few investments (which have higher rates of return) is higher than the present value of revenue from later investments with lower rates of return.

Figure 2 – Effect of a corporate income tax on the present value of benefits and costs from an equity-financed investment

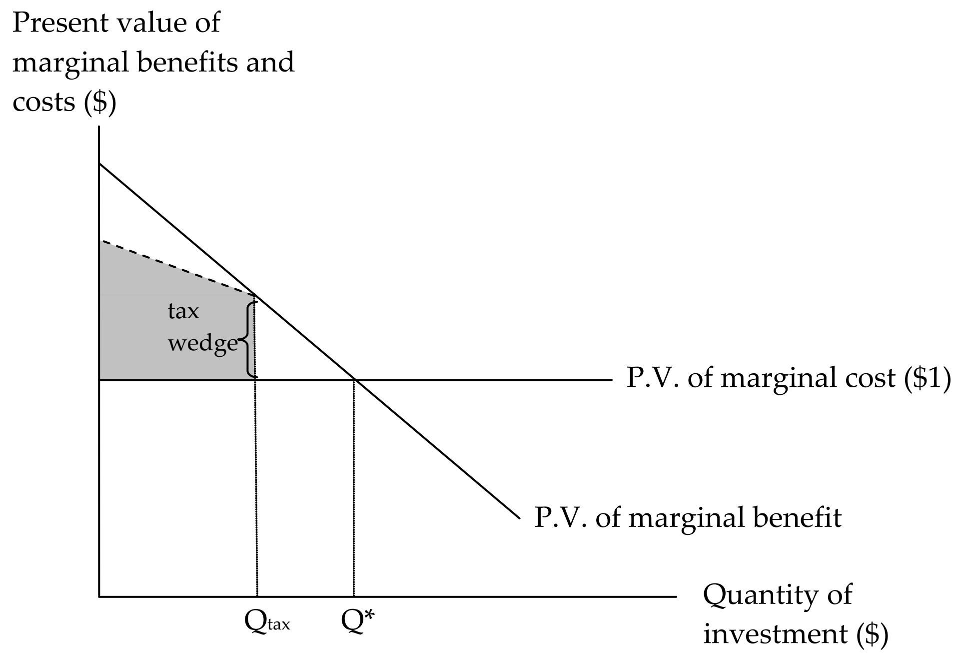
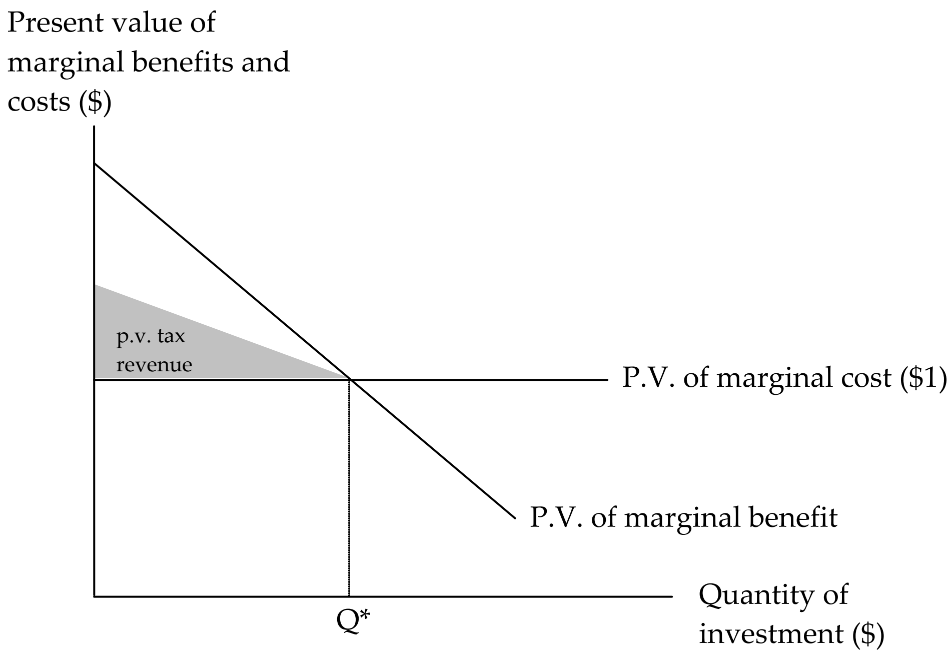


Figure 3 below illustrates the effects of a cash-flow (expensing) or ACE business tax on the present value of benefits and costs from investing. As shown in the examples above, both taxes impose no present-value tax burden on a marginal investment, so there is no "wedge" between the present value of marginal benefits and marginal costs at the margin, and investment remains at the efficient level Q*. For investments with above-normal returns, some present value tax burden is imposed, with the present value of tax burden rising with higher above-normal rates of return. But that has no effect on the quantity of investment, because these investments still have rates of return above the discount rate even after subtracting out the effects of taxes. The shaded gray area in the diagram below shows the present value of tax revenues raised by the cash-flow or ACE tax.

Figure 3 – Effect of a cash-flow tax or ACE on the present value of benefits and costs from an investment



Extending the examples to more than two years

In reality, investments usually pay off and depreciate over multiple future years. All the essential things you need to know can be illustrated with the simple two-period framework used above, but you might be interested to know how this could be extended to multiple years. The tricky part when doing this is how to calculate the rate of return on an investment that provides benefits over multiple years. The basic idea is that the rate of return on an investment is the discount rate that would set the present value of benefits just equal to the present value of costs. It's possible, but tedious, to solve for this algebraically. In practice, a good way to find the rate of return on an investment which spins out benefits over multiple years is to use an Excel spreadsheet, and to calculate the rate of return using the IRR() function (for "internal rate of return"). To take one relatively simple example, suppose we have an investment in a machine that costs $100 today. One year from now, it produces a benefit of $55 and experiences $45 depreciation, and then two years from now it produces a benefit of $60.50 and experiences another $55 of depreciation, after which the machine is dead and of no further use. If you use Excel's IRR() function on the series of cash flows -100, 55, 60.5, you find the internal rate of return (that is, the annual rate of return on the investment) is 10%. Let's suppose that 10% is also the "normal rate of return" (discount rate). In that case, note that economically, the pattern of economic depreciation is internally consistent as well. At each point in time, the value of a capital good should equal the present value at that time of future benefits to be obtained from it (if it wasn't, there would be an arbitrage opportunity). Next year, after the $45 depreciation, the machine is worth $55. That is equal to the present value at that time of the future benefit; that is $60.5/1.1 = $55.

Try this with a 30% cash flow tax, assuming a 10% discount rate. The tax savings today is 30%*$100 expensing deduction = $30. The tax next year is 30%*$55 = $16.5, which equals $16.5/1.1 = $15 in present value. The tax two years from now is 30%*$60.50 = $18.15. Discounted to present value, that's $18.15/(1.1)^2 = $15. So the net effect of the investment on the present value of taxes is -$30 + $15 + $15 = $0, just like in the two-period model.

Now try it with a 30% corporate income tax, economic depreciation, and an equity-financed investment. There's no tax consequence today. One year from now, tax = 30%*($55 sales revenue - $45 depreciation deduction) = $3. Two years from now, tax = 30%*($60.50 sales revenue - $55 depreciation deduction) = $1.65. The present value tax burden on the investment = $3/1.1 + $1.65/(1.1)^2 = $4.09. The after-tax cash flows from the investment are -$100 in the first year, ($55-$3) = $52 in the second year, and ($60.5-$1.65) = $58.85 in the third year. If we put that series of after-tax cash flows in a spreadsheet and use the IRR() function to calculate the rate of return, we get an internal rate of return of 7%. So the effective tax rate on this marginal investment is (10%-7%)/10% = 30%, the same as the statutory tax rate, just as in our simpler two-period example.

References

Keen, Michael, and King, John. 2002. "The Croatian Profit Tax: An ACE in Practice." *Fiscal Studies*, September 2002, v. 23, iss. 3, pp. 401-18.

Slemrod, Joel, and Jon Bakija. Forthcoming. *Taxing Ourselves: A Citizen's Guide to the Debate over Taxes*. 5th edition. Cambridge: MIT Press.