Taxing Risky Investment

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Abstract

This paper re-examines the impact of consumption and capital income taxes on (a) the incentive to undertake risky investment and (b) the revenue generated from such taxes. It challenges a well-known claim in the literature that a capital income tax with full loss offset can leave incentives to invest "basically unaffected" because the tax liability is offset by a reduction in the post-tax risk of the investment. Instead, it argues that such a tax would have a significantly negative impact on the incentive to invest.

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"Over the last 50 years, U.S. stocks have given a real return of about 9% on average. Of this, only about 1% is due to interest rates; the remaining 8% is a premium earned for holding risk." Cochrane (2001).

1. Introduction

The literature on tax and risky investment seems to have reached a consensus about the incentives generated by a tax on capital income. This consensus is summarised by Gordon (1985), which states that "taxation of corporate income can leave corporate investment incentives, and individual savings incentives, basically unaffected, in spite of sizable tax revenues collected" (Gordon, page 1). Others have applied a similar logic to capital income more generally. For example, Hubbard (1997) states that "in contrast to the base of the consumption tax, the income tax includes ... the rate of return on a marginal riskless project ... If only the risk-free interest rate is exempt under a consumption tax (relative to an income tax), the stimulus to domestic household saving may not be large" (Hubbard, page 140). Auerbach (2008), citing Hubbard, claims: "Hubbard argues that since both the income tax and the consumption tax hit economic rents, and since both tax the returns to risk-taking in the same manner, the only distinction between their treatments of capital income is the income tax on the safe rate of return. As this safe rate of return is not large, the distinction between the income tax and consumption tax does not appear to be large, either" (Auerbach, page 27). These are striking claims implying, according to Weisbach (2004), that a choice between a capital income tax and a consumption tax can be made on the basis of administrative costs: "a Haig-Simons tax is basically the same as a consumption tax (which imposes a zero rate of tax on capital), and the debate between the two tax bases is not particularly meaningful. The decision might best be made on administrative grounds" (Weisbach, page 1).

This paper challenges this consensus. It agrees that the basic difference between a consumption tax and an income tax is in the treatment of the risk-free element of the return. However, it argues that this creates a substantial difference in incentives between the two taxes. Gordon's claim does hold for consumption taxes, or equivalently a cash flow tax, or expenditure tax. But it does not hold for a capital income tax or tax on corporate income.

Contributions dating back to Domar and Musgrave (1944), and including Tobin (1958), Mossin (1968) and Stiglitz (1969) have all analysed how an income tax passes risk from the investor to the government. If individuals no longer bear that risk, then with a pure income tax with full offset, this suggests that individuals would take on more risk. Gordon (1985), Bulow and Summers (1984) and Kaplow (1994) all consider a general equilibrium framework in which the government passes the risk back to the private sector. In particular, Gordon sets up a general equilibrium model which demonstrates conditions under which a set of taxes meets the conditions of raising revenue while having no effect on investment incentives. However, it is straightforward to show that the set of taxes derived by Gordon is equivalent to a cash flow tax, but not to a capital income tax.

The basis of Gordon's claim that a corporate income tax has little effect on incentives to invest arises from an analysis of the cost of capital. In the absence of tax, the required expected return on an investment can be decomposed into two components, a risk-free rate of return and a risk premium. For an investment with a stochastic return $\widetilde{p}$ (where a tilde indicates a stochastic variable), the minimum required expected rate of return is $E(\widetilde{p}) = r + \gamma$, where r is the risk-free rate of return and γ is the risk premium. Now introduce a tax at rate τ on the stochastic return, $\widetilde{p}$, and assume that r is unaffected. The required expected post-tax return must satisfy: $(1-\tau)E(\widetilde{p}) = r + \gamma^T$, where γ^T is the risk premium in the presence of tax. If the underlying risk of the investment does not change, the risk premium is reduced by the same factor, $(1-\tau)$, so that $\gamma^T = (1-\tau)\gamma$. Solving for $E(\widetilde{p})$ in the presence of tax yields $E(\widetilde{p}) = r/(1-\tau) + \gamma$. That is, the impact of the tax is to raise the cost of capital only on its risk-free element. Given r =1% and γ =8%, as cited from Cochrane (2001) above for example, a 50% tax rate would raise the required rate of return only from 9% to 10%.

This paper does not dispute this analysis. However, it argues that such a rise in the cost of capital represents a significant disincentive to invest. The reason is that in comparing the cost of capital in this way in the presence and absence of tax, it is assumed that the risk of the investment is unchanged. That implies that the tax requires the additional return to be *risk free.* But this is important. Consider a marginal risky investment, which has an expected rate of return of 9%. The market values the stochastic return from this investment at the same price as the return from an equivalent risk-free investment which earns 1%. So, if the tax requires an additional 1% return risk-free, this must *double* the pre-tax market value of the investment. The change from 9% to 10% overall is not a small, insignificant, change in the required expected pre-tax rate of return, it is a very substantial change.

Gordon (1985) pointed out that a tax which gave relief for the risk-free element of the return, and which was returned in lump-sum fashion to individuals, would have no economic effects. He also showed that such a tax could raise considerable revenue, implying that the average tax rate is a poor measure of investment incentives. This paper argues that these claims refer to a cash flow tax, or a consumption tax. A capital income tax does not give relief for the risk-free element of the return. While this difference from a cash flow tax implies that the income tax would raise more revenue, it also implies that it would impose a considerable disincentive to invest.

This paper attempts to demonstrate this more formally, while making a comparison between these two alternative forms of taxation: a cash flow tax, and an income tax, both with full loss offset. The setting analysed is an investment with a required rate of return which may depend on the tax levied. As such it is natural to consider the taxes analysed to be levied on a corporation, or other business. However, the general principles involved apply also to a personal tax on the return to individual saving, where the saver faces a given pre-tax rate of return.[1] The paper also attempts to shed light on various statements in the literature about a "tax on the risk premium", and the market value of such a tax. It also reconciles the results in this paper with those of Gordon (1985). Finally, it proposes a measure of the impact of a tax in the incentive to invest which is independent of the risk of the investment project. Rather than basing the measure on the cost of capital, it bases it on the current market value of the returns to a marginal investment. This is equivalent to a typical empirical measure of the cost of capital which ignores risk.

[1] The general equilibrium effects of a residence-based tax on saving in a small open economy would generally differ from those of a source-based tax on corporate income. This paper abstracts from these general equilibrium considerations.

2. Project appraisal in the presence of risk

A crucial part of understanding the role of risk in affecting the impact of taxes on investment is determining how risk is priced. The fundamental approach used here is a simple value function, $V[\widetilde{x}]$ which gives the current market value (in period t) of a stochastic cash flow $\widetilde{x}$ arising in one period's time (period $t+1$). This approach is consistent with the "fundamental" pricing equation of Cochrane (2001):

$$V[\widetilde{x}] = E(\widetilde{m}\widetilde{x}) \tag{2.1}$$

where $\widetilde{m}$ is a stochastic discount factor. This discount factor can be generated from a simple two-period model of consumption, in which the investor optimally allocates consumption over periods t and $t+1$. Given a utility function $u(c)$, where c is consumption, and a rate of time preference, β, then

$$\widetilde{m} = \beta \frac{u'(\widetilde{c}_{t+1})}{u'(c_t)}. \tag{2.2}$$

If there were no uncertainty, then m would simply reflect the risk-free rate of interest, r - that is, $m = 1/(1+r)$. More generally, $E(\widetilde{m}) = 1/(1+r)$. Using this, and expanding the expected value of the product of $\widetilde{m}$ and $\widetilde{x}$, we can also write $V[\widetilde{x}]$ as:

$$\begin{aligned} V[\widetilde{x}] &= E(\widetilde{m})E(\widetilde{x}) + cov(\widetilde{m}, \widetilde{x}) \\ &= \frac{E(\widetilde{x})}{1+r} + cov(\widetilde{m}, \widetilde{x}). \end{aligned} \tag{2.3}$$

The first term on the RHS of this expression is the value of receiving a certain $E(\widetilde{x})$ next period. The second term captures the effect of risk. Note that, given strict concavity of the utility function, $cov(\widetilde{m}, \widetilde{x})$ has the opposite sign to $cov(\widetilde{c}_{t+1}, \widetilde{x})$. Hence if $\widetilde{x}$ is positively correlated with

$\widetilde{c}_{t+1}$, then $cov(\widetilde{m}, \widetilde{x}) < 0$, implying a lower $V[\widetilde{x}]$.

The value function $V[.]$ satisfies value additivity, or linear pricing, which implies that for any stochastic cash flows $\widetilde{A}$ and $\widetilde{B}$, and scalars a and b:

$$V[a\widetilde{A} + b\widetilde{B}] = aV[\widetilde{A}] + bV[\widetilde{B}]. \tag{2.4}$$

Value additivity is satisfied in all asset valuation models, including the CAPM, and is implied by the more primitive concept of no arbitrage (see Dybvig and Ross, 1989). This approach is therefore quite general.

One of the central issues in investigating the impact of taxes on investment is whether - for a given distribution of $\widetilde{x}$ - the introduction of the tax affects $\widetilde{m}$ and hence $V[.]$. One of the contributions of Gordon (1985) is to consider a general equilibrium framework. While introducing a symmetric tax may reduce the dispersion of possible outcomes to the investor, ceteris paribus, the overall level of risk in the economy is not reduced. Gordon considers a model in which tax revenues are passed back to consumers as a lump sum, and derives conditions under which asset prices and investment are unaffected by the tax.[2].

This paper does not present a general equilibrium model. The main reason for not doing so is that the insights of the paper can be made in a simpler way by assuming that $\widetilde{m}$ is not affected by the introduction of tax. In general, given (2.2), $\widetilde{m}$, and hence $V[.]$, do depend on the allocation of consumption between periods t and $t+1$ which will be generally be affected by taxes. That is, the pricing of future stochastic cash flows will generally be affected by the

[2] Whether or not the government can absorb risk costlessly plays an important role in other contexts as well, such as in comparing alternative forms of consumption tax; see Zodrow (1995).

introduction of a tax. However, as Gordon implicitly shows, $\widetilde{m}$ would not be affected by the introduction of a symmetric cash flow tax in which the revenues were paid back in a lump sum to individuals. In addition, in a small open economy where companies can access the world capital market, a source-based corporate income tax should have no effect the post-tax required rate of return, and also in this case the pricing of future stochastic cash flows within the company will also not generally be affected by domestic taxation. In what follows we abstract from any general equilibrium effects in order to focus on the direct impact of taxation. That is, we assume throughout that $\widetilde{m}$ and $V[.]$ and are unaffected by tax.

Consider now a very simple investment. An asset is purchased for one dollar in period t. In period $t+1$, it generates a stochastic return, $\widetilde{R}$. The asset is then sold for its stochastic value, $\widetilde{K} = 1 - \widetilde{\delta}$, where $\widetilde{\delta}$ is the stochastic economic depreciation rate. The total return $\widetilde{R}$ incorporates a financial return, denoted $\widetilde{p}$, plus compensation for the reduction in the value of the asset, $\widetilde{\delta}$, that is: $\widetilde{R} = \widetilde{p} + \widetilde{\delta}$. Hence $\widetilde{R} + \widetilde{K} = 1 + \widetilde{p}$. The period t value of the period $t+1$ stochastic cash flows can be written as

$$\begin{aligned} V^* &= V\left[\widetilde{R} + \widetilde{K}\right] = V\left[1 + \widetilde{p}\right] \\ &= \frac{1 + E(\widetilde{p})}{1 + r} + cov(\widetilde{m}, \widetilde{p}) \end{aligned} \tag{2.5}$$

where an asterisk denotes a value in the absence of tax. Deducting the cost of the investment from this gives the net present value of the investment, or, economic rent:

$$NPV^* = -1 + V^*. \tag{2.6}$$

The project is worth undertaking if NPV^* is positive, but not otherwise.[3]

[3] In the context of the investment literature, given that the initial cost of the asset is 1, then V^* can also be

Much of the investment literature works with the cost of capital, the minimum expected pre-tax rate of return on the investment. Setting $NPV^* = 0$, and solving for the implied value of $E(\widetilde{p})$ yields the cost of capital in the absence of tax:

$$\begin{aligned} NPV^* &= 0 \Rightarrow \\ E(\widetilde{p}) &= c^* = r - (1+r)cov(\widetilde{m}, \widetilde{p}) = r + \gamma. \end{aligned} \tag{2.7}$$

Here γ represents the risk premium.

We now introduce taxation. It is useful to begin with the benchmark case of a pure cash flow tax, which can be regarded as a consumption tax. We then consider a "pure" income tax, defined below.

3. A Cash Flow Tax

Consider first a symmetric tax[4] levied at rate τ on all net cash flows of the investment set out in the previous section. The tax generates a rebate worth τ on the investment in period t, and taxes the entire cash flows, $1 + \widetilde{p}$ in period $t + 1$. The market value in period t of this tax is

$$T^{CF} = -\tau + \tau V \left[1 + \widetilde{p}\right] = \tau NPV^* \tag{3.1}$$

and the net present value of the investment is

$$NPV^{CF} = -(1-\tau) + (1-\tau)V^* = (1-\tau)NPV^*. \tag{3.2}$$

Thus, the post-tax value of the investment is proportional to NPV^*, or economic rent. Note

thought of as a measure of average Q.

[4] Note that symmetry of the tax system is assumed throughout. Lund (2002) also analyses the case of uncertainty with respect to the tax position (ie. whether the firm is in a profit or loss making position) and hence the effective tax rate.

again that this is based on the assumption that the introduction of the tax does not change the valuation of a given cash flow arising next period: specifically, the valuation function $V[.]$ is unaffected by tax, since $\widetilde{m}$ is unaffected by tax. We also assume that the pre-tax stochastic return is unaffected by the tax. As a result, the tax is neutral, in the sense that (for $0 \leq \tau \leq 1$) the tax cannot change the sign of the net present value. If the project is worth undertaking in the absence of the cash flow tax, it is worth undertaking the presence of the tax. (This is of course consistent with neither the valuation function, nor the required pre-tax stochastic cash flow, changing as a result of the tax).

Of course, a well-known interpretation of a cash flow tax is that the government in effect becomes a shareholder in the project, contributing the same proportion to costs as it takes from revenues. Given value additivity, splitting an investment into two cannot change its overall value. The risk associated with each fraction of the investment is the same as the risk associated with the whole. The tax does not affect the risk perceived by the investor; from her perspective, the project is simply smaller by a fraction $1 - \tau$. Because there is no tax on a marginal project - and because the marginal project is the same in the absence and presence of tax - then the cost of capital under the cash flow tax is exactly the same as in the absence of tax: $c^{CF} = r + \gamma$.

Now consider the value of the tax collected by a cash flow tax. The current market value of the tax in (3.1) is proportional to NPV^*. For a marginal investment $NPV^* = 0$ and so the market value of the tax is also zero. However, the expected revenue in period $t + 1$ is not zero.

To see this, consider writing the market value of the tax in another way:

$$\begin{aligned} T &= \tau V\left[1+\widetilde{p}-(1+r)\right] \\ &= \tau V\left[\widetilde{p}-r\right] \end{aligned} \tag{3.3}$$

Here the tax rebate of τ received in period t has been expressed as $\tau V[1+r]$; that is, it is equivalent to receiving $\tau(1+r)$ with certainty in period $t+1$. This mirrors the treatment in Fane (1987) and Bond and Devereux (1995, 2003), who analyse in the presence of uncertainty generalised cash flow taxes, similar to that of Boadway and Bruce (1984). The generalised R-based cash flow tax may delay payment of the period t allowance generated by the pure cash flow tax, but carries it forward at an appropriate mark-up to compensate for the delay, so that the present value of the allowance remains τ. If the allowance is certain to be paid at some future date, then the appropriate rate of mark-up is the risk-free rate.

The second line of this expression gives the impression that, for a marginal investment, the cash flow tax is effectively levied on the risk premium, ie. the stochastic return of the investment, $\widetilde{p}$, less the risk free rate, r. For a marginal investment, the market value of this risk premium is zero. However, expected revenues are not zero. To see this, consider the expected value of the tax in period $t+1$, for a marginal investment:

$$\begin{aligned} E(\widetilde{T}^{CF}_{t+1}) &= \tau\left[E(\widetilde{p})-r\right] \\ &= \tau(1+r)cov(\widetilde{m},\widetilde{p}) = \tau\gamma. \end{aligned} \tag{3.4}$$

Given risk, so that $\gamma > 0$, the expected value of the overall tax paid on the investment is positive. Given the values cited by Cochrane (2001) at the beginning of this paper, across the economy $E(\widetilde{p}) = 0.09$ and $r = 0.01$, so that $\gamma = 0.08$. So the tax can raise substantial revenue, despite its market value being zero.

How is this possible? The answer simply reflects the higher return investors demand to accept risk. To invest in a project of average risk, investors demand a premium eight times the risk-free return (which compensates only for timing). To summarise:

Proposition 3.1. *A cash flow tax with full loss offset does not distort investment decisions; ex-ante it is a tax only on economic rent. In the absence of economic rent, the tax has no market value when the investment is undertaken. Ex-post, however, tax revenue is positive. In expected terms, the tax could be seen as a tax on the risk premium.*

4. A "Pure" Income Tax

Now consider a "pure" capital income tax levied at rate τ. This is defined here as a symmetric tax on the gross return $\widetilde{R}$, less an allowance for true economic deprecation, $\widetilde{\delta}$ - ie. the ex-post change in the value of the asset. This is equivalent to a tax on the stochastic financial return, denoted in the presence of the pure income tax as $\widetilde{p}^I$. The period t market value of the tax is

$$T^I = \tau V\left[\widetilde{R} - \widetilde{\delta}\right] = \tau V\left[\widetilde{p}^I\right]. \tag{4.1}$$

The difference from the cash flow tax is in the treatment of the allowance. Relative to the cash flow tax, the income tax implicitly gives an allowance of 1 in period $t+1$ rather than in period t (the tax in period $t+1$ is on $\widetilde{p}^I$, not on $1+\widetilde{p}^I$). But the treatment of the stochastic income is the same: the return $\widetilde{p}^I$ is taxed under both taxes. This therefore represents a tax on the full stochastic financial return, including the risk premium.

The period t market value of the investment is

$$\begin{aligned} V^I &= V\left[1+\widetilde{p}^I(1-\tau)\right] \\ &= (1-\tau)V[1+\widetilde{p}^I] + V[\tau] \\ &= (1-\tau)V^* + \frac{\tau}{1+r} \end{aligned} \qquad (4.2)$$

where we have again used the fact that the non-stochastic part of the return can be discounted at the risk-free rate of interest, r. The net present value of the project with a given pre-tax stochastic cash flow, $\widetilde{p}^I = \widetilde{p}$, is

$$\begin{aligned} NPV^I &= -1 + \frac{\tau}{1+r} + (1-\tau)V^* \\ &= (1-\tau)NPV^* - \frac{\tau r}{1+r}. \end{aligned} \qquad (4.3)$$

The last element of (4.3) clearly reduces the NPV below that of the cash flow tax. Hence it is possible for a project which is worth undertaking in the absence of tax ($NPV^* > 0$) to become not worth undertaking the presence of tax ($NPV^I < 0$).

This represents a significant impact on the incentive to invest. One way of measuring the impact on this incentive is to ask what the period t value of the period $t+1$ stochastic cash flow would need to be for an investment to be marginal either in the presence or absence of tax. In the absence of tax, define the stochastic cash flow of a marginal investment to be $\widetilde{p}_M^*$, so that

$$\begin{aligned} NPV^* &= -1 + V\left[1+\widetilde{p}_M^*\right] \\ &= -\frac{r}{1+r} + V\left[\widetilde{p}_M^*\right] = 0. \end{aligned} \qquad (4.4)$$

Note that the return of capital of 1 in period $t+1$ is risk-free and therefore can be discounted at the risk-free rate, r. Hence $V\left[\widetilde{p}_M^*\right] = r/(1+r)$.

In the presence of the pure capital income tax, the post-tax net present value of a marginal investment is

$$NPV^I = -1 + \frac{1}{1+r} + (1-\tau)V\left[\widetilde{p}_M^I\right] = 0. \tag{4.5}$$

In this case $V\left[\widetilde{p}_M^I\right] = r/(1+r)(1-\tau)$. Clearly, then

$$V\left[\widetilde{p}_M^I\right] = V\left[\widetilde{p}_M^*\right]/(1-\tau). \tag{4.6}$$

That is, the impact of tax is to gross up the market value of the break-even required period t value of the pre-tax stochastic cash flow by a factor $1-\tau$. This represents a significant impact on investment incentives.

How does this relate to the approach of Gordon (1985)? To see this, consider what happens to the cost of capital. In the presence of the income tax, the cost of capital is the value of $E(\widetilde{p}^I)$ for which $NPV^I = 0$, denoted $E(\widetilde{p}_M^I)$. Using the approach in (2.5), we have

$$NPV^I = -1 + \frac{1 + (1-\tau)E(\widetilde{p}_M^I)}{1+r} + cov(\widetilde{m}, (1-\tau)\widetilde{p}_M^I) = 0 \tag{4.7}$$

which implies that

$$E(\widetilde{p}^I) = c^I = \frac{r}{1-\tau} - (1+r)cov(\widetilde{m}, \widetilde{p}_M^I) = \frac{r}{1-\tau} + \gamma. \tag{4.8}$$

Implicitly here we have assumed that the marginal investments in the presence and absence of tax have the same risk - that is $cov(\widetilde{m}, \widetilde{p}_M^*) = cov(\widetilde{m}, \widetilde{p}_M^I)$. The tax therefore requires the additional return (relative to the case in the absence of tax) to be risk-free. This is equivalent to the approach of Gordon (1985) and implies that only the risk-free rate is grossed up by $1-\tau$. But this does not imply that the disincentive effect of the tax is small. For a marginal investment, a risk-free rate of return is only 1%. Yet this is as valuable as a risky investment yielding on average 9%. So a tax rate of 50%, say, requires a doubling of the value of the investment - as is expressed more clearly in (4.6)

What about the expected tax revenue in period $t+1$? If the stochastic return were the same irrespective of the tax levied ($\widetilde{p}^I = \widetilde{p}$), then the expected period $t+1$ value is

$$\begin{aligned} E(\widetilde{T}^I_{t+1}) &= \tau E(\widetilde{p}) \\ &= E(\widetilde{T}^{CF}_{t+1}) + \tau r. \end{aligned} \tag{4.9}$$

So the pure income tax generates an expected revenue only slightly higher than the cash flow tax. If we take the values considered above, the tax generates expected revenue which rises from 8% of the value of the investment to 9%: a rise of one eighth.

In sum then, we have shown:

Proposition 4.1. *A capital income tax with full loss offset has a significant effect on investment incentives. This is reflected in the fact that the market value of the returns of a marginal investment must be grossed up by a factor* $1-\tau$ *for an investment to be marginal in the presence of tax. This tax does have a market value ex-ante. It raises more revenue in expected terms than the cash flow tax, but only to the extent that it also taxes the risk-free rate of return.*

5. Interpretation of the neutral tax in Gordon (1985)

It is worth noting the relationship between these results and those of Gordon (1985). In a general equilibrium framework, Gordon finds conditions in which the introduction of a set of taxes is neutral, in the sense that they have no impact on investment or asset prices. Ignoring personal taxes and inflation here for simplicity, Gordon's set of taxes include a property tax[5] at rate T levied in period $t+1$ on the initial value of the asset (ie. 1 in the case of the investment considered here). He also considers a capital income tax at rate τ, levied on the financial return net of the property tax. In the context of the investment considered here, the taxes introduced by Gordon amount to a total tax liability in period $t+1$ of $G = -T + \tau(\widetilde{p} - T)$. Gordon demonstrates that this combination of taxes is neutral if:[6]

$$(1-\tau)T + r\tau = 0. \tag{5.1}$$

Clearly, for this to hold, a positive capital income tax requires a negative value of T. Solving for T from this expression, and substituting into the expression for total taxes paid implies that the total tax liability in Gordon's model is equal to $G = \tau(\widetilde{p} - r)$. This is identical to the cash flow tax shown in (3.3). In fact, Gordon's property tax is exactly equivalent to the allowance under a generalised cash flow tax. Instead of giving relief of τ in period t, the tax effectively gives (a certain) relief of $\tau(1+r)$ in period $t+1$. Hence the reason that Gordon's set of taxes has no impact on investment or asset prices is that they are equivalent to a cash flow tax. They cannot be considered to be a capital income tax.

6. Measurement of investment incentives

This paper has shown that a capital income tax, even with full loss offset, has a significant impact on investment incentives. While this is true even when the incentive is measured by the

[5] Defined as t in Gordon (1985).
[6] Gordon (1985), p 12.

cost of capital, it is clear from the literature that this is not generally appreciated. We therefore propose an alternative measure, essentially the one used above.

Consider the investment analysed in this paper. In the absence of tax, the cost is 1, and one period later, the return is $1+\widetilde{p}$. To calculate the cost of capital, we solve for the value of the expected stochastic return $E(\widetilde{p}^*_M)$ which generates a marginal investment for which $NPV^* = 0$. We can do the same in the presence of any arbitrary tax, solving in this case for expected value, $E(\widetilde{p}^T_M)$ which generates $NPV = 0$. A marginal effective tax rate can be defined as

$$EMTR_E = \frac{E\left[\widetilde{p}^T_M\right] - E\left[\widetilde{p}^*_M\right]}{E\left[\widetilde{p}^T_M\right]}. \tag{6.1}$$

where all the expected values refer to the case of marginal investments, in the presence or absence of tax.

A slight modification of this is to replace the expected values of $\widetilde{p}$ with their market values in period t: $V[\widetilde{p}^*_M]$ and $V[\widetilde{p}^T_M]$, where these represent market values of the returns to marginal investments in the absence and presence of tax respectively. The advantage of using these values is that the market value takes into account the risk associated with the stochastic return. This yields a natural alternative measure of the effective marginal tax rate as

$$EMTR_V = \frac{V\left[\widetilde{p}^T_M\right] - V\left[\widetilde{p}^*_M\right]}{V\left[\widetilde{p}^T_M\right]}. \tag{6.2}$$

In the case of the cash flow tax, $EMTR^{CF}_E = EMTR^{CF}_V = 0$. However, in the case of the pure capital income tax analysed above, the two measures give very different indications of investment incentives. Based on the standard measure using expected values, the pure capital income tax has an effective marginal tax rate of

$$EMTR_E^I = \frac{\tau r}{r + \gamma(1-\tau)}. \tag{6.3}$$

Clearly this measure depends on the risk premium, γ. By contrast, given the expression for $V[\widetilde{p}]$ in the case of a pure capital income tax in (4.5), the alternative measure based on the period t market value is

$$EMTR_V^I = \tau. \tag{6.4}$$

Evaluated at $r = 0.01$, $\gamma = 0.08$ and $\tau = 0.5$, $EMTR_E^I = 10\%$ and $EMTR_V^I = 50\%$. This paper has made the case that the value of the $EMTR_E^I$ is misleading and needs to be treated with caution.[7] By contrast, $EMTR_V^I$ generates a more appropriate measure of the disincentives generated by the tax.

Many studies have measured effective marginal tax rates to make comparisons over time, and across countries and companies, and have used them in econometric investigation of the impact of taxes on investment. In practice, it would be extremely difficult to measure $V[\widetilde{p}]$ to enable $EMTR_V$ to be calculated. However, in practice, I am also not aware of any empirical studies which explicitly take account of risk in measuring $EMTR_E$. In practice, it is common to ignore the treatment of the risk premium, and in effect to treat the effect of the tax as grossing up the entire cost of capital by $1-\tau$, instead of grossing up just the risk-free element. Following this approach by setting $\gamma = 0$ in (6.3) yields $EMTR_E^I = \tau$. By ignoring risk, common empirical practice therefore yields an appropriate measure of the impact of the tax on incentives.[8]

[7] This mirrors the results of Gordon and Wilson (1989), who examine the efficiency cost of taxing risky capital income, and show that the appropriate tax rate to use is the market value of taxes paid on a marginal investment, which is identical across all marginal investments, whatever their characteristics.

[8] This applies also in a more general framework, allowing for depreciation at a given rate.

7. Conclusion

This paper re-examines the impact of taxes on the incentive to invest in the presence of risk. It uses a general framework for the pricing of risk to analyse a simple investment which generates a stochastic cash flow one period after the investment is undertaken.

Using this framework, the paper disputes the claim of Gordon (1985) that "taxation of corporate income can leave corporate investment incentives, and individual savings incentives, basically unaffected, in spite of sizable tax revenues collected" (Gordon, page 1). The paper shows that such a claim does hold for a cash flow tax - equivalent to the tax analysed by Gordon which he describes as a tax under which "a risk-free investment would pay no taxes on net" (page 12). The market value of the tax revenue received from such a tax on a marginal investment is zero. However, the expected value of future tax revenues is positive. The difference between these two perspectives reflects the risk premium associated with risky investment. In effect, the government shares in the risk, but also takes a share of the risk premium. The risk premium itself has zero market value, by definition.

However, this paper shows that the first part of Gordon's claim does not hold for a standard tax on capital income. Instead, it argues that the taxation of corporate income can have large effects on investment incentives. Gordon shows that, for a given level of risk, only the risk-free element of the cost of capital is grossed up by the tax rate. This has only a small effect on the overall measured cost of capital, but in this formulation, the whole of the additional return has to be risk-free. That implies significant effect on investment incentives. Such a tax raises slightly more revenue in expected terms than the cash flow tax. However, it does so at the cost of a significant effect on incentives. This implies that, contrary to the claim of Weisbach (20004), the cash flow tax - or equivalently, a consumption tax - has very different properties from a Haig-Simons income tax.

This paper proposes an alternative measure of incentive effects, based on the change in the required market value of the pre-tax stochastic cash flows induced by the introduction of tax, rather the change in the required expected rate of return. This is independent of risk of the project.

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