Corporate Tax Preferences:
Identification and Accounting Measurement

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**ABSTRACT:** This study evaluates the use of the long-run cash effective tax rate (ETR) as a measure of the extent to which a corporation’s projects are tax-favored or tax-disfavored. We first derive a measure of the extent to which a project is tax-favored that is independent of the project’s financial accounting treatment. We argue that our measure, which focuses on the present value of the government’s tax collections from the project, is superior to the traditional measure that compares the pretax and after-tax internal rates of return of the project. We then use our measure as a benchmark with which to examine the relation between the ETR and tax preferences. We find that the long-run cash effective tax rate is an unreliable tax preference measure, even when the asset is depreciated for financial reporting purposes at the rate at which its productivity declines.

**Keywords:** tax preferences; book-tax differences; effective tax rates
I. INTRODUCTION

We investigate the relation between a corporation’s book-tax differences and the extent to which that corporation’s project are tax-favored or tax-disfavored. Book-tax differences cause the cash effective tax rate, the ratio of cash taxes paid to pretax financial accounting income, to deviate from the statutory tax rate. Dyreng, Hanlon and Maydew (2008) use the long-run cash effective tax rate in their measure of corporate tax avoidance. Many recent papers have also used this measure (Chen, Chen, Cheng, and Shevlin 2010; Dyreng, Hanlon, and Maydew 2010; Armstrong, Blouin, and Larcker 2011).

In order to evaluate whether book-tax differences reliably measure corporate tax preferences, we first derive a measure of tax preferences that does not rely on financial accounting measures; instead, it is based on the present value of pretax and after-tax cash flows from a project. Second, we determine the firm’s book-tax differences in the steady state when the firm reinvests so as to maintain the productivity capacity of the initial investment. Third, we compare our tax preference measure to the firm’s book-tax differences in order to evaluate whether book-tax differences reliably measure tax preferences.

In order to evaluate whether book-tax differences reliably measure tax preferences, we need a definition of tax preferences that does not depend on financial accounting measures. Public finance economists define a project’s marginal effective corporate tax rate in terms of pretax and after-tax internal rates of return (IRR) (Fullerton 1984). This measure takes the difference between the discount rate for which the present value of the project’s pretax cash flows is equal to the cost of the investment (the pretax
IRR), and the discount rate for which the present value of the project’s after-tax cash flows is equal to the cost of the investment (the after-tax IRR). The Congressional Budget Office (2006) and Metcalf (2010) use this measure to estimate the effective tax rate on capital investments. It is also used in Scholes et al. (2009) in their definition of implicit and explicit tax rates. As is standard in this literature, we focus on marginal projects, i.e., those for which the NPV of the project is zero.

However, IRR has several problems as a measure of a project’s pretax performance. First, as discussed by Solomon (1956), some projects may have multiple positive IRRs. This can occur when the cash flows change sign more than once during the life of the project. For example, consider a project with a cost of capital of 20% and an after-tax cash outflow of $1800 on date zero, an after-tax inflow of $3600 on date one, and another after-tax outflow of $1728 on date two. This project earns exactly its cost of capital. Now suppose the pretax cash flows associated with the project are an $1800 outflow on date zero, a $5940 inflow on date one, and a $4356 outflow on date two. The pretax IRR has two positive solutions, 10% and 120%. According to this measure, the tax system either doubles the taxpayer’s rate of return from a 10% pretax rate of return to a 20% after-tax rate of return, or reduces it from a 120% pretax rate of return to a 20% after-tax rate of return. Second, some projects may not have a real-valued IRR; rather, the only IRRs could be complex numbers, i.e., ones that involve $i = \sqrt{-1}$. Osborne (2010) provides a literature review of the issue of multiple IRRs and an interpretation of complex IRRs. Third, IRR can rank projects incorrectly in that if one compares two projects with the same life, initial investment, and cost of capital, one project could have a higher IRR but lower net present value than the other project. We find that all of these
problems with IRR itself carry over to the effective tax rate. The finance literature has previously recognized shortcomings of the IRR method when making capital budgeting decisions, and pointed out that application of the Net Present Value (NPV) rule avoids these problems, e.g., Brealey, Myers, and Allen (2008).

We focus on projects with long-run negative cash flows, for which the drawbacks of IRR are particularly pronounced. Many important investment settings exhibit this pattern. For example, mining projects often generate positive cash flows from the extraction and sale of minerals, but incur long-term environmental costs. Operating a nuclear power plant involves substantial decommissioning costs at the end of its useful life. A factory whose workers receive post-retirement health care benefits that are paid by their employer can exhibit a similar pattern, as the workers may outlive the plant by many years.

The problems with a measure that relies on IRR motivates our search for a better measure. We derive a new tax preference measure based on NPV instead of IRR. We compare the present value of taxes collected from a project to the present value of shareholder pretax returns on capital. This in turn requires a division of shareholders’ returns into a portion that represents a return on capital and a portion that represents a return of capital.

The measure we propose has three advantages over a measure based on IRR. First, our measure is unique, whereas a project can feature multiple IRRs. Second, our measure does not feature solutions that involve complex numbers. Third, we show that two projects can be identically tax-favored using our measure, yet have different pretax
IRRs. This occurs because although the after-tax rate of return corresponds to the market price for capital, the pretax rate of return typically does not.

We find that if the initial investment is depreciated at the same rate at which the productivity of the asset declines, a project with long-term losses is tax-disfavored. This occurs because slower decay of the long-run costs causes the value of the project to fall more rapidly than the rate at which the productivity of the asset declines.

We then use our measure as a benchmark to examine the relation between a firm’s long-run cash effective tax rate and tax preferences in a setting in which the firm reinvests so as to maintain the productive capacity of its assets. We identify two ways in which the book-tax difference is an unreliable tax preference measure. First, if the rate at which assets are depreciated for financial reporting purpose is different than the rate at which the productivity of the assets declines, a measure based on book-tax differences could be misleading even in the absence of long-run costs. Second, even if assets are depreciated for financial reporting purpose at the rate at which their productivity declines, a tax-neutral project will generate favorable book-tax differences if long-run costs are not accrued for financial reporting purposes, but will generate unfavorable book-tax differences if the present value of long-run costs are accrued for financial reporting purposes when the related investment takes place. We conclude that the long-run cash effective tax rate is an unreliable measure of corporate tax preferences.

We present the basic model in Section 2. Section 3 presents two of the tax preference measures and discusses their basic properties. Section 4 examines whether the book-tax differences reflect the tax-favored and tax-disfavored aspects of a project. Section 5 concludes.
II. MODEL

On date zero the firm acquires at cost $K$ an asset that generates $e^{-\delta t}$ units at time $t$, where the parameter $\delta > 0$ represents the rate at which the productivity of the asset decays over time. The production and sale of each unit generates a net pretax cash inflow of $y$ per unit. The initial investment also results in the firm’s making cash outflows in the future; the expected cash outflow on date $t$ is $xe^{\lambda t}$, $0 \leq x < y$, $\lambda \geq 0$. We focus on the case in which $x > 0$ and $\delta > \lambda$, which ensures that the project generates negative cash flows in the later years of the project’s life. The cost of capital for the project is $r > 0$.

Therefore, the social value $V$ of the project once the investment $K$ is made is

$$ V = \int_0^\infty (ye^{-\delta t} - xe^{-\lambda t}) e^{-rt} \, dt = \frac{y}{r + \delta} - \frac{x}{r + \lambda}. $$

(1)

On an arbitrary date $T$, the social value of the project is

$$ V(T) = \int_T^\infty [ye^{-\delta t} - xe^{-\lambda t}] e^{-r(t-T)} \, dt = \frac{ye^{-\delta T}}{r + \delta} - \frac{xe^{-\lambda T}}{r + \lambda}. $$

(2)

An example of this setting is a mining project, where $K$ is the cost of acquiring and developing the mine, $y$ is the revenue minus variable extraction costs, and $x$ is the environmental cost associated with the development of the mine.

We consider a competitive equilibrium in which the investment $K$ is equal to the present value of the after-tax cash flows from the project, discounted at the cost of capital $r$. Therefore, the present value of the taxes collected on the project is $G = V - K$.

We first ask how the social value $V$ is divided between $G$ and $K$ if the income tax system were neutral and income were taxed at a constant statutory rate $\tau$. We motivate our approach with the following thought experiment. On date zero, the value of the firm
is $K$ due to our zero NPV assumption. This value reflects the fact that the government will tax some of the returns to the investment of $K$. Suppose instead of an income tax system, the government took an ownership stake on date zero without contributing any capital. This would increase the value of the firm from $K$ to $V = K + G$, with $G$ representing the value of the government’s shares. We emphasize that in general, $G \neq \tau V$ when a project is tax-neutral. An exception is when $\delta = \lambda = 0$, in which case the project is a perpetuity. In general, however, the payments to shareholders are in part an untaxed portion that represents the return of capital, and a taxed portion that represents the after-tax return to capital. For example, consider a one-period investment in which $700 (K)$ is invested on date zero and $840$ is received on date one. Suppose that the tax rate is 40% and the cost of capital is 12%. The government collects tax of $56$ on date one, which has a present value of $50$ on date zero, so the social value ($V$) of the project on date zero is $750$. The private value of the project declines from $700$ on date zero to nothing on date one; the present value of this decline is $700/1.12 = 625$, so the initial $750$ social value of the investment comprises a $625$ return of capital and a $125$ pretax return on capital, of which $50$ goes to the government and the remaining $75$ goes to the shareholders.

In the context of our model, we need to characterize how $V$ is divided between the present value of the government’s tax collections, $G$, and the present value of the cash flows going to shareholders. The zero NPV assumption implies that the present value of the cash flows going to shareholders is equal to $K$. We divide $K$ into two parts: a return of capital and a return on capital. The former, $K_U$, should not be taxed; the latter, $K_T$, is the
after-tax return on capital. The return of capital is the present value of the decline in the value of $K$ over time, so

$$K_U = -\int_0^\infty K'(t)e^{-rt} dt. \tag{3}$$

We denote the present value of the government tax collections under a tax-neutral system as $G^\tau$. We define the system as tax-neutral if $G^\tau = \tau(V - K_U)$, i.e., if the present value of the government tax collections is a fraction $\tau$ of the pretax return on capital. We characterize $G^\tau$ in our model in Proposition 1.

**Proposition 1:** The present value of government tax collections if a project is subject to a neutral tax system is

$$G^\tau = \frac{r\tau y}{(r + \delta)[r + \delta(1 - \tau)]} - \frac{r\tau x}{(r + \lambda)[r + \lambda(1 - \tau)]}.$$ 

The proof is in the appendix.

We now consider how the project is actually taxed. The cash inflow $ye^{-\delta t}$ is taxed and the cash outflow $xe^{-\lambda t}$ is deducted for tax purposes at the statutory rate $\tau$ on the date they occur. We define $\theta$ to be the present value tax reductions associated with the initial investment per dollar invested, so that the investment $K$ reduces the present value of the firm’s future taxes by $\theta K$. This reduction includes, but is not limited to, depreciation deductions; it also includes the effects of tax credits, percentage depletion in excess of cost depletion, etc. In the special case in which the only tax reduction associated with $K$ is tax depreciation that occurs at the rate $\delta$, the rate at which the productivity of the asset declines over time, the present value of the tax savings associated with the investment $K$ is
Another important special case is when the investment is expensed for tax purposes, in which case \( \theta = \tau \).

The present value of after-tax cash flows associated with the project after the initial investment \( K \) is made is

\[
\int_0^\infty [((1-\tau)ye^{-\delta t} - (1-\tau)x e^{-\lambda t}) + \theta K dt + \theta K = \frac{(1-\tau)y}{r+\delta} - \frac{(1-\tau)x}{r+\lambda} + \theta K.
\]

A competitive equilibrium implies that the present value of the future cash flows in (3) equals the investment cost \( K \), which implies

\[
K = \frac{V(1-\tau)}{1-\theta}.
\]

The competitive equilibrium assumption implies that a project’s tax treatment is reflected in input costs and/or output prices.

The present value as of date zero of the government’s future tax revenue, \( G \), is

\[
G = \int_0^\infty \tau ye^{-(\delta+\lambda)t} - \tau x e^{-(\lambda+\lambda)t} - \theta K dt = \frac{y(\tau - \theta)}{(r+\delta)(1-\theta)} - \frac{x(\tau - \theta)}{(r+\lambda)(1-\theta)}.
\]

Using Proposition 1 and (7), we classify projects into five categories, which we summarize in Table 1.

[INSERT TABLE 1 ABOUT HERE]

### III. MEASURING TAX PREFERENCES USING IRR

In this section, we compare the project’s pretax rate of return to the pretax rate of return on a tax-neutral project, and evaluate the usefulness of this comparison when determining whether a project is tax-disfavored, tax-neutral, tax-favored, tax-exempt, or
tax-subsidized. We first define the function \( f(R) \), which is based on the pretax cash flows of the project.

\[
f(R) \equiv \int_{0}^{\infty} [ye^{-\delta t} - xe^{-\lambda t}] e^{-Rt} - K. \tag{8}
\]

Integrating and simplifying yields

\[
f(R) = \frac{y}{\delta + R} - \frac{x}{\lambda + R} - K. \tag{9}
\]

We emphasize that the function \( f(R) \) is not the pretax value of the project, because \( R \) is not a cost of capital determined in a market. Equation (9) is simply a device for determining the discount rate for which the project would have zero net present value on a pretax basis. A pretax IRR is any value of \( R \) that satisfies \( f(R) = 0 \). A project is tax-favored by the IRR metric if \( R(1 - \tau) < r \) and tax-disfavored if \( R(1 - \tau) > r \).

Using (9), the solutions to \( f(R) = 0 \) are

\[
R = \frac{y - x - K(\delta + \lambda)}{\delta + R} \pm \frac{\sqrt{[y - x - K(\delta + \lambda)]^2 + 4K(y\lambda - x\delta - K\lambda\delta)}}{2K}. \tag{10}
\]

There can be zero, one, or two positive real-valued solutions to (10). The integral

\[
\int_{0}^{\infty} e^{-Rt} dt
\]

will not converge unless \( R > 0 \); hence we ignore negative roots (even though (9) can have negative roots for certain parameter values). There is a single, positive, real value of \( R \) that solves (8) if and only if \( y\lambda - x\delta - K\lambda\delta > 0 \). Using (1) and the equilibrium value of \( K \) from (6) shows that (10) has a single positive real-valued solution if and only if

\[
x < \frac{y\lambda(r + \lambda)[r + \delta\tau - \theta(\delta + r)]}{\delta(r + \delta)[r + \lambda\tau - \theta(\lambda + r)]}. \tag{11}
\]
We illustrate the possible solutions to (10) with an example. Let $y = 4825, x = 2793, \delta = .12, \lambda = 0.08, r = 13\%, \text{ and } \tau = 35\%$. These assumptions imply that $V = 6000$ and $K = 3900/(1 - \theta)$. We plot $f(R)$ in Figure 1 for three values of $\theta$. The different values of $\theta$ induce different values of $K$; When $\theta = .25$ (the $f(R)$ plot with the highest values in Figure 1), $f(R) = 0$ has one positive real-valued solution at $R \approx .19$. When $\theta = .36$, $f(R) = 0$ has two positive real-valued solutions at $R \approx .01$ and $R \approx .12$. When $\theta = .44$, (the $f(R)$ plot with the lowest values in Figure 1), $f(R) = 0$ has no positive real-valued solution.

[INSERT FIGURE 1 ABOUT HERE]

If the project has a single positive real-valued solution pretax rate of return $R$, then $R$ has a convenient economic interpretation when either the project is tax-neutral ($G = G^*$), or if it is tax exempt ($G = 0$). Using Proposition 1 and (7), the sign of $G - G^*$ is the same as the sign of

$$K [\theta (\delta + r) - \delta \tau] - \frac{x r (1 - \tau) (\delta - \lambda)}{(r + \lambda) [r + \lambda (1 - \tau)]}. \tag{12}$$

Furthermore, using (10), when the expression in (12) is zero, $R(1 - \tau) = r$. Therefore, $R(1 - \tau) = r$ is equivalent to $G = G^*$, the definition of a tax-neutral project.

Whether the project is tax-favored or tax-disfavored can be characterized in terms of the tax treatment of the initial investment $K$ and the magnitude of the long-term losses, $x$. The first term of (12) is the difference between the present value of tax savings associated with each dollar invested on date zero, $\theta$, and what the savings would be if the entire investment were capitalized and depreciated at the rate $\delta, \tau \delta / (\delta + r)$. The second term of (12) depends jointly on $x$ and the sign of $\delta - \lambda$. When $x > 0$ and $\delta > \lambda$, the net
pretax cash flow from the project, \( ye^{-\delta t} - xe^{-\lambda t} \), decays more rapidly than the rate at which the productivity of the asset decays, \( \delta \). Thus the presence of long-term losses makes the project tax-disfavored. The opposite effect occurs if \( x > 0 \) and \( \delta < \lambda \).

The pretax rate of return \( R \) also has a convenient economic interpretation when \( G = 0 \). Equation (7) can be characterized as

\[
G = \frac{V(\tau - \theta)}{1 - \theta}.
\]

Because \( V > 0 \), (13) implies that \( G = 0 \) is equivalent to \( \tau = \theta \). Using (6), \( G = 0 \) also implies that \( K = V \). Using (10) and (1) shows that \( \tau = \theta \) is equivalent to \( R = r \), and so \( R = r \) is equivalent to \( G = 0 \), the definition of a tax-exempt investment.

Although the comparison of a project’s pretax rate of return \( R \) to its after-tax rate of return \( r \) is economically meaningful in the two special cases that we have considered, in general this approach will fail to correctly characterize the extent to which a project is tax-favored or tax-disfavored. We consider two problems with this approach. First, the IRR measure can yield multiple or imaginary pretax rates of return, whereas the measure based on present values is always unique and economically meaningful. To illustrate the possible problems that can arise in the context of our model, consider a project for which \( y = 6200, x = 1976, \delta = .12, \lambda = 0\%, r = 13\%, \) and \( \tau = 35\% \). We show the values of \( G, G^* \) and \( R \) in Table 2.

[INSERT TABLE 2 ABOUT HERE]

In each of the four cases, the present value of the project’s tax savings from capital recovery deductions or credits exceeds that of economic depreciation and the project has long-term negative cash flows, so it is not obvious whether the project is tax-
favored or tax-disfavored. In the first case, the value of $\theta$ is the value that makes the project tax-neutral, from (12). The tax preference measure based on the present value of tax collections reflects tax-neutrality because $G = G^*$. However, the IRR measure is ambiguous; the higher value, $R = 20\%$, is consistent with tax-neutrality, but the lower value, $R = 12\%$, suggests that the project is heavily tax-favored because the lower pretax IRR is even less than $r$. In the second case, the project is taxed on a cash flow basis. Because the project has zero net present value on both a pretax and after-tax basis the present value of government tax collections is zero. Here, it is the lower IRR value that is economically meaningful, because the lower value of $R = 13\%$ is equal to $r$. The higher value of $R = 19\%$ suggests that the project is only slightly tax-favored, which is clearly incorrect because the present value of taxes is zero. In the third case, the present value of taxes is negative, and thus the project is heavily tax-favored; nevertheless, both IRR measures are greater than $r$, suggesting that some of the pretax return $R$ is going to the government. In the fourth case, the project is even more tax-favored, but the IRR features a complex number, which lacks a convenient economic interpretation.

Second, two zero-NPV projects can be identical in terms of their social value $V$, how this value is divided between the initial investment $K$ and the present value of government tax collections $G$, and the present value of the government tax collections if the project were tax-neutral, $G^*$, yet have different pretax rates of return $R$. We illustrate this possibility in Table 3. Only in the special cases of a tax-neutral project ($\theta = 107/575$) or a tax-exempt investment ($\theta = .35$) are the pretax rates of return on the two projects the same. When $\theta = .10$, the projects are tax-disfavored. Even though the projects are identically tax-disfavored in that the social value $V$ is divided the same way between the
shareholders’ value $K$ and the government’s value $G$, project $A$ has a higher pretax rate of return than does project $B$ and thus would be considered more tax-disfavored using the IRR measure. When $\theta = .28$, the projects are tax-favored. Project $A$ has a lower pretax rate of return than does project $B$ and thus would be considered more tax-favored using the IRR measure. When $\theta = .40$, the projects are tax-subsidized. Project $A$ has a higher pretax rate of return than does project $B$ and thus would be considered less tax-favored using the IRR measure.

These anomalous results arise because the IRR measure discounts pretax cash flows by the pretax rate of return $R$ instead of the cost of capital $r$. Because $R$ is simply the solution to $f(R) = 0$, there is no reason to assume that a tax-preference measure that uses $R$ will be economically meaningful. As Table 3, indicates, projects that are identical in terms of the extent to which they are tax-favored can exhibit different values of $R$.

[INSERT TABLE 3 ABOUT HERE]

**IV. EVALUATING THE LONG-RUN CASH EFFECTIVE TAX RATE**

In this section, we evaluate whether the long-run cash effective tax rate is a reliable measure of tax preferences. We focus on the case in which the differences between taxable income and pretax financial accounting income are temporary in nature. Our examination of book-tax differences requires us to shift our focus from the project to the firm, because accounting data are available at the firm level, whereas our tax preference definition is derived at the project level. To do this, we assume that the firm reinvests in the project at the rate $\delta$, which implies that the productive capacity of the asset is maintained over time.
We assume that the initial investment $K$ is capitalized for tax purposes and depreciated at a constant rate $\phi$, $\phi \geq \lambda$. This implies that the tax basis of the assets, denoted $B_T$, is $K$ on date zero and evolves according to

$$dB_T = (\delta K - \phi B_T)dt.$$ 

Solving for $B_T$ yields

$$B_T = K \left[\frac{\phi - \delta}{\phi}\right] e^{-\phi t} + \frac{\delta K}{\phi}.$$ 

The tax depreciation expense is $\phi B_T$. Using (4),

$$\theta = \frac{r \phi}{r + \phi}.$$ 

We let $L$ denote the undiscounted future cash outflows associated with the current size of the project. On date zero when the initial investment is made, $L$ is

$$\int_0^\infty xe^{-\lambda t} dt = \frac{x}{\lambda}$$

and evolves according to

$$dL = (x\delta/\lambda - \lambda L)dt.$$ 

Solving for $L$ yields

$$L = \frac{x}{\lambda} \left[\frac{\delta}{\lambda} - \frac{e^{-\lambda t}(\delta - \lambda)}{\lambda}\right].$$ 

The cash payment associated with these costs is $\lambda L$. For tax purposes, the recognition of a liability that generates a current tax deduction requires “economic performance,” a higher standard than what is required for liability recognition for financial accounting purposes [IRC §461(h)]. For example, warranty costs are recognized only when warranty costs are incurred, not when the associated sales are made [Treas. Reg. §1.461-4(d)(7)]. We assume that economic performance occurs when the costs are paid, so the tax deduction is $\lambda L$. 


The cash effective tax rate is the ratio of cash taxes paid to pretax financial accounting income. Therefore, we must characterize financial accounting income in our setting. We first consider the financial accounting treatment of the future costs $x/\lambda$ associated with the initial investment and $\delta x/\lambda$ associated with each subsequent reinvestment. For financial accounting purposes, whether and how much of a liability for future expenditures is accrued when the event that generates the future expenditures takes place depends on the economic context. Undiscounted future warranty costs are accrued in full, whereas only the present value of future post-retirement health care benefits are accrued. Contingent liabilities for future environmental costs are only accrued when the loss is both probable and can be reasonably estimated. We represent this wide range of possible financial accounting treatments by having a fraction $\alpha$ of the undiscounted future costs $L$ accrued for financial accounting purposes. The amount accrued is not expensed; rather, it increases the cost basis of the initial investment from $K$ to $K + \frac{\alpha x}{\lambda}$, and similarly for future reinvestments.

The value of the asset for financial accounting purposes, $B_A$, is $K + \frac{\alpha x}{\lambda}$ on date zero, increases as new investment occurs, and depreciates at the rate $\beta$. Therefore, the book value of the asset evolves according to

$$ dB_A = \left\{ \delta \left[ K + \frac{\alpha x}{\lambda} \right] - \beta B_A \right\} dt. $$

Solving for $B_A$ yields

$$ B_A = \left[ K + \frac{\alpha x}{\lambda} \right] \left\{ \frac{\delta}{\beta} + \frac{e^{-\beta t}(\beta-\delta)}{\beta} \right\}. $$

Book depreciation is $\beta B_A$. 

(17)
For financial reporting purposes, the liability for future losses is \(\alpha L\). The payment \(\lambda L\) reduces this liability to the extent it has been accrued for financial reporting purposes, \(\lambda \alpha L\), and hence reduces pretax financial accounting income by \((1 - \alpha)\lambda L\).

Pretax financial accounting income on date \(t\) is
\[
y - \beta B_A - (1 - \alpha)\lambda L. \tag{18}
\]
Taxable income on date \(t\) is
\[
y - \phi B_T - \lambda L. \tag{19}
\]

The long-run cash effective tax rate is the ratio of taxes paid to pretax financial accounting income. Because taxes paid is the product of taxable income from (19) and \(\tau\), the long-run cash effective tax rate is above the statutory tax rate if taxable income exceeds pretax financial accounting income and is below the statutory tax rate if taxable income is less than pretax financial accounting income. Because we have an infinite horizon model, we compute the difference between taxable income and pretax financial accounting income over the infinite horizon. Even though all temporary book-tax differences reverse over the life of any particular investment, our reinvestment assumption ensures that in general, aggregate book-tax differences over the infinite horizon are neither zero nor infinite.

Subtracting (19) from (18) and integrating over the infinite time horizon yields our accounting-based tax preference measure.
\[
\int_0^\infty \phi B_T - \beta B_A + \alpha \lambda L \, dt = \frac{\delta}{\beta} \left[ \frac{k(\phi - \beta)}{\phi} - \frac{\alpha x (\beta - \lambda)}{\lambda^2} \right]. \tag{20}
\]
If (20) is positive, pretax financial accounting income exceeds taxable income, and thus the firm is tax-favored according to the long-run accounting effective tax rate.
In section three, we defined a project as tax-favored if \( G < G^* \) and tax-disfavored if \( G > G^* \). Using (15), (12) implies that whether the project is tax-favored, tax-disfavored, or tax-neutral depends on the sign of

\[
\frac{K r T (\phi - \delta)}{T + \phi} - \frac{x r T (1 - T)(\delta - \lambda)}{(T + \lambda)(T + \lambda T - 1)}
\]

(21)

The project is tax-favored when (21) is positive, tax-disfavored when it is negative, and tax-neutral when it is zero.

We compare (20) and (21) to illustrate the extent to which one can use measures based on book-tax differences to draw inferences regarding whether the firm’s projects are tax-favored or tax-disfavored. Each measure has a component that is proportional to \( K \), the capital recovery component, and a component proportional to \( x \), the long-term expenditure component. The capital recovery component is tax-favored if \( \phi > \delta \); the capital recovery component of the accounting tax preference measure is positive if \( \phi > \beta \). Therefore, if \( \phi = \beta \), the accounting measure suggests that the capital recovery portion of the project is tax-neutral, even though whether the capital recovery component of the project is tax-favored or tax-disfavored depends on the sign of \( \phi - \delta \). For example, suppose the initial investment is a research expenditure, which is expensed for both book and tax purposes. Then both \( \phi \) and \( \beta \) are high but equal to each other. Therefore, the capital recovery portion of the project is tax-favored, but does not affect the accounting tax preference measure.

Similarly, the long-term expenditure component makes the project tax-disfavored (or less tax-favored) if \( x > 0 \) and \( \delta > \lambda \) because the future expenditures mean that the project’s cash flows decline more rapidly than productive capacity of the asset. However, the accounting measure will only be decreasing in \( x \) if \( \alpha > 0 \), which means that at least
part of the future costs \( x \) are accrued for financial reporting purposes when the investment is made.

To further explore further the question of whether the long-run cash effective tax rate measures whether a project is tax-favored or tax-disfavored, we consider the case in which the rate of book depreciation \( \beta \) is equal to the rate at which the productivity of the asset declines, or \( \beta = \delta \). This case is plausible and ensures that the capital recovery and long-term expenditures components in expressions (20) and (21) do not have opposite signs.

Suppose the project is tax-neutral, so expression (21) is zero. Then the sign of the accounting tax preference measure in (20) is the same as the sign of

\[
x(\delta - \lambda)\{\lambda^2(\phi + r)(1 - \tau) - \alpha\phi(\lambda + r)[r + \lambda(1 - \tau)]\}.
\]

Therefore, as long as \( x > 0 \) and \( \delta > \lambda \), that is, as long as the project has some level of tax-disfavored long-term expenditures, the long-run cash effective tax rate of a firm investing in tax-neutral projects will in general differ from the statutory tax rate. The direction of the bias depends on the accounting parameter \( \alpha \), the fraction of the undiscounted future losses that are accrued for financial reporting purposes when the investment takes place.

We consider two focal values of \( \alpha \). First, we consider the case in which long-run costs are accounted for on a cash basis (\( \alpha = 0 \)), as is done in the case of most contingent liabilities. In this case (22) implies that pretax financial accounting income exceeds taxable income, and thus the firm’s long-run cash effective tax rate will be below the statutory tax rate. In this case, the accounting measure is biased downward because it does not reflect the tax-disfavored long-term costs when \( \alpha = 0 \).
Second, we consider that case in which the present value of the future costs are accrued when the investment is made \( \alpha = \frac{\lambda}{\lambda + r} \), so that (22) simplifies to

\[
-x(\delta - \lambda)\lambda r [\phi - \lambda (1 - \tau)] \leq 0.
\]

(23)

In this case, taxable income exceeds pretax financial accounting income, and thus a firm investing in tax-neutral projects would have a long-run cash effective tax rate that exceeds the statutory tax rate. The long-run cash effective tax rate is biased upward in this case because is an undiscounted measure, putting equal weight on the book-tax differences, irrespective of when they occur.

To summarize, we consider a measure of book-tax differences, such as the long-run cash effective tax rate, to be an unreliable measure of tax preferences for two reasons. First, book-tax differences depend on the rate at which investments are depreciated for financial accounting purposes. As internally developed intangible assets are often expensed for financial reporting purposes, book-tax differences are particularly unreliable measures of tax preferences for firms with high levels of research and development investments. Even when book depreciation corresponds to the rate at which an asset’s productivity declines, the long-run cash effective tax rate mischaracterizes a tax-neutral project as tax-favored when long-run costs are not accrued for financial reporting purposes, and mischaracterizes a tax-neutral project as tax-disfavored when the present value of long-run costs are accrued for financial reporting purposes when the investment that generates the future costs occurs.
V. CONCLUSIONS

Our study makes two contributions to the study of corporate tax preferences. First, we present a new effective tax rate measure that compares taxes paid to the pretax returns on capital, both discounted to their present values. A key feature of the measure is the division of shareholder returns between a return of capital and a return on capital. Our measure avoids the problems of multiple or meaningless effective tax rates based on internal rates of return. We find that if an asset is depreciated at the rate of its decay in productivity, a project with long-term losses is tax-disfavored because the cash flows of the project decay more quickly than does the productive capacity of the asset.

Second, we use this tax preference measure as a benchmark with which to evaluate the ability of the long-run cash effective tax rate to measure the extent to which a corporation’s investments are tax-favored or tax-disfavored. We identify two ways in which the long-run cash effective tax rate can fail to correctly measure the extent a corporation’s investments are tax-favored or tax-disfavored. First, the rate at which investment costs are expensed for financial reporting purposes might differ from the rate at which the productivity of the asset decreases. An example is an investment in internally developed intangible assets that are expensed for both book and tax purposes, such as R&D, which are tax-favored but do not create book-tax differences. Second, an investment that generates long-run negative cash outflows that are deducted for tax purposes on a cash basis, such as future environmental clean-up costs, are tax-disfavored. However, even if the asset is depreciated for financial reporting purposes at the rate at which its productivity declines over time, a firm that makes a tax-neutral investment and maintains the asset’s productivity via reinvestment will exhibit a long-run cash effective
tax rate that is less than the statutory tax rate when long-run costs are not accrued for financial reporting purposes, but will exhibit a long-run cash effective tax rate that exceeds the statutory tax rate when the present value of long-run costs are accrued for financial reporting purposes when the investment takes place.
REFERENCES


APPENDIX

Proof of Proposition 1

We seek to divide the social value of the project on date $T$, $V(T)$, from equation (2) into the portion going to the government, $G(T)$, and the portion going to the shareholders, $K(T)$, so that $G = \tau(V - K_U)$, where $K_U$ is as defined in equation (3). Consider the division

$$G(T) = \frac{r\tau ye^{-\delta T}}{(r + \delta)(r + \delta(1 - \tau))} - \frac{r\tau xe^{-\lambda T}}{(r + \lambda)(r + \lambda(1 - \tau))}$$

and

$$K(T) = \frac{(1 - \tau)ye^{-\delta T}}{r + \delta(1 - \tau)} - \frac{(1 - \tau)xe^{-\lambda T}}{r + \lambda(1 - \tau)}.$$ Then

$$K_U = -\int_0^\infty K'(t)e^{-\tau t} dt = \frac{(1 - \tau)\delta y}{(r + \delta)[r + \delta(1 - \tau)]} - \frac{(1 - \tau)\lambda x}{(r + \lambda)[r + \lambda(1 - \tau)]}$$

and thus

$$\tau(V - K_U) = \frac{r\tau y}{(r + \delta)[r + \delta(1 - \tau)]} - \frac{r\tau x}{(r + \lambda)[r + \lambda(1 - \tau)]},$$

which is equal to $G(T)$ when $T = 0$. QED
<table>
<thead>
<tr>
<th>Description</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax-disfavored</td>
<td>$G &gt; G^*$</td>
</tr>
<tr>
<td>Tax-neutral</td>
<td>$G = G^*$</td>
</tr>
<tr>
<td>Tax-favored</td>
<td>$G &lt; G^*$</td>
</tr>
<tr>
<td>Tax-exempt</td>
<td>$G = 0$</td>
</tr>
<tr>
<td>Tax-subsidized</td>
<td>$G &lt; 0$</td>
</tr>
</tbody>
</table>
TABLE 2

Example illustrating tax preference measures

<table>
<thead>
<tr>
<th></th>
<th>$\theta$</th>
<th>$K$</th>
<th>$V$</th>
<th>$G$</th>
<th>$G^*$</th>
<th>$R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>tax-neutral</td>
<td>217/633</td>
<td>9495</td>
<td>9600</td>
<td>105</td>
<td>105</td>
<td>12%, 20%</td>
</tr>
<tr>
<td>tax-exempt</td>
<td>.35</td>
<td>9600</td>
<td>9600</td>
<td>0</td>
<td>105</td>
<td>13%, 19%</td>
</tr>
<tr>
<td>tax-subsidized</td>
<td>.36</td>
<td>9750</td>
<td>9600</td>
<td>−150</td>
<td>105</td>
<td>14%, 17%</td>
</tr>
<tr>
<td>tax-subsidized</td>
<td>.375</td>
<td>9984</td>
<td>9600</td>
<td>−384</td>
<td>105</td>
<td>.15 ± .03i</td>
</tr>
</tbody>
</table>

The values shown here highlight the disadvantages of using R as a benchmark for determining whether a project is tax-favored. In each case, $y = 6200$, $x = 1976$, $\delta = .12$, $\lambda = 0$, $r = 13\%$, and $\tau = 35\%$. In all four cases, there is no unique value of $R$. The first row features a tax-neutral project because $G = G^*$. The higher root $R = 20\%$ is economically meaningful, but the lower root is not. The second row features a tax-neutral project because $G = 0$. The lower root $R = 13\%$ is economically meaningful, but the lower root is not. The third and fourth rows feature tax-subsidized projects because $G < 0$. In row three, $R > r$ for both roots even though the present value of the government’s share ($G$) is negative. Finally, the fourth row features complex values of $R$. 


TABLE 3
Example illustrating tax preference measures with a single positive real-value of \( R \)

<table>
<thead>
<tr>
<th>( \theta )</th>
<th>( V )</th>
<th>( K )</th>
<th>( G )</th>
<th>( R_A ) &amp; ( R_B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>tax-disfavored</td>
<td>.10</td>
<td>196,560</td>
<td>141,960</td>
<td>54,600</td>
</tr>
<tr>
<td>tax-neutral</td>
<td>107/575</td>
<td>196,560</td>
<td>156,975</td>
<td>39,585</td>
</tr>
<tr>
<td>tax-favored</td>
<td>.28</td>
<td>196,560</td>
<td>177,450</td>
<td>19,110</td>
</tr>
<tr>
<td>tax-exempt</td>
<td>.35</td>
<td>196,560</td>
<td>196,560</td>
<td>0</td>
</tr>
<tr>
<td>tax-subsidized</td>
<td>.40</td>
<td>196,560</td>
<td>212,940</td>
<td>(16,380)</td>
</tr>
</tbody>
</table>

The values shown here compare two projects A and B for different values of \( \theta \). For project A, \( y = 107,640 \), \( x = 53,820 \), and \( \lambda = .10 \). For project B, \( y = 57,720 \), \( x = 5148 \), and \( \lambda = .02 \). For both projects, \( \delta = .12 \), \( r = 13\% \), \( \tau = 35\% \), \( V = 196,560 \), and \( G^* = 39,585 \). For any given value of \( \theta \), each project has the same values of \( K \) and \( G \).
The figures are all based on $y = 4825$, $x = 2793$, $\delta = .12$, $\lambda = 0$, $r = 13\%$, and $\tau = 35\%$, but feature different values of $\theta$. The top plot features $\theta = .25$ and has only one positive root, $R \approx .19$. When $\theta$ is increased to .36 (middle plot), there are two positive roots ($R \approx .01$ and $R \approx .12$). Finally, if $\theta$ increases to .44 (bottom plot), $f(R)$ has no real roots.