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Fixed and Variable Tax Expense and the Cost of Equity Capital

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ABSTRACT: Prior studies provide mixed evidence on the relation between tax avoidance and cost of equity capital. To understand how this relation varies across firms, we model income tax as containing both a fixed component (like a tax credit or deduction) and a variable component (a tax rate) and investigate how each type of tax expense affects the cost of equity capital. Unlike other fixed costs, the fixed tax component may be negative (a tax benefit). A lower fixed tax component always reduces cost of capital. The effect of a lower tax rate depends on the sign of the fixed tax component. With a negative fixed tax component, a lower tax rate increases cost of capital. Results of empirical tests are generally consistent with our predictions. Our results suggest the relation between cost of equity capital and tax avoidance is ambiguous when tax avoidance is accomplished through a lower tax rate.

JEL Classifications: G12.

Keywords: cost of capital; tax avoidance; operating leverage; fixed and variable costs.

I. INTRODUCTION

An important research question in both accounting and finance is the extent to which tax avoidance by a corporation affects that firm's cost of equity capital. Despite considerable effort by a number of scholars, the findings to date have been inconclusive. For example, whereas Goh, Lee, Lim, and Shevlin (2016) find that tax avoidance reduces cost of equity capital, Cook, Moser, and Omer (2017) show that cost of equity capital increases as levels of tax avoidance deviate from investors' expectations. Using latent class mixture models, Hutchens, Rego, and Williams (2024) find that the relation between tax avoidance and priced risk varies across their subsamples. Specifically, they show that although firms, on average, exhibit a negative relation between tax avoidance and priced risk, with the magnitude of the negative relation being stronger than that of the positive relation, a nontrivial proportion of their sample firms (35.6 percent) exhibits a positive relation. Based on this finding, Hutchens et al. (2024) argue that the relation between corporate tax avoidance and cost of equity capital is complex and is not a single fixed relation for all firms.

We investigate this question using the cash-flow-based capital asset pricing model of Lambert, Leuz, and Verrecchia (2007) (LLV) to identify factors that affect the relation between tax expense and cost of equity capital. Our model shows that tax avoidance that reduces a firm's tax rate can either increase or decrease a firm's cost of equity capital; the result depends on whether the firm's tax expense contains a fixed tax component (one that does not covary with pretax income) and whether that fixed tax component is an expense or a subsidy (a reduction in tax expense, such as a tax credit).

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In the LLV model, a firm's cost of equity capital depends on a ratio, called the H-ratio, where the numerator of the H-ratio is the expected future cash flow to the firm, and the denominator is the expected covariance of the firm's cash flow with market cash flow. The higher (lower) the H-ratio, the lower (higher) is the firm's cost of equity capital. Goh et al. (2016) rely on the H-ratio from the LLV model to examine empirically whether corporate tax avoidance reduces the cost of equity capital. They argue that tax avoidance should reduce cost of equity capital to the extent that the tax avoidance increases a firm's cash flow (the numerator of the H-ratio), but does not increase the covariance of that firm's cash flow with market cash flow (the denominator of the H-ratio). Their empirical results are consistent with this prediction. However, the idea that the additional cash flow from tax avoidance does not covary with market cash flow is simply assumed by Goh et al. (2016) and is never explicitly tested.

Our goal is to expand the theoretical argument that underpins the empirical findings in Goh et al. (2016) by asking the question: what happens if tax avoidance increases both cash flow and covariance? To the extent that a firm's tax expense covaries with the firm's pretax income, the correlation between the two measures is what we refer to in this paper as a tax "rate." We use the term rate for expositional convenience, but emphasize that the tax rate in our study is not necessarily the firm's statutory, marginal, or effective tax rate, but simply reflects a statistical relation between tax expense and pretax income that is represented by the slope coefficient from a regression. The tax rate in our study represents the expected amount of change in a firm's tax expense for every one-dollar change in that firm's pretax income. As such, it reflects the statutory tax rates of jurisdictions in which the firm is taxed, but it also reflects the tax effect of book-tax differences that covary with pretax income.

We model a firm's tax expense as consisting of three components: (1) a component that covaries with the firm's pretax income, which we call the tax rate component; (2) a component that does not covary with pretax income, but reflects a fixed dollar amount, such as a tax credit or the tax effect of a book-tax difference that does not covary with pretax income; and (3) a random component. This approach is consistent with the argument in Sikes and Verrecchia (2020), who examine how costs of capital for all firms are affected if more firms in the economy engage in tax avoidance. Sikes and Verrecchia (2020, 3) argue that tax expense "is comprised of two parts: a tax/subsidy on firm size and a tax on income, where the former represents a fixed tax and the latter represents a variable tax." They refer to the fixed component of tax as the "tax base" and the variable tax as the "tax rate" and go on to state: "When engaging in tax avoidance, a firm can either reduce its tax base or reduce the marginal tax rate on its income" (Sikes and Verrecchia 2020, 4). Similarly, Lampenius, Shevlin, and Stenzel (2021) argue that firms engage in both tax-base avoidance (by reducing taxable income) and tax-rate avoidance (by shifting taxable income to lower tax jurisdictions). In addition, Edwards, Kubata, and Shevlin (2021, 231) suggest that cash taxes paid (Compustat TXPD) can be expressed as a regression intercept (α), which represents a fixed component, plus the product of pretax income and a slope coefficient (β), which represents a rate component.

To the extent that the firm reduces its tax base (the "fixed tax" component in the terminology of Sikes and Verrecchia), and the tax base reduction does not covary with pretax income, this represents the type of tax avoidance that is the focus of the Goh et al. (2016) study. However, if the tax avoidance reduces the tax rate (the "variable tax" component in the terminology of Sikes and Verrecchia 2020) or is a reduction in the tax base that covaries with pretax income, the cash flow generated from the tax avoidance will covary with pretax income. To the extent that the firm's pretax income covaries with market cash flow, the covariance risk will be increased by this type of tax avoidance.

How will this affect the firm's cost of equity capital? The effect of a reduction in the tax rate on the firm's H-ratio is to increase the numerator (expected cash flow) by the reduction in the tax rate multiplied by the firm's pretax income. The tax rate reduction also increases the denominator of the H-ratio by the reduction in the tax rate multiplied by the covariance of pretax income with market cash flow. For a firm without a fixed component to its tax expense, both the numerator and denominator of the H-ratio are increased by the same proportion (the percentage change in tax rate), so there is no effect on the overall ratio and, therefore, no effect on the cost of equity capital.

However, this result holds only if the firm's tax expense does not contain a fixed component. When a firm's tax expense includes a fixed component, the amount of this fixed component—scaled by the covariance risk—is subtracted from the H-ratio (in the case of a fixed tax expense) or added to the H-ratio (in the case of a fixed tax subsidy). When the tax rate is reduced, it results in an increase in covariance risk in the denominator and, thus, reduces the size of the scaled fixed component that is subtracted from or added to the H-ratio. If the fixed tax component is an expense, subtracting a smaller scaled expense results in a higher overall H-ratio, which decreases the cost of capital. Conversely, if the fixed tax component is a subsidy, adding a smaller scaled subsidy results in a lower overall H-ratio, which increases the cost of capital.

This is a key idea that underlies the empirical tests in our study: a firm's fixed tax component may be either positive (a fixed tax expense) or negative (a fixed tax subsidy). To the extent that the firm's fixed tax component is a tax subsidy (a negative fixed component), it increases the firm's cash flow. In that situation, any reduction in the firm's tax rate, which increases the covariance of the firm's cash flow with market cash flow, and thus increases the denominator of the H-ratio, will result in a decrease in the firm's H-ratio and a corresponding increase in the firm's cost of equity capital.

Examples of this negative fixed tax component are a tax credit, the tax deduction from a fixed amount of bonus depreciation, or a fixed amount of tax-exempt income. A tax credit/deduction is part of the fixed tax component since the amount of tax savings does not vary with the level of pretax cash flow. On the other hand, an example of a positive fixed tax component would be an expense incurred by the firm that is not deductible for tax purposes, such as a fine or penalty, or excess officer compensation. A fixed tax component can also result when different components of a firm's pretax cash flow are taxed at different rates, as with a progressive tax rate structure.

We test the prediction of our model empirically by first generating firm-specific estimates of both the fixed and variable (i.e., tax rate) components of tax expense for a sample of U.S. Compustat firms using firm-specific time-series regressions. Following Goh et al. (2016), we generate firm-specific cost of equity capital estimates based on the Easton (2004) implied cost of capital measure. We find that cost of capital is positively related to the fixed component of tax expense, suggesting that a lower fixed component of tax expense is associated with a lower cost of equity capital. We also find that the relation between cost of capital and the tax rate component depends on the sign of the fixed component. As predicted by our model, when the fixed component of tax expense is negative, there is a negative relation between the firm's tax rate and the cost of equity capital (i.e., a lower tax rate is associated with a higher cost of capital). However, when the fixed component of tax expense is positive, the relation between the firm's tax rate and the cost of equity capital is not significantly different from zero.

Following the research design of Goh et al. (2016), we also conduct a cross-sectional test of the relation between cost of equity capital and firms' five-year cash effective tax rate (Cash ETR). We separate our sample into three groups: the highest, middle, and lowest one-third, based on the size of the Cash ETR. Cross-sectional regressions of cash taxes paid on pretax income show that firms in the groups with the lowest (highest) Cash ETRs have, on average, a negative (positive) fixed component to cash taxes paid. We also find that the average of our tax rate estimates is increasing with the size of the Cash ETR, and we therefore use the size of the Cash ETR as a proxy for the tax rate component of tax expense. When we regress cost of capital on the Cash ETRs, we find that the relation is negative for firms with the lowest Cash ETRs (those having, on average, a negative fixed tax component), suggesting that lower Cash ETRs (i.e., more tax avoidance) are associated with higher cost of equity capital. We find that the relation between cost of capital and Cash ETRs is positive for firms with the highest Cash ETRs (those having, on average, a positive fixed tax component), suggesting that lower Cash ETRs (i.e., more tax avoidance) are associated with lower cost of equity capital, a result consistent with Goh et al. (2016).

Note that this result—that a decrease in a firm's tax rate can increase the firm's cost of equity capital—is a different result than that discussed in Sikes and Verrecchia (2020). The Sikes and Verrecchia result reflects the cost of capital for all firms in the economy when multiple firms decrease their tax rates at the same time. Sikes and Verrecchia relate the average cost of capital to aggregate tax rate reduction, and their result is driven by the reduction in the sharing of market risk with the government that occurs with an income tax. In contrast, we examine, for a given level of market risk, how one firm's tax expense affects its cost of capital; our result focuses on the cross-sectional differences in the relation between firm-specific cost of capital and firm-specific tax avoidance and is driven by the presence of a negative fixed component in the firm's income tax expense. A recent study by Lewellen, Landon, and Watson (2021) documents that incorporating a firm's parent entity in a tax haven is associated with a higher cost of capital. To the extent that tax haven parent incorporation provides the multinational corporation (MNC) firm with greater opportunities to lower its tax rate, this finding is consistent with our prediction that lowering the tax rate can increase the cost of equity capital.

Our results make several important contributions to accounting research. First, our results demonstrate how understanding a firm's cost structure can help in understanding the relation between the firm's costs and its cost of equity capital. In particular, our findings complement existing studies examining the relation between corporate tax avoidance and cost of equity capital (Goh et al. 2016; Cook et al. 2017; Hutchens et al. 2024) by demonstrating that this relation is conditional on the structure of tax expense. Compared with other types of expenses, corporate income tax is an important and relatively exogenous cash outflow. Our results thus facilitate a better understanding of how cost of capital depends on primitive distribution properties of cash flows.

Second, our results demonstrate that reducing the tax rate, although increasing the firm's covariance risk and decreasing the variable tax expense by the same proportion, may still result in a lower cost of capital when the fixed expense component is positive. This conclusion is not limited to tax expenses. To the extent that the firm's operating expenses contain a fixed component that does not vary with sales, reducing the variable operating expense rate would result in lower cost of capital, despite the same proportional increase in the contribution margin and the covariance risk.

Finally, our results point out how tax expense differs from other types of costs that the firm faces, in that the fixed component of tax expense is negative for many firms, making the effect of tax expense on cost of capital different from

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other costs. Fixed operating costs are necessarily positive since some inputs are always required to initiate an economic activity. However, the progressive nature of corporate income tax, combined with tax benefits like credits and deductions, often results in a negative fixed tax component, which results in "diseconomies of scale" in the sense that as the pretax cash flow increases, the tax saving as a percentage of pretax cash flow decreases. Consequently, when the tax rate is lower, expected cash flow increases by a smaller percentage than covariance risk, resulting in higher cost of capital.

II. MODEL

Lambert et al. (2007) recast the capital asset pricing model (CAPM) to express a firm's expected return (or cost of equity capital) in terms of the mean-variance property of its expected future cash flow Equation 4(b) in Lambert et al.):

$$E\left(\widetilde{R}_i|\Phi\right) = \frac{R_f H(\Phi) + 1}{H(\Phi) - 1}, \text{ where } H(\Phi) = \frac{E\left(\widetilde{V}_i|\Phi\right)}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I} \widetilde{V}_j|\Phi\right)}. \tag{1}$$

In the above expressions, $\widetilde{R}_i$ is the rate of return on firm *i*'s stock, Φ is the information available to market participants to make assessments regarding the expected distribution of future cash flows, R_f is the risk-free rate, $\widetilde{V}_i$ is the end-of-period cash flow to firm *i*, *N* is the number of investors, *I* is the number of firms, λ is the individual investor's risk tolerance, and $N\lambda$ is the aggregate risk tolerance of the marketplace.

Given that idiosyncratic firm risk can be diversified away, the risk relevant to investors is the firm's covariance risk with the market, which is represented by the denominator $\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I} \widetilde{V}_j|\Phi\right)$, the covariance of the firm's cash flow with aggregate market cash flow, discounted by the aggregate market risk tolerance. The ratio $H(\Phi) = \frac{E\left(\widetilde{V}_i|\Phi\right)}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I} \widetilde{V}_j|\Phi\right)}$ thus measures the firm's expected cash flow per unit of covariance risk. Cost of capital, $E\left(\widetilde{R}_i|\Phi\right)$, is decreasing in $H(\Phi)$, so if the firm's expected cash flow increases without a commensurate increase in the covariance risk, the cost of capital will decrease. Our focus is on how a decrease in a firm's expenses, in particular, through tax avoidance, affects the distribution of the end-of-period cash flow $\widetilde{V}_i$ and changes the value of the H-ratio. Before introducing particular types of expenses into Equation (1), we first adopt a simplified notation by eliminating the conditional expectation expression $(|\Phi)$ and denoting the market cash flow as $\widetilde{V}_M \equiv \sum_{j=1}^{I} \widetilde{V}_j$, so that the H-ratio becomes

$$H = \frac{E\left(\widetilde{V}_i\right)}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \widetilde{V}_M\right)}. \tag{2}$$

This expression helps in analyzing how the primitive distribution properties of the firm's cash flow affect its cost of capital. As stated in Lambert et al. (2007, 394), there is no reason to expect that all components of a firm's cash flow belong to the same "risk-class" or change in ways that always result in the same mean-variance characteristics, as captured by the H-ratio: "While it is common in some corporate finance and valuation models to assume that the level of cash flow and the covariances move in exact proportion to each other (i.e., all cash flow is from the same risk class), we are unaware of any theoretical results or empirical evidence this should be the case. On the contrary, *the existence of fixed costs in the production function*, economies of scale, et cetera, generally make the expected values and covariances of firms' cash flows change in ways that are not exactly proportional to each other" (emphasis added).

Our focus is on how tax expense affects the distribution characteristics of its after-tax earnings and changes its cost of capital. The standard capital asset pricing model assumes a single-period time horizon, but a convincing analysis incorporating corporate taxation and book-tax difference requires a multiperiod framework. In Appendix A, we embed the above analyses into the multiperiod CAPM framework adapted for taxes by Brennan (1970). Under the assumption that firms generate uncertain cash flows over an indefinite future and that CAPM holds on a period-by-period basis, we show that a firm's cost of capital for each period can again be expressed as a decreasing function of the H-ratio associated with the end-of-period after-tax cash flow. Such an analysis facilitates a better understanding of the model's relevance, but the derivation does not differ in nature from Lambert et al. (2007) and, therefore, is delegated to the appendix.

Cost of Capital and Tax Avoidance

Now, we use Equation (2) to analyze how a firm's cost of equity capital responds to tax avoidance that decreases tax expense. The firm's after-tax earnings are the net result of its pretax earnings and tax expenses. As we demonstrate below, the H-ratio of end-of-period after-tax earnings can be expressed as (1) the H-ratio of the pretax earnings, minus (2) fixed tax costs per unit of covariance risk. In the absence of any fixed tax cost, the firm's after-tax earnings would simply be a percentage of its pretax earnings and, thus, have the same mean-covariance property as pretax earnings.

Tax is a special type of cost that increases with the firm's pretax income. Different from other cost items, the "fixed" component of tax expense can be negative, as in the case of a tax credit. We show that this feature gives rise to situations where the cost of equity capital might be higher for tax-avoiding firms, even though tax avoidance has a positive impact on cash flow.

Assume a linear tax payment function ($\widetilde{T}_i$) that contains a rate component (τ_i), a nonrate component (c_i), and a random component ($\widetilde{\varepsilon}_i$) such that

$$\widetilde{T}_i = c_i + \tau_i \widetilde{\Pi}_i + \widetilde{\varepsilon}_i, \tag{3}$$

where $\widetilde{\Pi}_i$ is the firm's pretax earnings, c_i and τ_i are firm-specific constants, and $\widetilde{\varepsilon}_i$ is an idiosyncratic random error that is independent across firms. Tax planning activities can thus be classified into two types of strategies: (1) a rate strategy that decreases τ_i, and (2) a nonrate strategy that decreases c_i.[1]

The above specification of $\widetilde{T}_i$ can be better understood in the context of Edwards et al. (2021) that examine the relation between cash ETR and pretax earnings. Specifically, let $\widetilde{TI}_i$ denote the taxable income and $\widetilde{BTD}_i$ denote the book-tax differences that include all items causing taxable income and pretax income to diverge due to the differences in GAAP (as reflected in $\widetilde{\Pi}_i$) and the tax law. Then,

$$\widetilde{TI}_i = \widetilde{\Pi}_i - \widetilde{BTD}_i, \tag{4}$$

where $\widetilde{BTD}_i$ can be thought of as a linear function of $\widetilde{\Pi}_i$:

$$\widetilde{BTD}_i = \theta_{0i} + \theta_{1i} \widetilde{\Pi}_i. \tag{5}$$

In this formulation, the intercept θ_{0i} captures book-tax differences (BTDs) that are independent of the current period's pretax income $\widetilde{\Pi}_i$. Examples include excessive non-performance-based executive compensation, cash received from unearned revenue, nontaxable municipal bond interest, accelerated depreciation or write-offs for tax purposes, and net operating loss (NOL) deductions from prior-period losses. The slope θ_{1i} captures the part of BTDs that is proportional to pretax income—for instance, corporate dividends received deduction or unrepatriated foreign earnings. Note that the effect from NOL originates when losses are incurred and reverses in later periods as income-independent BTDs (i.e., increasing θ_{0i}) when NOL deductions are used.[2] Similarly, the effect from foreign earnings, unearned revenue, and accelerated depreciation or direct write-offs also represent temporary BTDs. On the other hand, excessive executive compensation, nontaxable municipal bond interest, and corporate dividends received deduction represent permanent BTDs. Edwards et al. (2021, Appendix A) provide a detailed summary of the nature and signs of these BTDs.

Edwards et al. (2021) further formulate a firm's explicit tax burden as the product of its taxable income $\widetilde{TI}_i$ and the statutory tax rate, τ_{st}, plus the net taxes paid as a result of audit adjustments A_i and tax credits C_i (e.g., research and development credits and foreign tax credits). Adopting their formulation, the tax payment $\widetilde{T}_i$ becomes

[1] See Lampenius et al. (2021) for an empirical investigation of these two types of tax avoidance and how they differ for domestic versus multinational U.S. firms. Note that tax avoidance can lead to increased public and regulatory scrutiny, as well as heightened operational complexity, both of which can contribute to a higher idiosyncratic risk for companies. We examine how tax avoidance affects a firm's covariance risk and cost of capital through the tax cost structure. We do not explicitly model the tax avoidance decision or its impact on idiosyncratic firm risk. The notion of "tax avoidance" in our study is broader than firms' strategic attempts of lower corporate tax burden; it includes all factors that result in *cross-sectional* differences in the fixed and variable tax components. However, empirical evidence on the relation between strategic tax avoidance and idiosyncratic firm risk is mixed. For instance, Guenther, Matsunaga, and Williams (2017) find that measures of tax avoidance commonly used in the literature are generally not associated with future overall firm risk, and Dyreng, Hanlon, and Maydew (2019) find that low ETRs are associated with the reserve for uncertain tax benefits, which they distinguish from "risky." In contrast, Hutchens, Rego, and Williams (2024) provide evidence of a significant and positive relation between Cash ETRs and idiosyncratic risk for a substantial proportion of their large sample.

[2] An exception occurs when an NOL deduction is limited by current period profitability, in which case these deductions can partially depend on current period income.

$$\begin{aligned}\widetilde{T}_i &= A_i - C_i + \tau_{st}\cdot\widetilde{TI}_i + \widetilde{\varepsilon}_i\\ &= A_i - C_i + \tau_{st}\cdot(\widetilde{\Pi}_i - \widetilde{BTD}_i) + \widetilde{\varepsilon}_i\\ &= \underbrace{A_i - C_i - \tau_{st}\cdot\theta_{0i}}_{c_i} + \underbrace{\tau_{st}(1-\theta_{1i})}_{\tau_i}\cdot\widetilde{\Pi}_i + \widetilde{\varepsilon}_i,\end{aligned} \tag{6}$$

which shows that to the extent that total book-tax differences are linearly related to pretax income, taxes paid will also be linearly related to pretax income. The rate component τ_i depends on the statutory tax rate τ_{st} and the portion of income-dependent book-tax difference θ_{1i}. The income-independent book-tax difference θ_{0i} translates to some taxes unrelated to pretax income $(-\tau_{st}\cdot\theta_{0i})$ which, together with $A_i - C_i$ that affect current taxes paid dollar for dollar, determines the fixed tax component c_i.

The firm's end-of-period after-tax earnings $\widetilde{V}_i$ equals

$$\widetilde{V}_i = \widetilde{\Pi}_i - \widetilde{T}_i = (1-\tau_i)\widetilde{\Pi}_i - c_i - \widetilde{\varepsilon}_i. \tag{7}$$

Because $\widetilde{\Pi}_i$ is scaled by $(1-\tau_i)$, as the rate component τ_i increases, the variability in $\widetilde{V}_i$ becomes less driven by the variability in $\widetilde{\Pi}_i$, which reduces the firm's covariance risk. Let $\widetilde{V}_M \equiv \sum_{j=1}^{I}\widetilde{V}_j$ denote the aggregate market after-tax payoff. Using Equations (3) and (4), the H-ratio of $\widetilde{V}_i$ becomes

$$\begin{aligned}H &= \frac{E\left[\widetilde{V}_i\right]}{\frac{1}{N\lambda}COV\left(\widetilde{V}_i,\widetilde{V}_M\right)}\\ &= \frac{(1-\tau_i)\cdot E\left[\widetilde{\Pi}_i\right] - c_i}{\frac{(1-\tau_i)}{N\lambda}COV\left(\widetilde{\Pi}_i,\widetilde{V}_M\right)}\\ &= \frac{E\left[\widetilde{\Pi}_i\right]}{\frac{1}{N\lambda}COV\left(\widetilde{\Pi}_i,\widetilde{V}_M\right)} - \frac{c_i}{\frac{(1-\tau_i)}{N\lambda}COV\left(\widetilde{\Pi}_i,\widetilde{V}_M\right)}.\end{aligned} \tag{8}$$

Equation (8) allows a computation of how the fixed tax component affects cost of capital:

$$\frac{\partial H}{\partial c_i} = -\frac{1}{\frac{(1-\tau_i)}{N\lambda}COV\left(\widetilde{\Pi}_i,\widetilde{V}_M\right)} < 0. \tag{9}$$

Any reduction in the fixed tax component has the effect of increasing the H-ratio and, therefore, reducing the cost of equity capital.

Prediction 1: (Cost of Capital and the Fixed Tax Component): The cost of equity capital $E(\widetilde{R}_i)$ increases with the fixed tax component c_i.

The above prediction is consistent with the notion that tax avoidance that increases earnings without increasing covariance risk has the effect of increasing the H-ratio, which, in turn, decreases the cost of capital.

Equation (8) also allows a computation of how a decrease in the tax rate (τ_i) affects cost of capital. In contrast to a change in the fixed tax component, changing the tax rate changes both the firm's expected cash flow and covariance risk:

$$\frac{\partial H}{\partial \tau_i} = -\frac{c_i}{\frac{(1-\tau_i)^2}{N\lambda}COV\left(\widetilde{\Pi}_i,\widetilde{V}_M\right)} \lesseqgtr 0 \;\; if \;\; c_i \gtreqless 0. \tag{10}$$

The sign depends on the sign of c_i, the fixed tax component. When the fixed component is positive, a decrease in the tax rate will increase the H-ratio and decrease the cost of equity capital. However, when the fixed tax component is negative (as with a tax credit), a decrease in the tax rate will decrease the H-ratio and increase the cost of equity capital. This relation is formalized below:

Prediction 2: (Cost of Capital and the Tax Rate Component): In our model, the tax rate τ_i captures the statistical correlation between firm *i*'s pretax income and tax expense and should not be interpreted as a statutory, marginal, or effective tax rate. The cost of equity capital $E(\widetilde{R}_i)$ increases with the tax rate (τ_i) if c_i is positive and decreases with the tax rate (τ_i) if c_i is negative.

To understand the intuition behind the above prediction, notice that when there is no fixed tax component $(c_i = 0)$, a change in τ_i would cause the same percentage change in the covariance risk and expected after-tax earnings and, thus, have no impact on the H-ratio. When c_i is positive (negative), the percentage change in after-tax earnings due to changes in τ_i is greater (less) than the percentage change in the covariance risk.[3] Therefore, when c_i is negative (i.e., a fixed amount of tax savings), an increase in τ_i causes a smaller percentage reduction in $E[\widetilde{V}_i]$ than in the covariance risk $COV(\widetilde{V}_i, \widetilde{V}_M)$, leading to higher H-ratio and lower cost of capital. The converse is true when c_i is positive.

Extensions and Discussions

In this section, we discuss how our results might be affected if the fixed tax component covaries with the market payoff $\widetilde{V}_M$ or if the fixed tax component covaries with the tax rates τ_i due to the cross-sectional variation in the firm-specific statutory tax rates averaged across different transactions.

Covariability between Fixed Tax Costs and Market Cash Flows

So far, our analysis is derived under the simplifying assumption that the fixed tax component is independent of the market payoff $\widetilde{V}_M$. When the fixed tax component is a random variable $\widetilde{c}_i$ that covaries with the aggregate market cash flow, the firm's after-tax covariance risk becomes $COV(\widetilde{V}_i, \widetilde{V}_M) = (1-\tau_i)COV(\widetilde{\Pi}_i, \widetilde{V}_M) - COV(\widetilde{c}_i, \widetilde{V}_M)$, and its expected after-tax cash flow equals $E[\widetilde{V}_i] = (1-\tau_i)\cdot \mathrm{E}[\widetilde{\Pi}_i] - \mathrm{E}[\widetilde{c}_i]$. The firm can be thought of as holding $(1-\tau_i)$ share of long position in the risky security $\widetilde{\Pi}_i$ and one share of short position in the risky security $\widetilde{c}_i$. Notice that when $E[\widetilde{c}_i]$ equals $\frac{E[\widetilde{\Pi}_i]COV(\widetilde{c}_i, \widetilde{V}_M)}{COV(\widetilde{\Pi}_i, \widetilde{V}_M)}$, $\widetilde{\Pi}_i$ and $\widetilde{c}_i$ have the same mean-covariance ratio, in which case the H-ratio of the firm would also equal this common ratio. Because the firm's H-ratio decreases with $E[\widetilde{c}_i]$, when $E[\widetilde{c}_i]$ is above (below) the aforementioned threshold value, the H-ratio of the firm will be pushed below (above) the mean-covariance ratio of $\widetilde{\Pi}_i$, so that as the tax rate τ_i decreases leading an increased long-position on $\widetilde{\Pi}_i$, the firm's H-ratio increases (decreases) to approach $\frac{E[\widetilde{\Pi}_i]}{COV(\widetilde{\Pi}_i, \widetilde{V}_M)}$. Since a higher H-ratio means a lower cost of capital, it follows that when there is more tax rate avoidance that lowers τ_i, the firm's cost of capital decreases (increases) when $E[\widetilde{c}_i]$ is above (below) the threshold $\frac{E[\widetilde{\Pi}_i]COV(\widetilde{c}_i, \widetilde{V}_M)}{COV(\widetilde{\Pi}_i, \widetilde{V}_M)}$. Thus, in this more general setting, a *sufficient* condition for the cost of capital to decrease (increase) in τ_i is when the expected fixed tax component $(\mathrm{E}[\widetilde{c}_i])$ is sufficiently negative (positive) (see Appendix B for an analysis), as summarized in the following modified version of Prediction 2:

Prediction 2′: (Cost of Capital and the Tax Rate Component): When the fixed tax component nontrivially covaries with the aggregate market payoff $(COV(\widetilde{c}_i, \widetilde{V}_M) \neq 0)$, the cost of equity capital $E(\widetilde{R}_i)$ increases with the tax rate (τ_i) if $\mathrm{E}[\widetilde{c}_i]$ is sufficiently positive and decreases with the tax rate (τ_i) if $\mathrm{E}[\widetilde{c}_i]$ is sufficiently negative.

The above analysis does not restrict the sign of $COV(\widetilde{c}_i, \widetilde{V}_M)$ but does require that $COV(\widetilde{\Pi}_i, \widetilde{V}_M)$ and $COV(\widetilde{V}_i, \widetilde{V}_M) = (1-\tau_i)COV(\widetilde{\Pi}_i, \widetilde{V}_M) - COV(\widetilde{c}_i, \widetilde{V}_M)$ be positive, which reflects the implicit assumption that the overall market movements and the behavior of firms' end-of-period after-tax cash flows are mainly connected through the variability of pretax earnings. Under this assumption, the size of $COV(\widetilde{c}_i, \widetilde{V}_M)$ is likely to be small relative to

[3] That a change τ_i leads to a larger percentage change in after-tax earnings $\widetilde{V}_i$ as c_i increases is analogous to the well-known impact of fixed operating costs on the volatility of profits as sales fluctuate.

$COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)$, so that $\frac{E\left[\widetilde{\Pi}_i\right] COV\left(\widetilde{c}_i, \widetilde{V}_M\right)}{COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)}$ is close to zero, in which case Prediction 2 and Prediction 2′ do not differ qualitatively.

Covariability between Fixed Tax Costs and Tax Rate

Central to our empirical analyses are Equations (9) and (10), the derivatives of the H-ratio with respect to c_i and τ_i. In our basic model setup, τ_i equals $\tau_{st} \cdot (1 - \theta_{1i})$ and c_i equals $A_i - C_i - \tau_{st} \cdot \theta_{0i}$, wherein τ_{st} is the *constant* statutory tax rate for all transactions—for example, when all transactions are taxed at the top federal U.S. statutory rate. In this setting, the cross-sectional difference in τ_i is entirely driven by θ_{1i} and, thus, independent of the cross-sectional difference in c_i.

Conceptually, τ_{st} should be interpreted as some weighted average of statutory tax rates across different transactions of a firm, which can vary across firms due to tax progression and tax avoidance strategies that shift income to countries or states with lower statutory tax rates (see Lampenius et al. 2021 for a formal analysis). However, the tax rates to which θ_{0i} (part of the fixed component) is exposed might only be a subset of all the tax rates to which the firm is exposed, so that it is unclear to what extent c_i covaries with τ_i. For example, Lampenius et al. (2021) find that multinational firms engage in relatively more tax avoidance that increases BTDs in their domestic operations than in their foreign operations, and the average statutory tax rates for their foreign income are significantly below those for their domestic income. Nevertheless, to the extent that transactions generating θ_{0i} can be exposed to the same tax rates affecting τ_i, variations in these tax rates affect both τ_i and c_i and, thus, affect the H-ratio through both the rate impact (as captured by Equation (10)) and the fixed tax impact (as captured in Equation (9)).

To examine the robustness of our analytical predictions to the potential covariability between c_i and τ_i due to their common exposure to statutory tax rates, we now assume that θ_{0i} is exposed to the set of tax rates that affect τ_i. We use τ_{sti} to denote the firm-specific statutory tax rate averaged across all transactions and assume that $\tau_i = \tau_{sti}(1 - \theta_{1i})$ and $c_i = A_i - C_i - \theta_{0i} \cdot \tau_{sti}$. If θ_{0i} is small, then regardless of the signs of θ_{0i}, τ_{sti} will have little impact on c_i, in which case Equations (9) and (10) fully capture the impacts of varying τ_i or c_i on the H-ratio. As θ_{0i} increases in size, it becomes more likely that $-\tau_{sti} \cdot \theta_{0i}$ dominates $A_i - C_i$ and determines the sign of c_i. When $c_i \approx -\tau_{sti} \cdot \theta_{0i}$, the linkage between c_i and τ_i due to τ_{sti} is of the biggest concern. Note that in this case, if θ_{0i} is positive (so that c_i is negative), a decrease in τ_{sti} reduces τ_i and makes the negative c_i less negative (i.e., c_i increases when τ_{sti} decreases) by reducing the tax savings associated with the taxable income decreasing θ_{0i}. The decrease in the tax rate τ_i and the increase in the fixed tax component c_i both have the effect of decreasing the H-ratio, per the fixed tax impact of Equation (9) and the rate impact of Equation (10). If θ_{0i} is negative (so that c_i is positive), a decrease in τ_{sti} decreases τ_i and also makes the positive c_i less positive (i.e., c_i decreases when τ_{sti} decreases) by reducing the tax payment associated with the taxable-income increasing θ_{0i}, both of which, per the fixed tax impact of Equation (9) and the rate impact of Equation (10), increase the H-ratio. Thus, as τ_{sti} varies, the fixed tax component c_i moves in the opposite direction with the H-ratio, whereas the tax rate τ_i moves in the same (opposite) direction with the H-ratio if c_i is positive (negative).[4] These comovements are observationally equivalent to Predictions 1 and 2, and the underlying mechanism is fully explained by the combined impact from Equations (9) and (10).

To summarize, Equation (10) measures the *partial* impacts of varying τ_i on the H-ratio holding the fixed tax component c_i unchanged. However, in situations where the fixed tax component c_i is sensitive to those tax rates affecting τ_i, the comovement between the tax rate and the H-ratio and the comovement between the fixed tax component and the H-ratio are still consistent with Predictions 1 and 2. In other words, when the fixed tax component is dominated by the income-independent book-tax differences (θ_{0i}), the *total* impact of tax rate avoidance (i.e., strategies that reduce τ_i) on the H-ratio, after considering the possible impact on c_i due to changes in τ_{sti}, still has the same sign as that identified in Equation (10). The same is true with respect to Equation (9) and the *total* impact on the H-ratio of tax avoidance strategies that reduce the fixed tax component c_i. When θ_{0i} and c_i have the same sign, the size of θ_{0i} is likely to be small, so that the cross-sectional variation in c_i is more likely to be independent of the cross-sectional variation in τ_i.[5]

[4] See Appendix C for a formal mathematical analysis.
[5] The above discussion focuses on situations where c_i is dominated by either $A_i - C_i$ or $-\theta_{0i} \cdot \tau_{sti}$. With a large sample, it is possible that these two fixed tax components are of comparable size for some firms, in which case c_i tends to change signs as τ_{sti} varies, and changes in τ_{sti} may not have a clear directional impact on the H-ratio. This will bias against finding empirically significant impacts on the cost of capital from either the fixed or variable tax expenses. Our empirical analyses, although not detecting a significant relationship between the tax rate and the cost of capital when the fixed tax component is positive, does indicate a significant negative relationship between fixed tax expenses and the cost of capital and between the tax rate and the cost of capital when the fixed tax component is negative, supporting our model's key predictions.

TABLE 1

Sample Selection

Firm-quarter observations from the Compustat universe with nonmissing pretax income and tax expense	808,574
Less quarter-level regressions with a R^2 less than 0.6	(228,926)
Less quarter-level regressions with less than 20 observations in the 21-quarter window	(361,603)
Less quarter-level observations missing estimated *c* or τ	(527)
Less if τ is negative	(30)
Firm-quarter observations	217,488
Collapsed firm-year observations	63,882
Less observations missing any regression variables	(39,594)
Less financial and utility firms	(2,317)
Final sample size	21,971

III. EMPIRICAL TEST

Testing Predictions 1 and 2

We estimate a firm's fixed tax component (*c*) and tax rate (τ) by estimating the following firm-specific rolling quarterly time-series regression model for each firm:

$$Tax_q = c + \tau PI_q + e_q, \tag{11}$$

where *Tax* is Total Tax Expense (TXTQ),[6] and *PI* is Pretax Income (PIQ), both scaled by lagged total assets.[7] We require that (1) *PI* is positive for the quarter; (2) each regression has at least 20 quarterly observations with positive *PI*;[8] (3) the estimate of τ must be positive; and (4) the regression has an R^2 greater than 0.6.[9] We estimate Equation (11) over a 21-quarter window centered around the focal quarter and use the average of the four quarterly estimates of (*c*) and (τ) as the yearly estimates. Table 1 shows the sample selection procedure.[10,11] Summary statistics on firm-specific quarterly regressions are reported in Table 2, Panel A.

We regress a firm's cost of equity capital (*R_PEG*) on our estimates of the firm's fixed tax component (*c*) and tax rate (τ), with control variables. Because in Prediction 2, the sign of the coefficient on the tax rate is conditional on the sign of the fixed tax component (*c*), the tax rate regression also includes a 0/1 dummy variable (*Pos_c*) equal to 1 when *c* is positive, and 0 otherwise. We eliminate financial firms and utilities and Winsorize all continuous variables at the 1st and 99th percentiles. We estimate the following regression model:

$$R\_PEG_{i,t} = \gamma_0 + \gamma_1 c_{i,t} + \gamma_2 Controls_{i,t} + e_{i,t} \tag{12a}$$

[6] We use Total Tax Expense because neither Cash Taxes Paid nor Current Tax Expense is available with quarterly data, whereas TXTQ is available since 1961. We could compute quarterly Current Tax Expense as Total Tax Expense minus Deferred Income Taxes (TXDIQ). However, TXDIQ is poorly populated in Compustat.

[7] We scale variables in firm-specific time-series regressions to mitigate the concern of spurious regression estimates due to nonstationarity and noncointegration of the accounting time-series data. See Qi, Wu, and Xiang (2000) and Callen and Morel (2000) for detailed explanations on how such scaled regression can be an effective approach to induce cointegration and stationarity. In our context, given that the fixed tax component likely varies with firm size, the intercept term in our scaled regression represents the fixed tax as a percentage of total assets. This intercept is then used in the cost of capital regression, where most financial control variables are also scaled by lagged total assets.

[8] We drop loss firms in our estimation, as the fixed and variable components are difficult to interpret when pretax income is negative. When loss firms are included in our estimation, we find that the coefficient on τ is always negative, regardless of the sign of *c*.

[9] Since our model is based on a linear tax function, we require R^2 from the tax function estimation to be greater than 0.6 so that there is an empirically evident linear relationship between tax expense and pretax income to generate meaningful and accurate estimates for *c* and τ. In untabulated tests, we find that the results for Prediction 1 are not sensitive to adjusting this R^2 threshold. For Prediction 2, we find that the tax rate always has a statistically significant negative impact on the cost of capital when the fixed tax component is negative, regardless of the R^2 values from the tax function estimation. However, when the fixed tax component is positive, the tax rate impact on cost of capital changes from insignificant to significantly negative as the cutoff level of R^2 drops below 60 percent.

[10] As shown in Table 1, we lose 527 firm-year-quarter observations due to missing *c* or τ. There is a small portion of the sample where tax expense is all zero through the estimation window, which makes it impossible to estimate *c* and τ.

[11] We do not require each firm-year to have a minimum number of quarters with nonmissing *c* and τ. In our firm-year sample, 69 percent of the observations have four quarters, and 81 percent have at least three quarters. Our main results are robust when we require the number of quarters to be three or four.

TABLE 2

Descriptive Statistics

Panel A: Descriptive Statistics for Firm-Specific Quarterly Regressions

Variable	n	Mean	Std. Dev.	Min.	25%	Median	75%	Max.
Tax	217,488	0.010	0.010	−0.007	0.002	0.007	0.015	0.055
PI	217,488	0.029	0.028	0.000	0.009	0.023	0.040	0.248
c	217,488	−0.001	0.003	−0.045	−0.001	−0.000	0.000	0.055
τ	217,488	0.379	0.122	0.000	0.339	0.384	0.439	1.844
R^2	217,488	0.895	0.101	0.600	0.842	0.931	0.974	1.000
Observations per regression	217,488	20.698	0.459	20	20	21	21	21

Panel B: Descriptive Statistics for Testing Predictions 1 and 2

Variable	n	Mean	Std. Dev.	Min.	25%	Median	75%	Max.
R_PEG	21,971	0.085	0.039	0.012	0.058	0.082	0.105	0.219
c	21,971	−0.001	0.002	−0.009	−0.001	−0.000	0.000	0.008
Pos_c	21,971	0.354	0.478	0.000	0.000	0.000	1.000	1.000
τ	21,971	0.383	0.078	0.162	0.341	0.380	0.424	0.608
Size	21,971	6.530	1.790	2.998	5.212	6.368	7.662	11.284
Leverage	21,971	0.225	0.198	0.000	0.056	0.199	0.329	0.954
MTB	21,971	3.020	2.535	0.432	1.526	2.309	3.549	16.387
Sales growth	21,971	0.137	0.174	−0.244	0.038	0.107	0.201	0.872
Return	21,971	0.120	0.305	−0.473	−0.056	0.061	0.238	1.363
CAPX	21,971	0.081	0.072	0.000	0.032	0.060	0.103	0.394
R&D	21,971	0.025	0.042	0.000	0.000	0.000	0.033	0.200
PP&E	21,971	0.349	0.242	0.018	0.168	0.297	0.472	1.088
NOL	21,971	0.236	0.425	0.000	0.000	0.000	0.000	1.000
Intangible	21,971	0.137	0.196	0.000	0.000	0.044	0.203	0.878
MNC	21,971	0.378	0.485	0.000	0.000	0.000	1.000	1.000

Panel C: Descriptive Statistics on Firm Characteristics by the Sign of the Fixed Tax Component (*c*)

	Positive *c* (n = 7,787)	Negative *c* (n = 14,184)	Difference
Size	6.569	6.509	0.060**
Leverage	0.223	0.226	−0.003
MTB	3.273	2.881	0.392***
Sales growth	0.142	0.134	0.008***
CAPX	0.076	0.083	−0.007***
R&D	0.022	0.026	−0.004***
PP&E	0.334	0.358	−0.024***
Intangible	0.149	0.130	0.019***
MNC	0.376	0.380	−0.004
NOL	0.249	0.246	0.003

Panel D: Descriptive Statistics on ETR Reconciliation Items by the Sign of the Fixed Tax Component (*c*)

	Positive *c* (n = 2,669)	Negative *c* (n = 4,762)	Difference
Credits	−0.604	−1.406	0.802***
DPAD	−0.358	−0.416	0.058***
Tax exempt income	−0.111	−0.168	0.057***
Nondeductible expenses	0.842	0.321	0.521***
Compensation	0.067	0.024	0.043**
Losses	0.099	−0.008	0.107*

*, **, *** Significant at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).

and

$$R\_PEG_{i,t} = \gamma_0 + \gamma_1 Pos\_c_{i,t} + \gamma_2 Pos\_c_{i,t} * \tau_{i,t} + \gamma_3 \tau_{i,t} + \gamma_4 Controls_{i,t} + e_{i,t}. \quad (12b)$$

Our sample has 21,971 firm-year observations from 1975 to 2017. Descriptive statistics are reported in Table 2, Panel B. The mean of *Pos_c* is 0.354, meaning that 64.6 percent of our sample has a negative fixed tax component.[12] To provide more details on the firms with a negative fixed tax component, in Table 2, Panel C, we show the descriptive statistics on firm characteristics between firms with a positive and a negative fixed component. Consistent with a negative fixed tax component representing tax credits and deductions, firms in the negative *c* group demonstrate higher capital expenditures, R&D expenses, and PP&E. To further verify the source for the negative fixed tax component, we merge our sample with the data on ETR reconciliations (Schwab, Stomberg, and Xia 2022). Descriptive statistics in Table 2, Panel D show that in a smaller sample, firms with a negative *c* have more reductions in ETR (in percentage points) due to credits, *DPAD*, and tax-exempt income, whereas firms with a positive *c* have more increases in ETR due to nondeductible expenses. These results support our arguments on the sources of the fixed tax component.

Regression results are presented in Table 3. In column (1), the coefficient on *c* is positive and significant at the 1 percent level, which is consistent with a positive relation between cost of capital and the fixed tax component (Prediction 1).

Results for Prediction 2 for the coefficient on the tax rate (τ) are mixed. The prediction is that the coefficient will be negative for those observations for which the fixed tax component is negative (i.e., when *Pos_c* is equal to 0). The coefficient for these observations is the one on τ, which is negative and significant in column (2). That means higher tax rates are associated with lower cost of equity capital when the fixed tax component is negative, which is consistent with Prediction 2. However, the prediction is that the coefficient will be positive for those observations for which the fixed tax component is positive. The coefficient for these observations is the sum of coefficients on τ and $Pos\_c * \tau$. This coefficient is not significantly different from 0, which suggests no relation between tax rates and cost of equity capital when the fixed tax component is positive.[13,14]

The economic magnitude of our results is comparable to those reported in Goh et al. (2016), where the association between Cash ETR and cost of equity capital is examined. In Goh et al. (2016), the coefficient on Cash ETR is 0.01 (see their Table 4[15]), and the standard deviation of Cash ETR is 0.189 (see their Table 2). Therefore, a one-standard-deviation increase in Cash ETR is associated with a 19-basis-point ($0.189 * 0.01 * 100 = 0.189$) increase in cost of equity capital. In our sample, the coefficient on τ for the full sample (combining positive and negative *c* firms) is -0.028 (untabulated). With a standard deviation of 0.078 (see Table 2, Panel B), a one-standard-deviation increase in τ is associated with a 22-basis-point ($0.028 * 0.078 * 100 = 0.218$) decrease in cost of equity capital.

Cross-Sectional Test

In this section, we conduct a purely cross-sectional test that does not rely on firm-specific time-series estimates of the fixed tax component or the tax rate. Our approach follows that of Goh et al. (2016), who find that cost of capital (*R_PEG*) is positively related to firms' five-year cash effective tax rate (*CETR5*), and we first attempt to replicate that result using the sample selection and variable definitions from Goh et al. (2016). We then demonstrate how their findings are consistent with our prediction.

To find cross-sections to estimates of *c* and τ, we separate the sample into three groups based on the size of CETR5. We split on CETR5, as we expect *c* and τ to vary as CETR5 increases. We refer to the one-third of firms with the lowest CETR5 as the "Low Group" and the one-third of firms with the highest CETR5 as the "High Group." We then estimate Equation (11) once for each of these three groups, providing cross-sectional estimates of the average fixed tax component (*c*) and tax rate (τ) for each of the three groups. Results of estimating these regressions are presented in Table 4. We emphasize two results that are important for our subsequent test. First, the average fixed tax component (*c*) for the lowest CETR5 sample (the Low Group) is negative, whereas the average fixed tax component for the highest CETR5 sample (the High Group) is positive. We use this result as a way to partition our sample to test Prediction 2 that the

[12] The prevalence of negative estimates for the fixed tax component reflects that tax costs behave in fundamentally different ways than operating costs. Firms with negative fixed tax components also tend to have a low cash effective tax rate (see the following subsection on cross-sectional test). Several recent studies document that firms utilize Net Operating Loss to attain and retain low ETRs (Christensen, Kenchington, and Laux 2022; Drake, Hamilton, and Lusch 2020; Schwab et al. 2022). To rule out the possibility that our results are driven by the sample of firms with NOL usage, we remove firm-year observations with an NOL decrease in all tests, and our results remain qualitatively similar.

[13] We use an F-test to determine the significance level of the sum of coefficients.

[14] Since prior studies (e.g., Heitzman and Lester 2021) suggest that the *NOL* (*TLCF*) variable may be mistakenly coded as missing in Compustat, we replace missing values with imputed values developed by Max, Wielhouwer, and Wiersma (2023) and find results that are almost identical.

[15] Since their "TAX" variable is Cash ETR multiplied by -1, we ignore the negative sign on the coefficient for the calculation of the economic magnitude with regard to Cash ETR.

TABLE 3

Regression of Cost of Capital (*R_PEG*) on Fixed (*c*) and Rate (τ) Components of Total Tax Expense; Component Estimates Use Quarterly Data

	(1)	(2)
c	0.764***	
	(4.27)	
Pos_c		−0.008*
		(−1.83)
τ		−0.036***
		(−4.31)
$Pos\_c * \tau$		0.022*
		(1.75)
$\tau + (Pos\_c * \tau)$		−0.014
		(−1.20)
Size	−0.005***	−0.005***
	(−13.61)	(−13.92)
Leverage	0.033***	0.033***
	(11.95)	(12.01)
MTB	−0.003***	−0.003***
	(−16.23)	(−16.08)
Sales growth	−0.012***	−0.012***
	(−5.11)	(−5.10)
Return	−0.007***	−0.007***
	(−8.05)	(−8.03)
CAPX	−0.015*	−0.015*
	(−1.65)	(−1.66)
R&D	0.001	−0.005
	(0.08)	(−0.34)
PP&E	−0.004	−0.004
	(−1.00)	(−1.12)
NOL	0.003***	0.003***
	(3.11)	(3.03)
Intangible	−0.015***	−0.015***
	(−5.14)	(−5.01)
MNC	−0.003**	−0.003***
	(−2.51)	(−2.77)
Controls	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
Clustered SE	Firm	Firm
Observations	21,971	21,971
R^2	0.166	0.166

*, **, *** Indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).
For each quarter, the regression $Tax = c + \tau \cdot PI + e$ is estimated for a 21-quarter window centered at the given quarter, where *Tax* is the total tax expense and *PI* is pretax income, both scaled by lagged total assets, as described in Appendix D. Estimates for *c* and τ are the year average intercept and slope regression coefficient for each quarter. Each firm-specific regression has at least 20 observations. Each firm-specific regression is required to have an R^2 greater than 0.6. Estimates of τ are required to be positive. All continuous variables are Winsorized at the 1st and 99th percentiles. Financial firms and utilities are eliminated. t-statistics are in parentheses. Standard errors are clustered at the firm level.

relation between cost of capital and the tax rate will differ for those firms for which the fixed tax component is negative. Second, we note that the average tax rate (τ) is increasing with the size of CETR5. We rely on this result to argue that CETR5 can act as a proxy for the tax rate in cross-sectional tests.

TABLE 4

Estimates of Fixed (*c*) and Rate (τ) Components of Cash Taxes Paid for Sample Terciles Based on Size of Five-Year Cash Effective Tax Rate (*CETR5*)

	(1)	(2)	(3)
	Low CETR5	***Medium CETR5***	***High CETR5***
c	−0.002***	−0.001**	0.006***
	(−5.85)	(−2.54)	(15.77)
τ	0.146***	0.281***	0.348***
	(36.05)	(136.13)	(97.14)
	Difference in *c* between Low and Median = −0.001***		
	Difference in *c* between Median and High = −0.007***		
	Difference in *c* between Low and High = −0.008***		
Observations	7,113	7,112	7,112
R^2	0.664	0.959	0.933

*, **, *** Indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).
Regression results are from estimating $TXPD = c + \tau \cdot PI + e$ on the sample used in Goh et al. (2016). One cross-sectional regression is estimated for each five-year Cash ETR tercile. t-statistics are shown in parentheses. Standard errors are clustered at the firm level.

Variable Definitions:
CETR5 = the five-year Cash ETR;
Low CETR5 = represents observations in the lowest one-third of the sample ranked by *CETR5*;
Medium CETR5 = represents observations in the middle one-third of the sample ranked by *CETR5*;
High CETR5 = represents observations in the highest one-third of the sample ranked by *CETR5*;
TXPD = five-year Cash Taxes Paid scaled by lagged five-year Assets; and
PI = five-year Pretax Income less five-year Special Items, scaled by lagged five-year Assets.

Table 5 shows the descriptive statistics of the sample. Table 6, column (1) reports results of our attempt to replicate the positive relation between cost of capital and CETR5 reported in Goh et al. (2016). We find a significant positive coefficient (0.023) in our replication.[16] Column (2) reports the same regression, but uses 0/1 dummy variables ("*Low Group*" and "*High Group*") to allow this coefficient to differ for those observations that have, on average, a negative fixed tax component (*Low Group*) and a positive fixed tax component (*High Group*).

The coefficient on *CETR5* for the *Low Group* observations, those with (on average) a negative fixed tax component, is represented by the sum of coefficients on *CETR5* and *CETR5* * *Low Group*, which is negative and significant. This is consistent with Prediction 2 that the association between cost of equity capital and tax rate (τ) will be negative for those observations for which the fixed tax component is negative.

The coefficient on *CETR5* for the *High Group* observations, those with (on average) a positive fixed tax component, is represented by the sum of coefficients on *CETR5* and *CETR5* * *High Group*, which is positive and significant. This is consistent with Prediction 2 that the association between cost of equity capital and tax rate (τ) will be positive for those observations for which the fixed tax component is positive. This is also consistent with the conjecture that lower ETRs result in a lower cost of capital, as reported in Goh et al. (2016). Notably, to the extent that Low and High Groups reflect cross-sections where the fixed component is greater in magnitude relative to the reference group (middle group), this evidence suggests that the predicted relation between cost of equity capital and tax rate (τ) is more pronounced in subsamples with a significant fixed tax component. It also supports Prediction 2′, which posits that, regardless of the sign of the covariance between the fixed tax component and the aggregate market cash flows, the association between cost of equity capital and tax rate (τ) will be positive (negative) when the fixed component is sufficiently positive (negative).

Alternate Measure of Cost of Equity Capital

To investigate whether our results are sensitive to the way that cost of capital is measured, we repeat all of our empirical tests using the cost of capital measure developed by Gode and Mohanram (2003). Results using this alternate measure of cost of capital are similar to those reported in the tables.

[16] We note that the main regression in Goh et al. includes accrual quality (AQ) as one of the controls. Including AQ in our regression would significantly reduce our sample. Nonetheless, the coefficient on *CETR5* is still positive and significant in this reduced sample.

TABLE 5

Descriptive Statistics for Cross-Sectional Tests

Variable	n	Mean	Std. Dev.	Min.	25%	Median	75%	Max.
R_PEG	21,337	0.110	0.059	0.022	0.073	0.098	0.132	0.356
CETR5	21,337	0.283	0.175	0.000	0.179	0.276	0.354	1.000
Low Group	21,337	0.333	0.471	0.000	0.000	0.000	1.000	1.000
High Group	21,337	0.333	0.471	0.000	0.000	0.000	1.000	1.000
Size	21,337	6.618	1.655	3.270	5.436	6.498	7.666	10.926
Leverage	21,337	0.201	0.177	0.000	0.029	0.181	0.315	0.744
MTB	21,337	2.784	2.501	−1.251	1.350	2.095	3.329	16.017
Return	21,337	0.100	0.493	−0.769	−0.216	0.039	0.310	2.181
Std. Dev._Return	21,337	0.118	0.059	0.035	0.076	0.105	0.146	0.347
EBITDA	21,337	0.217	0.113	−0.027	0.142	0.201	0.277	0.605
Std. Dev._EBITDA	21,337	0.059	0.057	0.005	0.023	0.041	0.073	0.345
CAPX	21,337	0.065	0.064	0.003	0.024	0.045	0.081	0.360
R&D	21,337	0.034	0.055	0.000	0.000	0.003	0.048	0.254
SG&A	21,337	0.290	0.220	0.000	0.126	0.245	0.403	1.053
Foreign	21,337	0.018	0.037	−0.045	0.000	0.000	0.024	0.180
NOL	21,337	0.337	0.472	0.000	0.000	0.000	1.000	1.000
TXBCO	21,337	0.219	0.414	0.000	0.000	0.000	0.000	1.000
FC Bias	21,337	0.007	0.093	−0.203	−0.030	−0.007	0.019	0.517
Spread	21,337	0.037	0.016	0.011	0.024	0.033	0.045	0.092
Beta	21,337	1.178	1.110	−1.407	0.481	1.069	1.752	4.878

TABLE 6

Cross-Sectional Tests Using Terciles Based on the Size of Cash Effective Tax Rates (Cash ETRs)

	(1)	(2)
CETR5	0.023***	−0.011
	(6.53)	(−0.62)
Low Group		0.003
		(0.61)
CETR5 ∗ Low Group		−0.023
		(−1.08)
High Group		−0.025***
		(−4.37)
CETR5 ∗ High Group		0.068***
		(3.64)
Size	−0.005***	−0.005***
	(−10.96)	(−10.54)
MTB	−0.003***	−0.003***
	(−11.66)	(−11.97)
Leverage	0.051***	0.047***
	(15.11)	(14.10)
Return	0.008***	0.008***
	(9.47)	(8.95)
Std. Dev._Return	0.073***	0.069***
	(6.11)	(5.87)

(continued on next page)

TABLE 6 (continued)

	(1)	(2)
EBITDA	−0.106***	−0.096***
	(−17.71)	(−16.29)
Std. Dev._EBITDA	0.090***	0.083***
	(9.34)	(8.74)
CAPX	0.029***	0.022**
	(3.08)	(2.30)
R&D	−0.005	−0.018
	(−0.40)	(−1.44)
SG&A	0.007**	0.009***
	(2.39)	(2.89)
Foreign	−0.009	−0.013
	(−0.64)	(−0.91)
NOL	0.004***	0.003***
	(3.99)	(3.09)
TXBCO	−0.011***	−0.010***
	(−7.87)	(−7.17)
FC Bias	0.143***	0.143***
	(20.90)	(21.05)
Spread	0.756***	0.721***
	(13.92)	(13.31)
Beta	−0.001***	−0.001***
	(−3.27)	(−3.03)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Clustered SE	Firm	Firm
Observations	21,337	21,337
R^2	0.419	0.424
CETR5 + (*CETR5* ∗ *Low Group*)		−0.034***
CETR5 + (*CETR5* ∗ *High Group*)		0.057***

*, **, *** Indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed test).
Column (1) is a replication of results from Goh et al. (2016). Column (2) shows the same regression with interaction terms to identify the highest and lowest one-third of sample observations based on the size of the five-year Cash ETR (*CETR5*). t-statistics are in parentheses. Standard errors are clustered at the firm level.

Variable Definitions:
Low Group = a binary variable equal to 1 when *CETR5* is in the lowest tercile, and 0 otherwise; and
High Group = a binary variable equal to 1 when *CETR5* is in the highest tercile, and 0 otherwise.

Summary

We find empirical evidence that is, in general, consistent with Predictions 1 and 2. We find that the fixed tax component is positively related to cost of capital and that the relation between the tax rate and cost of capital is negative for those observations for which the fixed tax component is negative. For those observations for which the fixed tax component is positive, we find results consistent with Prediction 2 in a cross-sectional test that relies on average measures of the fixed tax component and the tax rate, but these results are not significant when firm-specific measures are used.

IV. CONCLUSION

We investigate the relation between corporate tax expense and cost of equity capital when tax expense has both a variable component (a tax rate) and a fixed component like a tax credit. We introduce tax expense into the model used in Lambert et al. (2007), and we assume that tax expense has both a fixed component and a variable component. Because the fixed component of tax expense can be negative (a tax credit or subsidy), the effect of a decrease in tax expense on the cost of capital can differ from the general result for other types of expenses. Our model shows that tax avoidance that decreases the fixed tax component will always decrease the cost of capital, making the effect of this type of tax decrease the same as decreasing any other type of expense. However, for tax avoidance that reduces the tax rate, such as shifting the firm's income into a low-tax country or state, the effect on the cost of capital depends on whether the fixed tax component is positive or negative. When the fixed tax component is negative, a reduction in the tax rate will increase the cost of equity capital.

We conduct empirical tests of the predictions of our model by first generating firm-specific estimates of both the fixed tax component and the tax rate for a sample of U.S. Compustat firms. We also generate firm-specific cost of capital estimates using the Easton (2004) implied cost of capital measure. Our results are, in general, consistent with our predictions. We find that cost of capital is positively related to the fixed tax component and that the relation between cost of capital and the tax rate depends on the sign of the fixed tax component, as predicted by our model. Nevertheless, we only find this result when the fixed tax component is negative. Results are not significant when the fixed tax component is positive.

We also conduct a cross-sectional test following the approach in Goh et al. (2016) by regressing cost of capital on five-year cash effective tax rates. We separate our sample into terciles based on the size of the Cash ETR and find a significant negative relation between cost of capital and Cash ETRs for the lowest tercile, for which the average fixed tax component is negative. We also find a significant positive relation between cost of capital and Cash ETR (consistent with the findings in Goh et al.) for the highest tercile, for which the average fixed tax component is positive. We interpret both of these results as consistent with the predictions from our model.

Our findings indicate that the relationship between tax avoidance and cost of equity capital varies across different types of firms due to differences in their tax cost structures. This may help explain the inconclusive results reported in related studies on this topic. Additionally, we highlight how tax expense differs from other types of costs that firms incur, in that the fixed component of tax expense is negative for many firms, making the effect of tax expense on cost of capital different from other costs. As corporate income tax is an important and relatively exogenous cash outflow compared to other expenses, our results also provide insights into how the cost of capital depends on primitive distribution properties of cash flows.

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APPENDIX A

Taxation and Multiperiod CAPM

Our focus is on how a decrease in a firm's expenses, in particular through tax avoidance, affects the distribution characteristics of its after-tax earnings and changes its cost of capital. To incorporate taxation and book-tax difference, we follow Brennan (1970) and use a no-growth setting with identical periods wherein CAPM applies on a period-by-period basis.

Consider a firm i that generates an uncertain *after-tax* earnings stream $\widetilde{V}_i$ at the end of each period t*, indefinitely into the future*. Since CAPM holds in every relevant period, the firm's equilibrium market value P_{it} at the beginning of period t must satisfy

$$P_{it} = \frac{E\left[\widetilde{V}_i + \widetilde{P}_{it+1}|\Phi\right] - \frac{1}{N\tau} Cov\left[\widetilde{V}_i + \widetilde{P}_{it+1}, \sum_{j=1}^{J}\left(\widetilde{V}_j + \widetilde{P}_{jt+1}\right)|\Phi\right]}{1 + R_f}, \tag{1}$$

which parallels Equation (3) in the single-period setting of Lambert et al. (2007).

Similar to Brennan (1970), we assume that investors' risk preferences and taxation structure remain constant through time, and the firm maintains a constant market valuation P_i at the beginning of each period. This beginning-of-period market valuation P_i can be solved from Equation (1) as[17]:

$$P_i = \frac{E\left(\widetilde{V}_i|\Phi\right) - \frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I}\widetilde{V}_j|\Phi\right)}{R_f} \tag{2}$$

Let $\widetilde{R}_i$ denote the rate of return on firm i's stock. The cost of equity capital $E\left(\widetilde{R}_i|\Phi\right)$ can then be expressed as a function of the H-ratio, paralleling Equation 4(b) in Lambert et al. (2007):

$$E\left(\widetilde{R}_i|\Phi\right) = \frac{E\left(\widetilde{V}_i|\Phi\right)}{P_i} = \frac{R_f H(\Phi)}{H(\Phi) - 1}, \quad \text{where } H(\Phi) = \frac{E\left(\widetilde{V}_i|\Phi\right)}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I}\widetilde{V}_j|\Phi\right)} \tag{3}$$

In this multiperiod setting, the H-ratio $H(\Phi) = \frac{E\left(\widetilde{V}_i|\Phi\right)}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \sum_{j=1}^{I}\widetilde{V}_j|\Phi\right)}$ measures the firm's expected *end-of-period payoff* per unit of covariance risk. The cost of capital, $E\left(\widetilde{R}_i|\Phi\right)$, takes a slightly different functional form than that in Equation (1), but still decreases in $H(\Phi)$, so if the firm's expected end-of-period payoff increases without a commensurate increase in the covariance risk, the cost of capital will decrease.

[17] The market valuation derived here is under the assumptions of normal distribution and negative exponential utilities and is consistent with the capitalized earnings valuation (Equations (3.4) and (3.6) in Brennan 1970), wherein the capitalization rate is given by the CAPM equilibrium condition under more general distribution and utility functions.

APPENDIX B

Covariability between Fixed Tax Costs and Aggregate Market Cash Flows

The firm's tax expense $\widetilde{T}_i$ equals

$$\widetilde{c}_i + \tau_i \widetilde{\Pi}_i + \widetilde{e}_i,$$

where $\widetilde{c}_i$ is the (random) fixed tax cost that is independent of $\widetilde{\Pi}_i$, τ_i is a constant that captures the tax rate, and $\widetilde{e}_i$ is the firm-specific random error.

Let $\widetilde{\Pi}_i$ denote the pretax cash flow and $\widetilde{V}_i$ denote the after-tax cash flow; then,

$$E\left[\widetilde{V}_i\right] = E\left[\widetilde{\Pi}_i\right] - E\left[\widetilde{T}_i\right] = (1-\tau_i)E\left[\widetilde{\Pi}_i\right] - E[\widetilde{c}_i]$$

The aggregate market cash flow $\left(\widetilde{V}_M\right)$ equals

$$\widetilde{V}_M = \sum_{i=1}^{I} \widetilde{V}_i.$$

Covariance is linear in its arguments so that

$$COV\left(\widetilde{V}_i, \widetilde{V}_M\right) = COV\left((1-\tau_i)\widetilde{\Pi}_i - \widetilde{c}_i, \widetilde{V}_M\right) = (1-\tau_i)COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right) - COV\left(\widetilde{c}_i, \widetilde{V}_M\right)$$

The firm's H-ratio equals

$$H = \frac{E\left[\widetilde{V}_i\right]}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \widetilde{V}_M\right)} = \frac{(1-\tau_i)E\left[\widetilde{\Pi}_i\right] - E[\widetilde{c}_i]}{\frac{1}{N\lambda}\left[(1-\tau_i)COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right) - COV\left(\widetilde{c}_i, \widetilde{V}_M\right)\right]}.$$

When $COV\left(\widetilde{V}_i, \widetilde{V}_M\right) = (1-\tau_i)COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right) - COV\left(\widetilde{c}_i, \widetilde{V}_M\right) > 0$, we have

$$\frac{\partial H}{\partial E[\widetilde{c}_i]} = -\frac{N\lambda}{\frac{1}{N\lambda} COV\left(\widetilde{V}_i, \widetilde{V}_M\right)} < 0.$$

Therefore, the firm's cost of capital increases with $E[\widetilde{c}_i]$; that is, the cost of capital decreases when the fixed tax cost $\widetilde{c}_i$ is reduced by a constant amount, while $COV\left(\widetilde{c}_i, \widetilde{V}_M\right)$ remains unchanged.

However, the impact on the H-ratio from changing the tax rate τ_i depends on $E[\widetilde{c}_i]$:

$$\frac{\partial H}{\partial \tau_i} = \frac{1}{N\lambda} \frac{E\left[\widetilde{\Pi}_i\right] COV\left(\widetilde{c}_i, \widetilde{V}_M\right) - E[\widetilde{c}_i] COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)}{\left[COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right) - \frac{COV\left(\widetilde{c}_i, \widetilde{\Pi}_M\right)}{(1-\tau_i)}\right]^2}.$$

Since $COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right) > 0$, we have

$$\frac{dH}{d\tau_i} \gtrless 0 \text{ when } E[\widetilde{c}_i] \lesseqgtr \frac{E\left[\widetilde{\Pi}_i\right] COV\left(\widetilde{c}_i, \widetilde{V}_M\right)}{COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)}.$$

Thus, sufficient condition for the cost of capital to decrease (increase) in the variable tax rate is that $E[\widetilde{c}_i]$ is sufficiently negative (positive).

APPENDIX C

Covariability between Fixed Tax Costs and Variable Tax Rate

Let τ_{sti} denote the weighted average of statutory tax rate across all transactions of a firm. To examine whether our prediction is robust to the covariability between the fixed tax component c_i and variable tax rate τ_i due to their exposure to the same set of statutory tax rates, we assume that transactions associated with θ_{0i} and θ_{1i} are all taxed at the same firm-specific weighted average tax rate τ_{sti}, so that the firm's tax payment $\widetilde{T}_i$ becomes:

$$\widetilde{T}_i = \underbrace{A_i - C_i - \tau_{sti}\cdot\theta_{0\mathrm{i}}}_{c_i} + \underbrace{\tau_{sti}(1-\theta_{1i})}_{\tau_i}\cdot\widetilde{\Pi}_\mathrm{i} + \widetilde{\varepsilon}_\mathrm{i}.$$

The H-ratio equals

$$H = \frac{E\left[\widetilde{\Pi}_i\right]}{\frac{1}{N\lambda}COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)} - \frac{c_i}{\frac{(1-\tau_i)}{N\lambda}COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)}$$

Let $A = \frac{(1-\tau_i)}{N\lambda}COV\left(\widetilde{\Pi}_i, \widetilde{V}_M\right)$. Recognizing that both c_i and τ_i are affected by τ_{sti}, the *total* impact of τ_{sti} on the H-ratio is captured by

$$\begin{aligned}\frac{dH}{d\tau_{sti}} &= -\frac{1}{A}\cdot\frac{\mathrm{dc_i}}{\mathrm{d}\tau_{sti}} - \frac{\mathrm{c_i}}{\mathrm{A}^2}\cdot\frac{\mathrm{dA}}{\mathrm{d}\tau_\mathrm{i}}\cdot\frac{\mathrm{d}\tau_\mathrm{i}}{\mathrm{d}\tau_{sti}}\\ &= \underbrace{\frac{\partial H}{\partial c_i}}_{<0}\cdot\underbrace{\frac{\mathrm{dc_i}}{\mathrm{d}\tau_{sti}}}_{-\theta_{0\mathrm{i}}} + \underbrace{\frac{\partial \mathrm{H}}{\partial \tau_\mathrm{i}}}_{\text{same sign of} -\mathrm{c_i}}\cdot\underbrace{\frac{\mathrm{d}\tau_\mathrm{i}}{\mathrm{d}\tau_{sti}}}_{(1-\theta_{1\mathrm{i}})>0},\end{aligned}$$

where $\frac{\partial H}{\partial c_i}$ is given by Equation (9) and $\frac{\partial H}{\partial \tau_i}$ is given by Equation (10).

To illustrate the robustness of our model's predictions, we focus on the following situations:

(1) θ_{0i} is small relative to $A_i - C_i$, so that $c_i \approx A_i - C_i$. In this case, the fixed tax component c_i is largely unaffected by the variation in the tax rate τ_i. Regardless of the sign of θ_{0i}, since τ_{sti} has a small impact on c_i (i.e., $\frac{dc_i}{d\tau_{sti}}$ is small in size), our base model still applies.

(2) θ_{0i} is large relative to $A_i - C_i$, so that $c_i \approx -\tau_{sti}\cdot\theta_{0i}$. In this case, when $\theta_{0i} > 0$ (so that $c_i < 0$ and represents fixed tax saving), lowering τ_{sti} leads to two effects: firstly, it reduces the tax rate τ_i, which lowers the H-ratio according to Equation (10); and, secondly, it reduces the fixed tax savings, which also lowers the H-ratio according to Equation (9). The opposite is true when $\theta_{0i} < 0$ (so that $c_i > 0$ and represents fixed tax expense). Thus, as τ_{sti} varies, the tax rate τ_i moves in the same (opposite) direction with the H-ratio if c_i is positive (negative), again consistent with the prediction from the base model.

To summarize, Equations (9) and (10) measure the *partial* impacts on the H-ratio from varying either c_i or τ_i, while holding the other constant. However, when there is strong covariability between c_i and τ_i, the *total* impact of varying c_i or τ_i, after accounting for the possible covariability between the two, is still the same as our prediction.

The above discussion focuses on situations where c_i is dominated by either $A_i - C_i$ or $-\tau_{sti}\cdot\theta_{0i}$. With a large sample, these two fixed tax components might be of comparable magnitude for some firms, in which case c_i tends to change signs as τ_{sti} varies, and τ_{sti} may not have a clear directional impact on the H-ratio. This will bias against finding empirically significant impacts on the cost of capital from either the fixed or variable tax expenses. Our empirical analyses, although not detecting a significant relationship between the tax rate and the cost of capital when the fixed tax component is positive, does indicate a significant negative relationship between fixed tax expenses and the cost of capital and between the tax rate and the cost of capital when the fixed tax component is negative, supporting our model's key predictions.

APPENDIX D

Variable Definitions

Variable Name	Definition
Variables used in firm-specific quarterly regressions	
Tax	Quarterly income tax expense (TXTQ) scaled by lagged quarterly total assets (ATQ).
PI	Quarterly pretax income (PIQ) scaled by lagged quarterly total assets (ATQ).
Variables used in testing Predictions 1 and 2	
R_PEG	Measure of cost of equity based on Easton (2004): $R\_PEG = \sqrt{\frac{eps2 - eps1}{P0}}$, where *eps*1 (*eps*2) refers to analysts' forecast of one (two)-year-ahead earnings and P_0 refers to current stock price.
c	Fixed tax component calculated as the intercept of Equation (11).
Pos_c	Binary variable equal to 1 when *c* is positive, and 0 otherwise.
τ	Variable tax component calculated as the slope of Equation (11).
Size	The natural log of total assets (AT).
Leverage	Short-term (DLC) and long-term debt (DLTT) scaled by total assets (AT).
MTB	Market value of equity (*PRCC_F* ∗ *CSHO*) scaled by book value of equity (*CEQ*).
Sales growth	Yearly change in sales (SALE) scaled by lagged sales.
Return	Stock return over the fiscal year.
CAPX	Capital Expenditures (CAPX) scaled by lagged total assets (AT).
R&D	Research and development expense (XRD) scaled by lagged total assets (AT); missing values are replaced with 0.
PP&E	Net property, plant, and equipment (PPENT) scaled by lagged total assets (AT).
NOL	Binary variable equal to 1 when the firm reports net operating loss carryforwards (TLCF), and 0 otherwise.
Intangible	Intangible assets (INTAN) scaled by lagged total assets (AT).
MNC	Binary variable equal to 1 when a firm reports nonzero pretax foreign income (PIFO), and 0 otherwise.
Variables used in cross-sectional tests	
CETR5	Five-year cash effective tax rate, calculated as five-year sum of cash tax paid (TXPD) scaled by five-year sum of pretax income (PI) less special items (SPI); this variable is Winsorized at [0,1].
Low Group	Binary variable equal to 1 when CETR5 is in the lowest tercile, and 0 otherwise.
High Group	Binary variable equal to 1 when CETR5 is in the highest tercile, and 0 otherwise.
Std. Dev._Return	The standard deviation of monthly stock return over the fiscal year.
EBITDA	Earnings before interest, tax, depreciation and amortization (EBITDA) scaled by lagged total assets (AT).
Std. Dev._EBITDA	The standard deviation of EBITDA over the prior five years, scaled by lagged total assets (AT).
SG&A	Selling and general expenses (XSGA) scaled by lagged total assets (AT).
Foreign	Binary variable equal to 1 if the firm reports positive foreign pretax income (PIFO), and 0 otherwise.
TXBCO	Binary variable equal to 1 if excess tax benefit of stock options (TXBCOF) is nonzero, and 0 otherwise.
FC Bias	Analysts' forecast bias, defined as the mean consensus analysts' forecast of EPS less the actual EPS, scaled by stock price at the beginning of fiscal year.
Spread	Effective bid-ask spreads over the fiscal year.
Beta	Beta estimated from CAPM model over the fiscal year.