

Investment Clienteles, Implicit Taxes, and Asset Prices

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Abstract

Financial economists have long debated the impact of investor-level taxes on asset prices, relative rates of return, and investment. Variation in marginal tax rates adds complexity to the debate because it is not clear whose tax rate is relevant, and investment clienteles may form. Historically, there has been little clear empirical evidence that taxes affect relative rates of return on financial assets, or implicit taxes, but recent studies provide evidence of tax capitalization in stock prices. In this study, we derive a multi-asset, multi-clientele model that helps reconcile the two sets of evidence. We demonstrate that tax capitalization is driven by the tradeoff between investment and consumption by all clienteles, whereas implicit taxes (as conventionally defined) are driven by tradeoffs among different financial assets by marginal clienteles. Therefore, tax capitalization and implicit taxes can occur independently from each other. In addition, our model implies that tax-exempt and other low-tax investors may have limited impact on the magnitude of tax capitalization.

Investment Clienteles, Implicit Taxes, and Asset Prices

Financial economists have long debated the impact of investor-level taxes on asset prices, relative rates of return, and investment. Cross-investor variation in marginal tax rates adds complexity to the debate because it is not clear whose tax rate is relevant. Tax-exempt institutions, middle-class individuals, or high-tax investors all could conceivably claim marginal status. In addition, the after-tax value of different equity and debt claims could vary across investors, leading to the formation of investment clienteles. Hence taxes create a potentially rich environment of clienteles and price effects influencing investment decisions.

For many years, the debate on investor-level taxes has faltered for lack of clear empirical evidence that taxes affect relative rates of return on assets. If taxes affect returns, then all else equal, it has been argued that fully taxable bonds should provide higher pretax returns than stocks, because stocks often are taxed on a deferred basis at low capital gains rates. The relatively low pretax rate of return for a tax-favored asset relative to the return on a fully taxable asset is defined as an implicit tax, but supporting evidence is limited. It has proven difficult to control for risk and liquidity differences between stocks and bonds (for a discussion, see Scholes and Wolfson, 1992, p. 358), and even when using futures market data to overcome these obstacles, Aboody and Williams (2001) still find relatively small implicit taxes for several stock indices.

In contrast to the limited empirical evidence of implicit taxes, several recent studies provide evidence that investors appear to capitalize dividend and capital gains taxes into stock prices (see, e.g., Lang and Shackelford, 2000, Collins and Kemsley, 2000, and Harris and Kemsley, 1999). At least two features of this new evidence are somewhat

puzzling. First, it is puzzling that the evidence for tax price effects in stocks is as strong as it is, whereas the evidence for relative returns on assets, or implicit taxes, is much weaker. Second, given the presence of tax-exempt and other low-tax investors, it is puzzling that the tax rate capitalized into stock prices is as high as the evidence seems to suggest. Given these questions, Shackelford and Shevlin (2001) call for a model of clienteles and investment that could reconcile the stock price evidence to the implicit tax evidence and help explain the large tax effects in asset prices.

Conventional implicit-tax modeling approaches are not up to the task. In particular, if we were to confine ourselves to a single marginal tax clientele that arbitrages two financial assets until both assets yield equivalent after-tax returns, implicit taxes and tax capitalization would be essentially equivalent. However, Dybvig and Ross (1986) demonstrate it is possible to model the simultaneous clearing of markets for at least three assets and for multiple tax clienteles. In this study, we extend the multi-asset, multi-clientele approach of Dybvig and Ross (1986) to consider how investor-level taxes may influence asset prices as well as implicit taxes in returns. In particular, we consider a simple setting in which we allow tax-exempt institutions and taxable individual investors to invest in fixed supplies of tax-free bonds, taxable bonds, and stocks, and investors face an investment-consumption decision which we model as an intertemporal consumption allocation problem with power utility.

In the model we develop, individual investors are at the margin between stocks and municipal bonds, and tax-exempt investors are at the margin between stocks and taxable bonds. Because tax-exempt investors are at the margin between stocks and taxable bonds, the relative returns of these two assets do not reflect any implicit taxes. Because

individual investors are at the margin between stocks and municipal bonds, municipal bond returns bear implicit taxes relative to the other two assets.

In regard to asset prices, we demonstrate the tradeoff between investment and consumption determines the degree of tax capitalization for all assets, particularly for stocks. In particular, tax capitalization reflects a weighted average of both clienteles' tax rates, weighted according to two factors. First, tax capitalization is a function of the total economic resources controlled by each clientele, not just a function of the amount of wealth each clientele invests in the capital markets. This is true because total economic resources reflect the amount of wealth each clientele has at stake in the tradeoff between investment and consumption. Second, tax capitalization is a function of each clientele's sensitivity to returns when making investment-consumption decisions. Because mid- to high-tax individuals control a substantial portion of non-governmental economic resources and are generally more sensitive to returns when making investment-consumption decisions than low-tax rate and tax-exempt investors, our model implies it is plausible that investors could capitalize substantial taxes into stock prices.

These results suggest tax capitalization and implicit taxes are not necessarily two sides of the same coin. Tax capitalization can occur quite independently from implicit taxes because tax capitalization is driven by the tradeoff between investment and consumption, whereas by definition, implicit taxes are driven by tradeoffs among different financial assets. Hence the lack of strong empirical evidence for implicit taxes does not necessarily conflict with the recent evidence for tax capitalization. Nevertheless, we also demonstrate that the wedge between tax capitalization and implicit taxes is largely a matter of definition. In particular, tax capitalization is directly related to implicit taxes if

implicit taxes are measured relative to a no-tax benchmark return. In our model, the no-tax benchmark is the marginal rate of substitution for consumption across time.

We proceed as follows. In Section 1, we develop the investment-consumption tradeoff by investors. In Section 2, we determine the implicit taxes on various assets. In Section 3, we determine stock prices and ascertain the factors related to tax capitalization. In Section 4, we develop a Fundamental Theorem of Investment Taxation that identifies the link between tax capitalization and implicit taxes and use this theorem to understand why these concepts seem disjoint in a multi-clientele setting. We conclude in Section 5.

1. Investment-Consumption Decision

To build our model, we begin by considering the allocation of economic resources by investors. Each agent must split his/her wealth endowment between investment and current consumption. Once the agent chooses how much to invest, the agent must then select a portfolio of assets. We analyze the portfolio choice problem in Section 2. For now, we assume the agent will receive an after-tax return r on investment.

Without loss of generality, we assume there are two time periods. Utility is a linearly separable function of consumption in the two periods with the form:

$$U(C_1, C_2) = u(C_1) + \gamma u(C_2), \gamma < 1, \tag{1}$$

where γ represents the discount factor for consumption. At this point, we defer specification of the function u , except to state it is monotonically increasing and concave. This implies that agents prefer to smooth consumption.

Consumption in period 2 is a function of the endowment of economic resources (W), the after-tax rate of return (r), and prior-period consumption as follows:

$$C_2 = (1+r)(W - C_1). \quad (2)$$

Substituting (2) into (1), differentiating with respect to C_1 , and setting to zero yields:

$$1+r = \frac{u'(C_1)}{\gamma u'((1+r)(W - C_1))}. \quad (3)$$

(3) is a standard result in economics. The marginal rate of transformation (LHS) equals the marginal rate of substitution (RHS). Because we will no longer refer to second-period consumption, we will suppress the subscript on C_1 in all subsequent analysis.

To proceed, we must specify the shape of the utility function. For our purposes, we seek a utility function that results in a realistic model in which agents increase investment as rates of return on investment increase (*i.e.*, we require a downward sloping demand curve for financial assets). Equilibrium cannot be obtained without this property, and logarithmic and exponential functions do not result in the property.¹ Therefore, we focus on a power utility function. Although we do not report it, we find that a quadratic function yields similar results.

The power utility function is as follows:

$$u(x) = x^{\bar{\omega}} / \bar{\omega}, \quad 0 < \bar{\omega} < 1.$$

$$u'(x) = x^{\bar{\omega}-1}.$$

$$(1+r)\gamma = \frac{C^{\bar{\omega}-1}}{[(1+r)(W - C)]^{\bar{\omega}-1}}.$$

$$C = \frac{W}{1 + (1+r)^{\bar{\omega}/(1-\bar{\omega})} \gamma^{1/(1-\bar{\omega})}}. \quad (4)$$

$$\frac{\partial C}{\partial r} = \frac{-C^2 \bar{\omega} (1+r)^{(2\bar{\omega}-1)/(1-\bar{\omega})} \gamma^{1/(1-\bar{\omega})}}{W(1-\bar{\omega})}. \quad (5)$$

¹ Logarithmic utility exhibits exactly offsetting income and substitution effects, while exponential utility exhibits greater income than substitution effects from a change in r .

As we require, (5) indicates $\partial C/\partial r < 0$, or consumption decreases in the available rate of return for investment. However, the nonlinear nature of (4) and (5) limits their usefulness for subsequent analysis. Fortunately, numerical simulations indicate (4) is a nearly linear function of r over the range of typical after-tax risk-free rates of return (2-8 percent), or equivalently that (5) is roughly constant.² Thus, linear approximation provides little error and simplifies subsequent analyses. The specific approximation involves recognizing that roughly half of wealth is consumed (*i.e.*, $C/W \approx 0.5$) and the $(1+r)$ and γ terms in (5) roughly cancel each other. Thus, we approximate the derivative by

$$\frac{\partial C}{\partial r} \approx \frac{-(0.5)^2 \bar{\omega} W}{1 - \bar{\omega}}. \quad (6)$$

Numerical simulations indicate (6) is slightly but consistently biased upward relative to the true derivative for a wide range of r , ω and γ .³ Adjusting for the average bias indicated by the simulations, we approximate the consumption function (4) as

$$C \approx (\alpha - \beta r)W, \quad 1 > \alpha > 0.5, \quad \beta = \frac{\bar{\omega}}{4.3(1 - \bar{\omega})}. \quad (7)$$

(7) indicates consumption increases in wealth and in the intercept (α), and consumption decreases in the rate of return on investment (r) and in the slope parameter (β). The exact intercept and slope in (7) could differ across agents with different utility

² With $\omega = \gamma = 0.95$, the numerical derivative ranges from 4.28 (at $r = 0.08$) to 4.50 (at $r = 0.05$). Linearity breaks down for utility parameters very close to 1 (their upper limit). For all parameter values less than 0.97, linearity is a very good approximation.

³ For example, for $r = 0.03$, $\omega = \gamma = 0.95$, the actual derivative is 4.37 while the approximate derivative is 4.75. For $r = 0.07$, $\gamma = 0.93$, and $\omega = 0.8$, the actual derivative is 0.93 while the approximate derivative is 1. For a wide range of utility parameters and interest rates, the approximate derivative in (6) is 106-110 percent of the actual derivative.

functions. As demonstrated later, however, the intercept (α) is irrelevant for tax capitalization, so we do not consider it in detail. In contrast, the slope β is important. As (7) indicates, β depends monotonically on the utility parameter ω , which indicates the strength of the agent's incentive to smooth consumption. High ω means low desire for smoothing, or high flexibility in the timing of consumption. Thus agents with high flexibility in regard to the timing of consumption will have a relatively high value for β .

We can now use (7) to characterize the aggregate demand for financial assets. To do so, we assume the existence of two types of investors. We refer to each type as a clientele, and we refer to an agent of that type as a member of the clientele. One type of investor is an individual, while the other type is a tax-exempt institution. In later sections, we will discuss their tax characteristics in detail. For now, it suffices to say that the two clienteles face different taxes, and consequently, each receives a different after-tax return on investment equal to r_i for individuals and r_e for tax-exempts. The two clienteles also differ in their aggregate wealth, denoted as W_i for individuals and W_e for tax-exempts. Each single member of a clientele acts independently of other members of the clientele and possesses sufficiently little wealth so as to act as a price taker in all decisions. Finally, the two clienteles potentially differ in their utility parameters. Consequently, the parameters in their consumption functions differ. We denote aggregate consumption of the two clienteles as:

$$\begin{aligned} C_i &= (\alpha_i - \beta_i r_i) W_i \quad \text{and} \\ C_e &= (\alpha_e - \beta_e r_e) W_e. \end{aligned} \tag{8}$$

Thus aggregate demand for financial assets by all investors (X_D) is:

$$X_D = (W_i - C_i) + (W_e - C_e) = (1 - \alpha_i + \beta_i r_i) W_i + (1 - \alpha_e + \beta_e r_e) W_e. \tag{9}$$

Given (8), (9) implies $\partial X_D/\partial r_i > 0$ and $\partial X_D/\partial r_e > 0$. That is, aggregate demand for financial assets increases in after-tax rates of return on investment.

2. Portfolio Choice and Implicit Taxes in Returns

After choosing the amount of wealth to invest in financial assets, agents must decide how to allocate investment across assets. In this section, our objective is to establish which assets members of the tax-exempt and individual clienteles include in their portfolios, and to determine relative pre-tax returns on the assets, or implicit taxes. To this end, we adopt a simplified version of the multi-clientele implicit tax model in Williams (2001a), adapting it to our setting.

Tax-exempts pay no taxes on their returns from any asset. Individuals pay taxes on interest and dividends at the ordinary rate t , and pay taxes on capital gains at a preferential rate g , where $g < t$. We allow the two clienteles to invest in the following three assets.

	Tax treatment	Supply	Return
Municipal bonds	none	X_m	r_m
Taxable bonds	ordinary rate	X_b	R_b
Stock (dividend yield D/P)	ordinary rate on D/P , capital gains rate on $r_s - D/P$	X_s	r_s

Returns on the three assets are endogenously determined within the model. At this stage, we need not worry about the specific division of stock returns between dividends

and capital gains, although this division will become important in Section 3. For now, it is sufficient to note that equity is taxed more favorably than taxable bonds. We denote the average tax rate on stock returns for individuals as t_e , where $t_e < t$.

We assume the supplies of all three assets are fixed. Alternatively we could follow Miller (1977) by modeling the supply of stocks and bonds as an endogenous choice. However this type of model would imply firms issue enough taxable debt to absorb the entire wealth endowment of the tax-exempts, leaving them without any wealth to invest in stocks. This result is inconsistent with empirical observations (*e.g.*, U.S. Flow of Funds data) that the amount of financial assets owned by tax-exempts is greater than the amount of taxable debt in financial markets, and that tax-exempts do in fact have substantial equity holdings. Hence the evidence indicates nontax factors (such as asymmetric information or bankruptcy costs) act as important limitations on firm leverage and a pure tax model of asset supply is unrealistic. Moreover, our objective in this paper is to model implicit taxes and tax capitalization in a realistic environment in which tax-exempts participate in the stock market.

Rather than attempt to model such nontax factors, which would be tangential to the focus of our paper, we adopt an agnostic viewpoint and simply assume that sufficient supplies of stocks and bonds exist to ensure a split of the stock market between individuals and tax-exempts. To that end, we require $(W_i - C_i) > X_m$ and $(W_e - C_e) > X_b$. Of course, these conditions are expressed in terms of C s, which are endogenous, but it would be easy to demonstrate they could be satisfied for a large range of exogenous parameter values.

Investors in each clientele select portfolios that maximize after-tax returns. As is common to other tax clientele models, short sale opportunities (including borrowing) would undermine any potential equilibrium because there would be unbounded tax arbitrage opportunities. As in Miller (1977), therefore, we preclude short sales entirely, although any finite bound on short sales would be sufficient to support the primary features of our model.

The returns listed for the available assets are the certainty equivalents to the actual risky returns. To use certainty equivalents, we rely on the Tax-Risk Separation Theorem of Williams (2001b), who demonstrates that tax and risk motives for portfolio choice can be linearly separated from each other and considered independently as long as there is an appropriate set of futures contracts in the marketplace. Thus certainty equivalents are well defined and can be treated as constants, which we do throughout the paper.⁴

We can now prove the following proposition, which we express in terms of returns on investment.

Proposition 1: There is a unique, stable equilibrium in the financial markets, characterized as follows: Individuals purchase all available municipal bonds, tax-exempt

⁴ As demonstrated in Williams (2001b), an investor can acquire any risky portfolio and then use stock index futures to swap the risk on that portfolio for any desired risk exposure. This risk swap is effectively tax-free regardless of the tax treatment of futures profits (as long as it is symmetric) because the futures position can be rescaled to offset any tax. In this manner, all investors can choose portfolios that are fully tax optimal while simultaneously selecting risk exposures that are optimal from a risk-return tradeoff standpoint. This separation of risk and tax incentives means that investors will act as if risk-neutral, and at the margin all investors will face the same disutility of risk ensuring a common well defined risk premium on every asset. This is critical as it allows us to transform all risky variables, including returns, future prices, future dividends, and future cash flows using the common certainty-equivalent measure. The number of futures

investors purchase all available taxable bonds, and both clienteles buy a positive fraction of available stocks. Relative returns on the three assets are:

$$\begin{aligned} r_m &= r_b(1 - t_e). \\ r_s &= r_b. \end{aligned} \tag{10}$$

Proof: Appendix.

The equilibrium possesses a preferred habitat flavor. Each clientele acquires two assets that are tax-favorable to them relative to the other clientele and avoids the third asset altogether. Both assets held by a particular clientele must generate identical after-tax returns for that clientele, while the asset that is not held by the clientele must generate an inferior after-tax return. For example, tax-exempt investors hold both stocks and taxable bonds, so these two assets must generate the same after-tax returns. Because pretax returns equal after-tax returns for tax-exempt investors, this implies $r_s = r_b$. That is, there is no implicit tax on equity relative to taxable debt. On the other hand, taxable individuals hold stocks and municipal bonds. To equalize after-tax returns on the two assets, municipal bonds must bear implicit tax (*i.e.*, municipal bonds must yield relatively low pretax returns). The implicit tax on municipal bonds reflects the effective tax rate on equity, not the effective tax rate on taxable bonds as might be assumed, because the clientele that holds municipal bonds (*i.e.*, individuals) also holds stocks, not taxable bonds.

A key implication of Proposition 1 is that in a multi-asset setting, different clienteles are at the margin for different pairs of assets. No single marginal clientele sets relative returns among all assets. We will now build upon this result, extending it to a multi-period setting, which allows us to develop an asset-pricing model.

contracts required to achieve this outcome equals the number of risk factors in the

3. Stock Prices and Tax Capitalization

3.1 Asset-Pricing Model

To model the effect of investor-level taxes on stock prices, we must consider the taxation of stock returns in greater detail. We also must consider the time-series properties of dividends.

Stock returns in any period are composed of two pieces, the dividend yield and the capital gain. Let D_j be the dividend received during period j , P_j be the stock price at the beginning of period j ; consequently P_{j+1} will be the stock price at end of period j (*i.e.*, the beginning of the next period). In that case, the dividend yield on the stock in period j is D_j / P_j , and the capital gain return in the same period is $(P_{j+1} - P_j) / P_j$. Therefore,

$$r_{s,j} = \frac{D_j}{P_j} + \frac{P_{j+1} - P_j}{P_j}. \quad (11)$$

where $r_{s,j}$ is the return on stock in period j . Given the dividend and capital gain tax rates of t and g , respectively, the average tax rate on stock in period j for individuals is:

$$t_{e,j} = \frac{D_j}{D_j + P_{j+1} - P_j} t + \frac{P_{j+1} - P_j}{D_j + P_{j+1} - P_j} g.^5 \quad (12)$$

economy (*e.g.*, one in the CAPM).

⁵ Note that price appreciation is taxed immediately at rate g . In practice, investors can defer capital gains taxes until they sell the stock. Thus, we could view g as the present value of the capital gains tax rate that will eventually be paid. This present value adjustment is one reason g is smaller than t (the statutory rate on capital gains could also be lower than the ordinary rate). By assuming a constant g over time, we are implicitly assuming that the average investor has the same investment horizon in each period, which is plausible in an overlapping generations context.

Given (11) and (12), (10) can be restated as

$$\begin{aligned}
 r_{b,j} &= \frac{D_j + P_{j+1} - P_j}{P_j}. \\
 r_{m,j} &= \frac{D_j(1-t) + (P_{j+1} - P_j)(1-g)}{P_j}. \\
 r_{m,j} &= r_{b,j}(1-t) + \frac{P_{j+1} - P_j}{P_j}(t-g). \tag{13}
 \end{aligned}$$

If (13) holds, investors will optimally choose the portfolios necessary to clear the two bond markets. If (13) does not hold, then either individuals will shun the municipal market (or flood it with excess demand) or tax-exempts will shun the taxable bond market (or flood it with excess demand) as discussed in the proof of Proposition 1.

To make further progress in determining the sequence of prices, we must specify the time series properties of dividends. We need to impose structure on the dividend sequence to solve the model. The specific structure we choose is exponential growth at rate h . That is, we assume

$$D_{j+1} = (1+h)D_j, \quad \forall j. \tag{14}$$

This assumption imposes two restrictions. The first restriction is smoothness – the structure does not allow for uneven changes in dividends over time. We believe this is a reasonable assumption for *ex-ante* expectations of future dividend growth, even if smoothness does not perfectly hold *ex-post*. Moreover, smoothness is innocuous to pricing.

The second, more substantial, restriction relates to the timing of dividends. In particular, this structure does not allow price to be a function of either accelerating or delaying dividends. As a robustness check, therefore, we later consider the effects of

delaying dividends for multiple periods (see Section 3.2). As we shall demonstrate, delaying dividends can alter firm value, but it does not materially alter the structure of the pricing function. Specifically, delaying dividends does not change the nature of dividend tax capitalization or how the different clienteles are weighted to determine the appropriate average tax rate determining tax capitalization. Thus, the primary findings in this paper are invariant to the timing of dividends.

We require that a steady-state balance exists with respect to the resources of the two clienteles and the supplies in the three asset markets. That is, both the clienteles and the supplies in the asset markets all grow at the same rate over time and thus remain in the same proportion (*e.g.*, W_e/W_i is the same every period, as is X_m/X_b and W_e/X_b). We also require a standard no-bubble transversality condition to rule out explosive pricing equilibria. That is, we assume

$$\lim_{j \rightarrow \infty} \frac{P_j}{D_j} < \infty. \quad (15)$$

Finally, we require dividends to grow at a slow enough rate for prices to be finite. In particular, we assume

$$h < \theta \equiv \frac{X_m + X_s + X_b + (\alpha_i - 1)W_i + (\alpha_e - 1)W_e}{\beta_i W_i + \beta_e W_e}. \quad (16)$$

where θ can be viewed as the discount rate. Given these assumptions, we can now prove the following proposition.

Proposition 2: If (14) characterizes dividends, then there is a unique equilibrium in which stocks have the following price sequence:

$$P_j = \frac{1 - \eta t}{\theta - h(1 - \eta g)} D_j \quad (17)$$

where $\eta = \beta_i W_i / (\beta_i W_i + \beta_e W_e)$.

Proof: Appendix.

Proposition 2 derives the only price sequence that is consistent in all time periods with the equilibrium derived in Proposition 1. The optimal portfolios in Proposition 1 indicate $r_e = r_b$ for tax-exempt investors, and $r_i = r_m$ for individual investors. The investment-consumption tradeoff implies a downward-sloping (*i.e.*, negative) relation between r_b and r_m . This is true because increasing either rate raises investment by its corresponding clientele, which requires a decrease in investment from the other clientele in order to maintain aggregate demand at the same level as aggregate supply. At the same time, the relative returns in (10) from Proposition 1 imply an upward-sloping relation between r_b and r_m . Equilibrium occurs at the intersection of these curves, which fixes r_b and thus r_s . Then, given dividends, it is simply a matter of inverting this return to derive a family of price sequences with the appropriate r_s . All but one price sequence in this family violates the no-bubble condition, so only one price sequence is consistent with Proposition the equilibrium in Proposition 1, which is the unique equilibrium in the financial markets.

There are several interesting features of the stock prices in (17). First, consider the case in which there are no taxes (*i.e.*, $t = g = 0$). In this case, (17) simplifies to

$$P_j = \frac{1}{\theta - h} D_j. \quad (18)$$

(18) is a classic result in the finance literature. Prices are a multiple of dividends, where the multiplier is one divided by the difference between the discount rate and the dividend growth rate. Thus, we can interpret θ as a discount rate applied by the investors in a no-tax environment. The appropriate discount rate for an investor is that investor's marginal

rate of substitution between current and future consumption minus 1. Indeed, $1+\theta$ is a weighted average of the clienteles' marginal rates of substitution, with weights η and $1+\eta$ for individuals and tax-exempts, respectively. Therefore, throughout the paper, we will interpret $1+\theta$ as the marginal rate of substitution.

Next, consider the special case in which only individuals have significant wealth and are in essence the only clientele. Then (17) simplifies to

$$P_j = \frac{1-t}{\theta - h(1-g)} D_j. \quad (19)$$

According to (19), dividend taxes reduce prices in a proportionate manner. That is, price is proportionate to after-tax dividends, rather than being proportionate to pre-tax dividends. In contrast, the capital gains tax also reduces share value, but in a different way. Dividend growth (h) leads to price appreciation at the same rate, which is taxed at capital gains rates. Thus capital gains taxes reduce the benefit of growth in the firm, by reducing the growth-based dividend multiplier in the price function.

Returning to (17), note that the magnitude of both dividend and capital gains tax capitalization is proportional to the parameter η . In effect, η is a weighting parameter. That is, the tax rates capitalized into stock prices are weighted averages of the tax rates of the two clienteles where η represents the weight for the individual clientele.

Two factors determine η . First, η depends on the fraction of total economic resources controlled by individuals. Total economic resources are relevant, rather than the amount of resources each clientele invests in stocks, because tax capitalization is driven by the choice between investment and consumption and total resources represent the amount of wealth each clientele has at stake on the investment-consumption margin. In the

economy, individuals control far more economic resources than the tax-exempt sector, especially when it is recognized that resources not only include financial assets, but also include current consumption, real estate, and durable goods. Therefore the fraction of wealth controlled by individuals is high, which implies substantial tax capitalization.

Second, η depends on the investment sensitivity parameter β . The higher β_i is relative to β_e , the larger η . Recall from (7) that β depends on ω , the utility curvature parameter. As discussed in Section 1, the more flexible the timing of consumption, the higher β . A variety of factors suggest this parameter is likely to be higher for individuals than for tax-exempts. For example, many tax-exempt investors are not really economic agents, but are merely investment conduits (*e.g.*, pensions and IRAs). Given limitations on contributions to these conduits and constraints on pre-retirement withdrawals, many of them are likely to be insensitive to returns in their tradeoff between investment and consumption, leading to low β s. Likewise, other tax-exempts, such as university endowments, face restrictions that limit their flexibility in timing consumption. Hence individuals dominate both factors that determine η , so according to (17), the tax rates for individuals are primary determinants of the magnitude of tax capitalization.

Conceptually, it is simple to extend Proposition 2 to a setting with additional clienteles. For example, if we added the middle class to our analysis, then tax capitalization would be a function of the weighted average tax rate of all three clienteles, with weights based on the same factors as η . Because the middle class in the United States controls substantial resources, it would likely have considerable weight.⁶ Hence the

⁶ Low tax-rate individuals also have significant economic resources as a group. However, the members of this class are largely inframarginal in the investment-consumption tradeoff

magnitude of tax capitalization could be largely driven by the middle-class, with a current federal tax rate of 28 percent. This tax rate is approximately equal to 71 percent of the top 39.6 tax rate, which implies $\eta = 0.7$.

When comparing Propositions 1 and 2, it is evident that tax capitalization in prices can occur in the complete absence of implicit taxes, at least if we follow the convention of defining implicit taxes as the relatively low return on a tax-favored asset relative to a fully taxable bond. Specifically, Proposition 2 implies substantial tax capitalization in stock prices, whereas Proposition 1 implies $r_s = r_b$. Both conditions hold simultaneously in equilibrium, essentially because tax capitalization reduces the prices of taxable bonds as well as the prices of stocks. Even though individuals do not invest in taxable bonds, taxes reduce taxable bond prices because taxes increase the pretax rates of return on stocks required to induce individuals to invest sufficient funds to clear the financial markets. If stock returns increase, taxable bond returns also must increase to ensure the bonds remain attractive to tax-exempt investors. Higher returns on bonds mean lower prices for the bonds. Even though tax-exempts are the only investors in taxable bonds, therefore, the bonds bear tax capitalization.

3.2 The Timing of Dividend Payouts

To derive Proposition 2, we assume the timing of dividend payouts does not affect prices (see (14)), which we assume to increase the tractability of the analysis. We now check the robustness of our findings to an alternative assumption, to help ensure that (14)

because they are at a corner (no investment) regardless of r . For this reason, they are likely to have a very low β and little influence on the level of tax capitalization.

does not drive our results. Specifically we consider the following alternative dividend stream, in which a firm delays the payment of dividends for n periods as follows:

$$\begin{aligned} D_j &= 0, \quad \forall j < n, \\ D_j &= (1+h)^{j-n} D_n, \quad \forall j \geq n, \end{aligned} \tag{20}$$

where D_n is the initial dividend and n is the dividend initiation period. (20) is identical to (14) for all periods following dividend initiation, but it differs substantially during the zero-dividend phase prior to n . Given (20) we derive the resulting equilibrium price sequence.

Proposition 3: If (20) characterizes dividends, then there is a unique equilibrium in which stocks have the following price sequence:

$$\begin{aligned} P_j &= \frac{1-\eta t}{\theta - h(1-\eta g)} \left[1 + \frac{\theta}{1-\eta g} \right]^{j-n} D_n, \quad \forall j < n. \\ P_j &= \frac{1-\eta t}{\theta - h(1-\eta g)} D_j, \quad \forall j \geq n. \end{aligned} \tag{21}$$

where $\eta = \beta_i W_i / (\beta_i W_i + \beta_e W_e)$.

Proof: Appendix.

We can interpret (21) as stating that price at each point in time is a multiple of the present value of the next dividend payment, discounted at the marginal rate of substitution between investment and consumption (adjusted upward to compensate for the weighted average capital gains tax rate), where the dividend multiplier is the same as in (17). Hence (21) implies that deferral of dividends, even for long time periods, does not decrease the magnitude of dividend tax capitalization. On the other hand, capital gains tax capitalization is greater in the pre-dividend initiation period than in the post-initiation period, because paying dividends reduces the rate of taxable price appreciation. Just as in (17), all tax capitalization effects in (21) are a function of the weighed average tax rates

for the clientele. Thus the primary findings in this paper are invariant to the timing of dividends.

4. The Relation between Implicit Taxes and Tax Capitalization

Our model demonstrates that tax capitalization can occur in the absence of implicit taxes, which may seem counterintuitive, because the two concepts seem closely related. In fact, they are indeed related, and we now identify the precise mathematical link between tax capitalization in prices and implicit taxes in returns.

To compare tax capitalization to implicit taxes, we begin by recognizing an important difference between them. Implicit taxes equal the difference in pretax returns between two assets, so they are a relative concept. In contrast, tax capitalization in an asset price is defined independently of the prices of other assets, so it is an absolute concept. To relate implicit taxes to an absolute concept like tax capitalization, we must choose an absolute benchmark return for measuring the implicit taxes.

As mentioned earlier, the conventional benchmark for measuring implicit taxes is the return on fully taxable bonds. Tax-favored assets then bear implicit taxes relative to the bonds (see, *e.g.*, Scholes and Wolfson, 1992). However, this benchmark cannot be used to map implicit taxes into tax capitalization. As we have demonstrated, implicit taxes could be unrelated to tax capitalization when using this benchmark. Instead, we must select an absolute benchmark return, which is the return all assets would provide if there were no taxes on investment, or r^* . When measuring implicit taxes relative to r^* , we can prove the following general relation between implicit taxes and tax capitalization.

Theorem 1: Fundamental Theorem of Investment Taxation

Let P_t be the sequence of prices for an asset and P_t^* be the sequence of prices for the same asset that would occur in the absence of taxes. Assume the asset generates a constant rate of return r . Finally define the implicit tax (I_t) on the asset at each point in time as

$$I_t = (r^* - r)P_{t-1}. \quad (22)$$

Then, tax capitalization at each point in time equals negative one times the present value of all future implicit taxes on the asset, or

$$P_t^* - P_t = -\sum_{i=1}^{\infty} (1+r^*)^{-i} I_{t+i}. \quad (23)$$

Proof: Appendix.

The theorem is “fundamental” in the sense that it ties two disparate concepts together in a general context (it must be true in any model). Indeed, even the assumption of constant returns is a mere notational convenience; the theorem can be proven for time-varying returns as well. The theorem demonstrates that tax capitalization results from the anticipation of all future implicit taxes. Specifically, there is a direct negative relation between tax capitalization and expected future implicit taxes. Importantly, however, this direct link between tax capitalization and implicit taxes only exists when measuring implicit taxes relative to a no-tax benchmark. There is no link between tax capitalization and implicit taxes measured relative to the conventional benchmark of the return on a fully taxable bond.

The theorem implies that two factors could cause the degree of tax capitalization to differ across a pair of assets. First, implicit tax rates could vary across the assets. Second, the duration of the assets could vary. Holding implicit tax rates constant,

increasing duration increases the number of future periods implicit taxes are incurred, which increases the total present value of the expected implicit taxes.⁷

We can interpret the earlier findings in the paper in light of Theorem 1. Recall that in our model, tax capitalization in equity is substantial while implicit taxes (as conventionally defined) are zero. Noting that in the context of our model $r^* = \theta$, we can define implicit taxes relative to θ , which is the marginal rate of substitution between current and future consumption (minus 1). Stock and bond returns are derived in the proof of Proposition 2 as

$$r_s = r_b = \frac{\theta - h\eta(t - g)}{1 - \eta t}. \quad (24)$$

Given $r^* = \theta$, it is evident that returns on both stocks and taxable bonds are greater than r^* (because $h < \theta$ from (16)), which implies negative implicit taxes and explains why both assets incur tax capitalization. Thus, the apparent contradiction between the empirical evidence for tax capitalization in stock prices versus the evidence for little or no implicit taxes in stock returns could largely be an illusion created by the use of a taxable bond benchmark return to measure implicit taxes, rather than the use of the more theoretically grounded no-tax benchmark return.

5. Conclusion

⁷ To illustrate the duration effect, we compare a one-year bond to a perpetual bond. Assume that both bonds are taxed the same and thus bear equal implicit tax. If $r^* = 5\%$ and $r = 10\%$, then a perpetuity paying \$1 per year is worth \$10 with taxes and would be worth \$20 without taxes, and thus bears tax capitalization equal to 50 percent of its untaxed value. In contrast, a one-year bond paying \$1 is worth \$0.91 with taxes and would be worth \$0.95 without taxes, and thus bears tax capitalization equal to 4.5 percent

In this study, we provide a model of investment clienteles that reconciles the rather weak empirical evidence for implicit taxes with the rather strong support for tax capitalization in asset prices. In particular, we demonstrate that tax capitalization is driven by a weighted average of tax rates for all clienteles in the financial markets, while implicit tax is driven by the tax rates of the marginal clientele that arbitrages returns between stocks and bonds, which could include tax-exempt entities. Two factors determine the weights of different clienteles in determining the magnitude of tax capitalization – the total economic resources controlled by each clientele, and each clientele’s sensitivity to rates of return when making investment-consumption decisions. Given the relatively large amount of total resources controlled by individuals, especially middle- to high-tax individuals, and the low flexibility of many tax-exempt and low-tax entities in the timing of investments, tax capitalization could be driven by high weighted average tax rates and thus be substantial.

To reconcile the lack of congruence between tax capitalization in prices and implicit taxes in returns as traditionally defined, we have proposed an alternative definition of implicit taxes. Specifically, instead of defining implicit taxes relative to the benchmark of a fully taxed bond, we propose a no-tax benchmark. We then derive a general theorem demonstrating there is a direct link between tax capitalization and implicit taxes defined in this manner.

Despite the fact that our model provides economic rationale for much of the recent empirical evidence for tax capitalization, it is subject to a variety of important limitations.

of its untaxed value. The relatively small amount of tax capitalization for the one-year bond results from the bond’s short duration.

For example, we do not attempt to derive a general equilibrium in which the supply of different assets is determined within the model (such as in Miller, 1977). We also assume all firms are identical, so we fail to capture potentially important differences across firms. Therefore much future work must be conducted before we fully understand investment clienteles, implicit taxes, and asset prices.

Appendix: Proofs

Theorem 1

We prove this Lemma by backward induction. Specifically, assume

$$P_{t+1}^* - P_{t+1} = -\sum_{i=1}^{\infty} (1+r^*)^{-i} I_{t+1+i}$$

as posited. The asset produces a sequence of pretax cash payments D_t . It also produces a return of r each period, and without taxes it would produce a return of r^* each period, so:

$$(1+r)P_t = D_{t+1} + P_{t+1}.$$

$$(1+r^*)P_t^* = D_{t+1} + P_{t+1}^*.$$

$$(1+r^*)P_t^* - (1+r)P_t = P_{t+1}^* - P_{t+1}.$$

$$(1+r^*)P_t^* - (1+r)P_t = -\sum_{i=1}^{\infty} (1+r^*)^{-i} I_{t+1+i}.$$

$$P_t^* - \frac{1+r}{1+r^*} P_t = -\sum_{i=1}^{\infty} (1+r^*)^{-i-1} I_{t+1+i}.$$

$$P_t^* - P_t + \frac{r^* - r}{1+r^*} P_t = -\sum_{i=2}^{\infty} (1+r^*)^{-i} I_{t+i}.$$

$$P_t^* - P_t = -\left[\sum_{i=2}^{\infty} (1+r^*)^{-i} I_{t+i} + \frac{r^* - r}{1+r^*} \frac{I_t}{r^* - r} \right].$$

$$P_t^* - P_t = -\sum_{i=1}^{\infty} (1+r^*)^{-i} I_{t+i}.$$

This demonstrates that if the formula holds at any point in time, it holds at all prior points as well. Similarly, it would be trivial to show that if there is a terminal payment date, the formula holds on that date. Given this fact, it would be easy to prove that it holds in the infinite limit as long as cash payments do not explode to infinity faster than r^* , which is a standard transversality condition that ensures finite prices.

Proposition 1

To prove that the relative returns specification (10) does in fact characterize an equilibrium, we will demonstrate that given these returns, investors will optimally choose the stated portfolios and all asset markets will clear simultaneously (for a specific absolute level of returns consistent with (10)).

Each investor is a price-taker, so he/she will only be willing to hold an asset if no other asset offers a higher after-tax return. Thus, each asset held by members of a clientele must generate an identical return, while each asset not held by members of the clientele must generate a (weakly) inferior return. Given the relative returns in (10), it is clear that tax-exempts earn an equal after-tax return on both stocks and taxable bonds (namely, r_b). Moreover, municipal bonds offer an inferior return to the other two assets because $t_e > 0$. Thus, tax-exempts would optimally shun municipal bonds while willingly holding the other two assets.

Given (10), the after-tax returns received by individuals for the three assets are $r_m = r_b(1-t_e)$ for municipal bonds, $r_s(1-t_e) = r_b(1-t_e)$ for stock, and $r_b(1-t)$ for taxable bonds. $t_e < t$, so it is clear that stocks and municipal bonds offer individuals identical returns, while taxable bonds offer inferior returns.

The remaining step in proving that (10) characterizes an equilibrium is to show that all asset markets will clear for returns consistent with (10). Recall that, by assumption, $(W_i - C_i) > X_m$, so individuals invest more resources in total than the amount of municipal bonds. Only individuals will choose to own municipal bonds and they are indifferent between owning these or stock, so the municipal market will clear if sufficient supply of stock exists to use up the remaining funds of the individual clientele. A similar

argument regarding tax-exempts holds for the taxable bond market. The stock market clears if the combined residual funds of the two clienteles (after investing in bonds) equals the supply of stock, X_s . Thus, market clearance requires

$$X_s = (W_i - C_i - X_m) + (W_e - C_e - X_b).$$

This is equivalent to $X_D = X_s + X_m + X_b$, *i.e.*, aggregate demand (characterized by (9)) equals aggregate supply (a fixed amount). Given (10) and the optimal portfolios, $r_e = r_b$ and $r_i = r_b(1-t_e)$. (9) indicates X_D is an increasing function of both r_e and r_i , so it is also an increasing function of r_b . Therefore, there exists a unique r_b that clears the asset markets, given (10).

That proves that an equilibrium exists which is characterized by (10). To see that this equilibrium is unique and stable, consider all possible deviations from (10). If $r_s > r_b$, then both tax-exempts and individuals will completely shun the taxable bond market (because its return is inferior), so supply will exceed demand in that market, and bond issuers will be forced to increase returns on taxable bonds to sell them. Likewise, if $r_s < r_b$, then tax-exempts will refuse to invest in either municipal bonds or stocks, so they will only invest in taxable bonds. However, $(W_e - C_e) > X_b$, so demand will exceed supply in the taxable bond market, resulting in competition between tax-exempts bidding down the return on taxable bonds to restore equilibrium. Similar arguments apply to the municipal bond market for deviations from $r_m = r_b(1-t_e)$.

Proposition 2

First note that Proposition 1 must hold in every period (it is the unique equilibrium). Thus, the specified portfolios (*e.g.*, individuals owning all municipal bonds and some stocks) must hold in every period. Likewise (10) must govern relative returns in every period, leading directly to (13). Further note that, from (9), clearance of financial markets requires

$$(1 - \alpha_i + \beta_i r_i)W_i + (1 - \alpha_e + \beta_e r_e)W_e = X_m + X_s + X_b. \quad (\text{A1})$$

Note that any (r_i, r_e) that solves (A1) in one period solves it in every period because the W s and X s maintain constant proportions to each other over time. Also note that given the investment portfolios of the clientele, $r_i = r_{m,j}$ and $r_e = r_{b,j}$. Substituting these into (A1) and rearranging yields

$$\beta_i r_{m,j} W_i + \beta_e r_{b,j} W_e = X_m + X_s + X_b + (\alpha_i - 1)W_i + (\alpha_e - 1)W_e. \quad (\text{A2})$$

(A2) establishes a locus of interest rate pairs that clears the investment-consumption market. The relationship between the interest rates within the locus is a downward sloping line, which we designate as the IC (investment-consumption) line. The line is downward sloping because everything in (A2) except the interest rates is a constant. According to (A2), therefore, any change in r_b must be balanced by an offsetting opposite change in r_m . Defining η as $\beta_i W_i / (\beta_i W_i + \beta_e W_e)$, the IC line has the following form (with θ defined in (16)):

$$r_{m,j} = \frac{\theta}{\eta} - \frac{1 - \eta}{\eta} r_{b,j}. \quad (\text{IC})$$

In addition, (10) implies that (13) holds at each point in time. Define the annual rate of price appreciation as

$$q_j \equiv \frac{P_{j+1} - P_j}{P_j}.$$

(13) simplifies to the following condition for clearance of the separate financial markets:

$$r_{m,j} = r_{b,j}(1-t) + q_j(t-g). \quad (\text{FM1})$$

Combining (IC) and (FM1) allows us to uniquely identify the interest rates that simultaneously clear all markets. Simultaneous satisfaction of both (IC) and (FM1) at all points in time is necessary for equilibrium.

$$\begin{aligned} \theta/\eta - [(1-\eta)/\eta]r_{b,j} &= q_j(t-g) + (1-t)r_{b,j}. \\ [(1-t) + (1-\eta)/\eta]r_{b,j} &= \theta/\eta - q_j(t-g). \end{aligned}$$

$$r_{b,j} = \frac{\theta - \eta q_j(t-g)}{1 - \eta t}. \quad (\text{A3})$$

Given (10), $r_{b,j} = D_j/P_j + q_j$. Rearranging and substituting in (A3) yields:

$$\begin{aligned} D_j/P_j &= r_{b,j} - q_j. \\ P_j &= \frac{D_j}{\frac{\theta - \eta q_j(t-g)}{1 - \eta t} - q_j}. \\ P_j &= \frac{1 - \eta t}{\theta - \eta q_j(t-g) - q_j(1 - \eta t)} D_j. \\ P_j &= \frac{1 - \eta t}{\theta - q_j(1 - \eta g)} D_j. \end{aligned} \quad (\text{A4})$$

(14) states that dividends grow at rate h each year. Thus,

$$P_{j+1} = \frac{1 - \eta t}{\theta - q_{j+1}(1 - \eta g)} D_{j+1} = (1+h) \frac{1 - \eta t}{\theta - q_{j+1}(1 - \eta g)} D_j. \quad (\text{A5})$$

There are three possibilities. The first possibility is that $q_{j+1} > q_j$. In that case, (A5) implies that $q_j > h$ and obviously increases every year thereafter. Thus, prices grow

faster than dividends over time and asymptotically become infinitely larger, violating the no-bubble condition (15). This cannot occur.

The second possibility is that $q_{j+1} < q_j$. In that case, (A5) implies that $q_j < h$ and obviously decreases every year thereafter. Thus, prices grow slower than dividends over time and asymptotically become infinitely smaller. This implies that

$$\begin{aligned}\lim_{j \rightarrow \infty} P_j / D_j &= 0. \\ \lim_{j \rightarrow \infty} \frac{1 - \eta t}{\theta - q_j(1 - \eta g)} &= 0. \\ \lim_{j \rightarrow \infty} [\theta - q_j(1 - \eta g)] &= \infty. \\ \lim_{j \rightarrow \infty} q_j &= -\infty.\end{aligned}$$

This implies that asymptotically, prices decrease at an infinitely fast rate. This guarantees that prices eventually become negative, which is impossible. Thus this case cannot occur.

The third possibility is that $q_{j+1} = q_j$. In that case, (A5) implies that $q_j = h$. In this case, prices and dividends remain in constant proportion over time, which is feasible.

Since this is the only feasible case, the price sequence consistent with $q_j = h$ (which is (17)) is the only price sequence that ensures that the equilibrium of Proposition 1 holds in every time period. Proposition 1 proves that its equilibrium is the unique equilibrium at each point in time, so (17) is the only price sequence consistent with equilibrium as well.

Proposition 3

The equilibrium characterized in Proposition 2 must hold for periods from n forward. Thus prices starting at time n must be the same as in (17). Moreover, Proposition 1 must hold in all periods, so returns must conform to (IC) and (10). Note

that in periods $j < n$, there are no dividends so all equity returns are subject to capital gains tax and $t_e = g$. Thus, (10) implies

$$r_{m,j} = r_{b,j}(1 - g). \quad (\text{FM2})$$

Combining (IC) and (FM2) yields:

$$\begin{aligned} r_{b,j}(1 - g) &= \frac{\theta}{\eta} - \frac{1 - \eta}{\eta} r_{b,j}. \\ r_{b,j}[\eta(1 - g) + (1 - \eta)] &= \theta. \\ r_{b,j} &= \frac{\theta}{1 - \eta g}. \end{aligned}$$

This also is the return on stock, which is exclusively due to price appreciation, so

$$\begin{aligned} \frac{P_{j+1} - P_j}{P_j} &= \frac{\theta}{1 - \eta g}. \\ P_j &= \left[1 + \frac{\theta}{1 - \eta g} \right]^{-1} P_{j+1} \end{aligned}$$

Applying this recursively starting with $j = n-1$ and going back in time results in the first part of (21) given the required price level at date n .

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