NBER WORKING PAPER SERIES

CAPITAL GAINS REALIZATIONS

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Working Paper 31059
http://www.nber.org/papers/w31059

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2023

We thank Johannes Becker, Sebastian Eichfelder, Christine Kim, Kyle Rozema, and participants in the Junior Tax Workshop, the Junior Faculty Forum, the Utah Tax Invitational, the Oxford University Centre for Business Taxation Summer Symposium, and the National Tax Association Annual Conference for helpful comments on earlier drafts. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 31059
March 2023
JEL No. G11,H24,H31

ABSTRACT

Evidence that high tax rates significantly depress capital gains realizations is inconsistent with the implications of neoclassical investment models in unchanging economic environments. Higher tax rates reduce after-tax investment returns, thereby encouraging investors to sell capital assets earlier. For a given investment horizon, higher tax rates need not reward accumulating unrealized gains over long periods – and even if they do, longer accumulations can lead to earlier realizations. Consequently, the sizeable observed effects of capital gains taxes likely reflect investor anticipations of future tax rate changes, rather than the time value of money.

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1. Introduction

The taxation of capital gains constitutes an important exception to the rule that income is taxable when earned. Investors are subject to capital gains taxes only when they realize their gains, which is typically the time of sale. The realization rule implies that, in the absence of sales, a long-term investment can accumulate considerable compound returns without triggering contemporaneous tax obligations.

Conventional wisdom has it that careful investors should aim to defer tax realizations by not selling appreciated assets, and that this incentive strengthens at higher capital gains tax rates. The idea is that by deferring tax obligations, investments earn returns on amounts not paid in taxes. The incentive to lengthen untaxed accumulations is thought to be an important part of the reason why higher capital gains tax rates are associated with significantly reduced capital gains realizations.

The purpose of this paper is to investigate the source of the realization incentives created by realization-based capital gains taxation. In order to identify the role played by compounded returns on untaxed accumulations, the paper considers a simple setting with complete certainty and an unchanging tax rate on realized capital gains. In this environment, the only reason to delay capital gains realizations is the time value of money: it is the opportunity to earn returns on funds that otherwise would be paid in taxes.

In the economic environment of the paper's model, higher capital gains taxes affect both investment length and patterns of realizations and reinvestments, but do not systematically encourage delayed realizations. Higher capital gains tax rates discourage long-term investment by reducing marginal after-tax returns, which has the effect of accelerating realizations. At any given investment horizon, longer untaxed asset accumulations are just as apt to be associated with earlier realizations as with later realizations. And there are important cases in which higher tax rates punish lengthy accumulations relative to the alternative of realizations after shorter intervals. As a result, the model suggests that there is little reason to expect higher tax rates to be associated with delayed realizations.

If tax advantages of unrealized accumulation do not explain the observed effects of capital gains tax rates on realizations, then something else must. An obvious candidate is

anticipated tax rate changes. Some investors anticipate holding appreciated capital assets until death, at which point taxes on accumulated gains are forgiven under current U.S. law; and short of that, investors might reasonably expect their personal tax situations to change, or the government to enact reforms, in ways that create tax environments that are favorable to realizing gains. Transitory tax rate fluctuations with anticipated long-run mean reversion have the property that the capital gains tax rate that an investor faces is more likely to be lower in the future if it is high today; and conversely it is more likely to be higher in the future if it is low today. In avoiding realizations when tax rates are high, investors leave open the possibility of realizing gains at more advantageous times in the future.

It is important to understand the considerations responsible for the observed behavioral effects of capital gains taxes on realizations. The empirical regularity that higher capital gains tax rates are associated with reduced realizations prompts some analysts and many legislators to favor lower tax rates on capital gains than on other sources of income. If this empirical pattern is actually the product of anticipated future tax rate changes, then governments wishing to impose higher capital gains tax rates will find that higher tax rates generate fewer holding distortions and more tax revenue when accompanied by measures that reduce the likelihood of future tax rate changes. As a result, governments that are able credibly to commit to limiting future capital gains tax rate changes can raise greater tax revenue for a given economic cost than would be the case in the absence of such commitment.

Section 2 of the paper reviews the taxation of capital gains along with available estimates of the effect of capital gain taxation on asset sales and investment. Section 3 evaluates the effect of capital gains taxes on investment horizons, with implications for realization timing. Section 4 considers the implications of arbitrary investment order for measured responses to tax rate changes. Section 5 identifies circumstances in which higher capital gains tax rates discourage longer investments. Section 6 offers implications of the analysis, and section 7 is the conclusion.

2. Taxation of Capital Gains

The United States taxes most income upon accrual, while taxing capital gains only upon realization. Consequently, an investor is able to defer capital gains tax liabilities by not selling assets with accrued gains. When taxpayers sell capital assets, gains on investments in capital

assets held longer than a year are currently subject to preferential tax rates with a maximum of 23.8 percent. Realized losses on capital investments are deductible against realized gains, and up to $3,000 of net losses on capital investments can be deducted against ordinary income each year. Finally, the basis of a capital asset is automatically reset to market value at the death of the owner, thereby effectively eliminating liability for accrued capital gains held until death.

The unusual features of capital gains taxes in part manifest concessions to certain practical difficulties of valuing capital assets and imposing taxes on the basis of such valuations. In the absence of realization, it can be very difficult to know just how much a capital asset has appreciated; and some owners might have difficulty obtaining the liquidity necessary to pay taxes imposed on unrealized gains. Executors and devisees may not have access to the financial records necessary to establish the basis of assets held by a decedent until death, a problem obviated by resetting the basis. The basis of a capital asset is not adjusted for general price inflation, so many apparent gains on long-term investments simply represent inflation, and can arise even though an investment declines in real value. The reduced statutory tax rates on long-term gains are in part concessions to the inflationary component of gains, in part adjustments for the punishing effect of progressive tax rates with lumpy capital gains realizations, and in part efforts to encourage long-term investments. Thoughtful critics (e.g., Auerbach, 1989; Auten and Cordes, 1991; Zodrow, 1993; Burman, 1999) note that these tax rate concessions are costly from the standpoints of efficiency and equity, and that arguably superior alternative tax treatments are available.

It stands to reason that taxation upon realization might discourage realizations, a phenomenon known as the "lock-in effect." Holt and Shelton (1962) and Beazer (1966) model the extent to which the lock-in effect discourages assets sales. Stiglitz (1983) argues that investors have incentives to realize losses immediately and defer indefinitely realization of any gains, a strategy that if it can be costlessly and relentlessly pursued creates negative effective tax rates on new investments. Constantinides (1983) considers optimal investment strategies when investors are subject to random shocks that can force realizations, finding that investors again have incentives to realize losses as they occur and to defer realization of gains until forced to do so – though Constantinides (1984) notes that a sufficiently low tax rate on capital gains can encourage gain realizations that would enable investors to claim deductions against ordinary income for any subsequent investment losses. Significant capital gains earned by specific risky

investments can create incentives to realize gains in order to rebalance portfolios; these incentives considered by Kovenock and Rothschild (1987), Leland (1999), and Klein (2004). Lippman and McCall (1981) and Kovenock and Rothschild (1983) analyze the effect of capital gains taxes on incentives to liquidate appreciating investments, and Kamin and Oh (2019) call attention to the effect of tax rate uncertainty on incentives to realize gains.

There is ample evidence that realization-based capital gains taxation affects realizations, though there is controversy over the nature and magnitudes of tax effects. Early studies reported that higher capital gains tax rates were associated with reduced proclivities to sell appreciated shares of stock (Feldstein and Yitzhaki, 1978) and somewhat lower subsequent stock return performance due to incomplete portfolio rebalancing (Yitzhaki, 1979). Subsequent studies offer evidence of considerable realization tax sensitivity (Poterba, 1987; Auten, Burman, and Randolph, 1989; Bogart and Gentry, 1995; Landsman and Shackelford, 1995; Eichner and Sinai, 2000; Ivkovic, Poterba, and Weisbenner, 2005; Daunfeldt, Praski-Ståhlgren, and Rudholm, 2010; Dowd, McClelland, and Muthitacharoen, 2015; Dowd and McClelland, 2019; Agersnap and Zidar, 2021), including gain realizations made in anticipation of higher subsequent rates introduced by the Tax Reform Act of 1986 (Auerbach, 1988; Burman, Clausing, and O'Hare, 1994). Auten and Joulfaian (2001) note that estate taxes limit the extent of lock-in produced by basis step-up at death, and Auten and Clotfelter (1982) and Burman and Randolph (1994) offer evidence that transitory capital gains realization elasticities may be considerably larger than permanent elasticities, though Auerbach and Siegel (2000) challenge some aspects of this interpretation.

Lower capital gains tax rates have the potential to encourage capital investment and reduce inefficiencies associated with lock-in effects. Auerbach (1989), Kiefer (1990), Auten and Cordes (1991), Hendershott, Toder and Won (1991), Zodrow (1993), Mariger (1995), Burman (1999), Sahm (2008), Agersnap and Zidar (2021), and Sarin et al. (2022) review evidence of the effects of capital gains tax rates on allocative efficiency, government tax revenue, and the distribution of tax burdens, applying this evidence to consider the effects of potential capital gains tax reforms. Schizer (1998) argues that in the absence of government commitment to future tax rates, the taxation of capital gains only upon realization credibly limits investor tax burdens and thereby encourages capital investment; Coyne, Fabozzi and Yaari (1989) calculate effective tax rates on new investments. Auerbach (1991) and Auerbach and Bradford (1994)

analyze the features of alternative tax regimes that would tax capital investments on realization without affecting incentives to realize gains.

3. Capital Gains Taxes and Investment Horizons

The analysis in this section considers the effect of capital gains taxes on realizations when investments terminate. In order to evaluate the role played by returns to untaxed accumulation, it is useful to consider a setting in which tax rates and other features of the economic environment are unchanging. Investments earn known positive rates of return that are continuous (and continuously differentiable) functions of investment length, with realized gains subject to taxation at rate τ. An investment of \$1 held for a time interval t_i earns a cumulative pretax return $r(t_i)$, and an after-tax return $(1-\tau)r(t_i)$. If the investor discounts the investment proceeds by a factor $\beta(t_i)$, then the investor's objective in managing a \$1 investment is to maximize $\psi_i(\tau,t_i)=\beta(t_i)\left[1+(1-\tau)r(t_i)\right]$. Moreover, $r(t_i)$ is assumed to be increasing in t_i, and $\beta(t_i)$ decreasing in t_i.[1]

Investment programs commonly entail multiple rounds of investment, realization, and reinvestment. A program producing returns in period *T* might consist of *N* investment rounds with all funds reinvested, realizations occurring at intervals $t_1,t_2,...,t_N$, and $T=\sum t_i$. The investor's objective in managing a \$1 investment is to maximize the value of $\psi(\tau,\mathbf{t})$, with the vector $\mathbf{t}=(t_1,t_2,...,t_N)$ denoting investment intervals, and $\psi(\tau,\mathbf{t})$ given by

$$\psi(\tau,\mathbf{t})=\beta(T)\prod\left[1+(1-\tau)r(t_j)\right]. \tag{1}$$

Expression (1) imposes that investors pay taxes out of investment proceeds, so an investor does not add or extract resources over the life of an investment.

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[1] Furthermore, the analysis assumes that $\psi_i(\tau,t_i)$ is concave with respect to t_i, and its derivative with respect to t_i is positive for sufficiently small t_i and negative for sufficiently large t_i. This assumption is consistent with the behavior of an investor who would invest for a positive but finite interval because the investment exhibits a falling pre-tax rate of return.

In evaluating (1), it is useful to impose the reasonable condition that

(2) $$\beta(T) = \prod \beta(t_j),$$

as a result of which (1) can be rewritten as

(3) $$\psi(\tau, \mathbf{t}) = \prod \psi_i(\tau, t_i) = \prod \beta(t_i)\left[1 + (1-\tau) r(t_i)\right].$$

The formulation in (3) implies that a value-maximizing choice of $\mathbf{t}$ maximizes $\psi_i(\tau, t_i)$ for every interval t_i. Differentiating this function with respect to t_i yields

(4) $$\frac{\partial \psi_i(\tau, t_i)}{\partial t_i} = \beta'(t_i)\left[1 + (1-\tau) r(t_i)\right] + \beta(t_i)(1-\tau) r'(t_i).$$

The first-order condition for a value-maximizing choice of t_i is $\frac{\partial \psi_i(\tau, t_i)}{\partial t_i} = 0$, and the second-order condition is that $\frac{\partial \psi_i^2(\tau, t_i)}{\partial t_i^2} < 0$. Differentiating the first-order condition with respect to τ, and applying the implicit function theorem, yields

$$\frac{\partial^2 \psi_i(\tau, t_i)}{\partial t_i \partial \tau} + \frac{\partial^2 \psi_i(\tau, t_i)}{\partial t_i^2} \frac{dt_i}{d\tau} = 0,$$

from which it follows that

(5) $$\frac{\partial^2 \psi_i(\tau, t_i)}{\partial t_i^2} \frac{dt_i}{d\tau} - \beta'(t_i) r(t_i) - \beta(t_i) r'(t_i) = 0.$$

Rearranging and substituting in the first order condition yields

(6) $$\frac{dt_i}{d\tau} = \frac{\beta(t_i)}{\dfrac{\partial^2 \psi_i(\tau, t_i)}{\partial t_i^2}} \frac{r'(t_i)}{\left[1 + (1-\tau) r(t_i)\right]}.$$

Since every term on the right side of (6) is positive, except for $\frac{\partial^2 \psi(\tau, \mathbf{t})}{\partial t_i^2}$, which is negative, it follows that $\frac{dt_i}{d\tau} < 0$.

Equation (6) implies that higher capital gains tax rates are associated with reduced investment horizons, as T is the sum of the t_is, and every t_i declines. This is simply a reflection of the fact that higher tax rates depress after-tax marginal returns to investment length, and the second order condition guarantees that reduced marginal returns shorten investment lives. A shorter investment horizon requires an earlier terminal capital gains realization, which induces a positive association between capital gains taxes and realizations, something other than what the empirical literature reports.

4. Capital Gains Taxes and Investment Order

Capital gains taxes affect realizations both by shortening investment timelines and by influencing patterns of realization and reinvestment within investment programs of any given duration. There are circumstances in which investors have fixed horizons due to inflexible revenue needs from long-planned expenses occasioned by retirement, children entering college, and other major life transitions; furthermore, some venture capital funds, hedge funds, private equity firms, and other investment operations organize their business practices to deliver realized returns with fixed duration. And for any investment timeline, whether constrained or unconstrained, it is useful to analyze the considerations that influence how taxes influence realizations of one investment relative to another.

This section considers the effect on realizations of changing the duration of individual investments while keeping the total length of an investment program unchanged. Much of the intuition that higher capital gains tax rates are associated with reduced realizations comes from considering scenarios with unchanging investment horizons. It is informative to see how much of this intuition survives analysis of the model presented in section 3.

One of the important features of the composition of investments in expression (1) is that the value of $\psi(\tau, \mathbf{t})$ is unaffected by the order of investments. With unchanging investment opportunities, a 20-year program consisting of an investment for twelve years, with after-tax profits reinvested for five years, followed by a subsequent three-year investment, produces the same after-tax return as investing for three years, reinvesting the proceeds for five years, and

reinvesting these proceeds for twelve years. The returns from investing and reinvesting are multiplicative, and multiplication is commutative.

The significance of order invariance is that it is impossible to forecast whether changes to the relative desirability of longer-term investments will lead to earlier or later realizations. Consider, for example, a ten-year horizon over which an investor has one seven-year investment and one three-year investment. If a tax change encourages the investor to lengthen the horizon of the seven-year investment to eight years, along with shortening the horizon of the three-year investment to two, then whether this change corresponds to an earlier or later realization depends on whether the seven- or three-year investment comes first in the ten-year program. Since the investor is indifferent to investment order, there is no presumption that the longer investment interval precedes the shorter. If the seven year investment comes first, then lengthening it to eight years delays realization, whereas if the seven year investment comes second, then the lengthening to eight year entails accelerating the first realization to year two. A tax change that rewards longer relative to shorter investment intervals need not encourage later realizations; nor does it necessarily encourage earlier realizations.

A related ambiguity arises in evaluating the effect of investment length on the present values of amounts realized, which have obvious potential importance for government finances. Applying a government discount rate $\tilde{\beta}(t_i)$ to realizations in period t_i, and considering for clarity a program with just two investments, it follows that the present value of taxable realizations, denoted $R(\tau, t_1, t_2)$, is

$$R(\tau, t_1, t_2) = \tilde{\beta}(t_1) r(t_1) + \tilde{\beta}(T)\left[1 + (1-\tau) r(t_1)\right] r(t_2), \tag{7}$$

with $T = t_1 + t_2$. Delaying the first realization and hastening the second by the same amount affects the present value of realizations by

$$\frac{\partial R(\tau, t_1, t_2)}{\partial t_1} - \frac{\partial R(\tau, t_1, t_2)}{\partial t_2} = \tilde{\beta}'(t_1) r(t_1) + \tilde{\beta}(t_1) r'(t_1) + \tilde{\beta}(T)\left\{(1-\tau) r'(t_1) r(t_2) - r'(t_2)\left[1 + (1-\tau) r(t_1)\right]\right\}. \tag{8}$$

In evaluating (8), it is useful to note that the investor's first-order condition that (4) equals zero implies that

(9a) $$-\frac{\beta'(t_i)}{\beta(t_i)} = \frac{(1-\tau)r'(t_i)}{\left[1+(1-\tau)r(t_i)\right]}.$$

Differentiating (2) with respect to t_1 and t_2 produces

(9b) $$\frac{\beta'(t_1)}{\beta(t_1)} = \frac{\beta'(t_2)}{\beta(t_2)},$$

which together with (9a) implies[2] that

(9c) $$\frac{r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]} = \frac{r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]}.$$

Equations (8) and (9c), together with $\tilde{\beta}(T) = \tilde{\beta}(t_1)\tilde{\beta}(t_2)$, yield

(10) $$\frac{1}{r(t_1)\tilde{\beta}(t_1)}\left[\frac{\partial R(\tau,t_1,t_2)}{\partial t_1} - \frac{\partial R(\tau,t_1,t_2)}{\partial t_2}\right] = \frac{\tilde{\beta}'(t_1)}{\tilde{\beta}(t_1)} + \frac{r'(t_1)}{r(t_1)}\left[1-\tilde{\beta}(t_2)\right].$$

Again applying the investor's first-order condition that (4) equals zero, (10) becomes

(11) $$\frac{1}{r(t_1)\tilde{\beta}(t_1)}\left[\frac{\partial R(\tau,t_1,t_2)}{\partial t_1} - \frac{\partial R(\tau,t_1,t_2)}{\partial t_2}\right] = \frac{\tilde{\beta}'(t_1)}{\tilde{\beta}(t_1)} - \frac{\beta'(t_1)}{\beta(t_1)}\left[1+\frac{1}{(1-\tau)r(t_1)}\right]\left[1-\tilde{\beta}(t_2)\right].$$

Equation (11) expresses the effect of a longer first investment interval and shorter second investment interval on the present value of realizations as a function of discount rates. In the special case that government discount rates are the same as those used by investors, then (11) becomes

(12) $$\frac{-(1-\tau)}{\beta'(t_1)}\left[\frac{\partial R(\tau,t_1,t_2)}{\partial t_1} - \frac{\partial R(\tau,t_1,t_2)}{\partial t_2}\right] = 1-\beta(t_2)\left[1+(1-\tau)r(t_1)\right].$$

Equation (12) indicates that the sign of the effect of extending the first investment interval and shortening the second on the present value of capital gains tax realizations depends on whether $\beta(t_2)\left[1+(1-\tau)r(t_1)\right]$ is greater than or less than one. With rational investors

[2] Another noteworthy implication of (9b) is that the discount factor takes the form $\beta(t_i) = e^{-\delta t_i}$, with δ a constant rate of discount.

$\beta(t_1)\left[1+(1-\tau)r(t_1)\right]$ must be greater than or equal to one, so if $t_2 < t_1$, then $\beta'(t) < 0$ guarantees that $\frac{\partial R(\tau,t_1,t_2)}{\partial t_1} - \frac{\partial R(\tau,t_1,t_2)}{\partial t_2} < 0$: if the first investment period is longer than the second, then delaying the first realization and hastening the second reduces the present value of total capital gains realizations. This is the sense in which it is possible be certain that lengthening an already-long holding period reduces the present value of capital gains realizations – though it relies not only on the use of investor discount factors, but also on the assumption that the longer investment comes first.

What if the first investment is shorter than the second? If $t_1 < t_2$, then lengthening the longer holding period at the expense of the shorter requires a smaller t_1 and a larger t_2, and is associated with a reduced present value of capital gains realizations only if $\beta(t_2)\left[1+(1-\tau)r(t_1)\right] < 1$. This condition is most likely to be satisfied for very small values of t_1, becomes decreasingly likely as t_1 gets closer to t_2, and is impossible if t_1 is arbitrarily close to t_2. Furthermore, it depends on the magnitude of $r(t_1)$, with greater inframarginal returns making the condition much less likely to be satisfied. Consequently, if the shorter investment comes first, then lengthening the longer investment at the expense of the shorter has an uncertain effect on the present value of capital gains realizations.

The preceding analysis based on equation (12) uses investor discount factors to calculate present values. It is common practice to calculate tax effects on capital gains realizations using discount factors that decay far more rapidly. Empirical analysis of the effects of capital gains tax rate changes necessarily examine no more than medium-term reactions, given the decaying signal-to-noise ratios of behavioral responses over time. And governments in estimating the revenue consequences of legislated changes typically consider medium-run budget windows of five or ten years. To the extent that these considerations increase the magnitude of $\frac{\tilde{\beta}'(t_1)}{\tilde{\beta}(t_1)}$ relative to $\frac{\beta'(t_1)}{\beta(t_1)}$, then from (11) they increase the likelihood that $\frac{\partial R(\tau,t_1,t_2)}{\partial t_1} - \frac{\partial R(\tau,t_1,t_2)}{\partial t_2} < 0$,

in which case lengthening a longer investment period that comes second will increase the present value of capital gains realizations.

Equation (11) implies that tax changes that delay realizations of longer-term investments relative to realizations of shorter-term investments may increase or decrease present values of total realized amounts. This ambiguity is largely a product of the indeterminacy of investment order. Notably, this exercise holds constant the total length of the investment program, which from the analysis in section 3 is apt to decrease at higher tax rates, reducing the likelihood that higher tax rates are associated with delayed realizations. And there is a separate question of the extent to which higher tax rates in fact encourage investors to delay or avoid realizations of gains on investments held over long time periods.

5. Capital Gains Taxes and Investment Length

If it were the case that all investments earned unchanging net rates of return, then investors subject to capital gains taxes would never sell them prior to terminal dates, as doing so would needlessly trigger tax obligations that reduce accumulated values on which the investors would otherwise earn returns. It is revealing that that is often not what investors do. Net marginal investment returns commonly vary over the course of holding periods, ultimately declining to the point that it makes sense for investors to sell and subsequently reinvest the proceeds somewhere else. Since capital gains taxes discourage asset sales if net marginal returns are unchanging, it is natural to extrapolate this implication to conclude that higher capital gains tax rates encourage longer accumulations in settings with time-varying net marginal returns. The purpose of this section is to evaluate this inference, finding that its validity is sensitive to the tax treatment and magnitude of costs associated with lengthy accumulations.

Investors incur costs that depress net returns to investment, and these costs will typically vary with investment length. Investors must devote time and energy to identifying worthwhile investments of differing lengths, and may need to pay consultants, financial intermediaries, or other investment advisors to find opportunities with desired combinations of duration and return. Some of these investment costs are deductible against taxable capital gains, or take the form of reduced returns, which makes them implicitly deductible; whereas other costs are either not

deductible or are deducted against ordinary income. Denoting by $c(t_i)$ the nondeductible (against capital gains) cost associated with an investment of length t_i, it is reasonable to expect that $c'(t_i) \geq 0$. Taking deductible costs to be incorporated into the net return $r(t_i)$, it follows that a commitment of \$1 invested for a length of time t_i produces realized after-tax value $\left[1-c(t_i)\right]\left[1+(1-\tau)r(t_i)\right]$.

For any given time horizon *T*, and again restricting attention to a program with just two investments, an investor chooses t_1 to maximize terminal value $\bar{\psi}(\tau, t_1, T)$, given by

$$\bar{\psi}(\tau, t_1, T) = \left[1-c(t_1)\right]\left[1+(1-\tau)r(t_1)\right]\left[1-c(t_2)\right]\left[1+(1-\tau)r(t_2)\right], \tag{13}$$

with $t_2 = T - t_1$. The first-order condition for value maximization is

$$\frac{\partial \bar{\psi}(\tau, t_1, T)}{\partial t_1} = \frac{(1-\tau)r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]} - \frac{c'(t_1)}{\left[1-c(t_1)\right]} - \frac{(1-\tau)r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]} + \frac{c'(t_2)}{\left[1-c(t_2)\right]} = 0, \tag{14}$$

and the second-order condition is $\frac{\partial^2 \bar{\psi}(\tau, t_1, T)}{\partial t_1^2} < 0$. Differentiating (14) with respect to τ, and applying the implicit function theorem, yields

$$\frac{\partial^2 \bar{\psi}(\tau, t_1, T)}{\partial t_1 \partial \tau} + \frac{\partial^2 \bar{\psi}(\tau, t_1, T)}{\partial t_1^2}\frac{dt_1}{d\tau} = 0,$$

from which it follows that

$$\frac{dt_1}{d\tau} = \frac{-1}{\dfrac{\partial^2 \bar{\psi}(\tau, t_1, T)}{\partial t_1^2}} \left\{ \frac{r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]^2} - \frac{r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]^2} \right\}. \tag{15}$$

Equation (15) identifies conditions influencing the effect of capital gains tax rates on investment holding periods. The first implication of (15) is that if nondeductible costs are unimportant, then higher capital gains tax rates increase the duration of longer investments at the expense of shorter investments. This is apparent from (14), which implies that in the absence of

important nondeductible costs, $\frac{(1-\tau)r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]} \approx \frac{(1-\tau)r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]}$. If t_1 is the longer of the two investment periods, then it follows that the term in braces on the right side of (15) is positive, which implies that $\frac{dt_1}{d\tau} > 0$, so a higher tax rate extends the longer of the two investment periods at the expense of the shorter. This is the intuitive response pattern.

The second implication of (15) is that there is a range of circumstances in which $\frac{dt_1}{d\tau} < 0$ when $t_1 > t_2$, in which case a higher capital gains tax rate reduces the longer of the two holding periods. Clearly this requires that there be significant nondeductible investment costs; and importantly, it requires that $\frac{c'(t_1)}{\left[1-c(t_1)\right]}$ significantly exceed $\frac{c'(t_2)}{\left[1-c(t_2)\right]}$, with (from (14)) implications for the difference between $\frac{r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]}$ and $\frac{r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]}$. If t_1 is a value-maximizing choice, then a high value of $\frac{c'(t_1)}{\left[1-c(t_1)\right]}$ requires a correspondingly high value of $\frac{r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]}$. It is possible for $\frac{c'(t_1)}{\left[1-c(t_1)\right]}$ to be so much greater than $\frac{c'(t_2)}{\left[1-c(t_2)\right]}$ that $\frac{r'(t_1)}{\left[1+(1-\tau)r(t_1)\right]^2}$ exceeds $\frac{r'(t_2)}{\left[1+(1-\tau)r(t_2)\right]^2}$, making the right side of (15) negative, and implying that higher capital gains tax rates reduce longer holding periods.

How can it be that higher capital gains tax rates reduce lengthy holding periods in favor of shorter ones? This possibility arises if costs that are nondeductible against capital gains taxes rise so rapidly with investment length that the taxable marginal product of the longer-term investment exceeds the corresponding taxable marginal product of the shorter-term investment. Important categories of costs that investors face, including the time, energy, and anxiety associated with finding places to park investment funds over long durations, may well have this

feature.[3] And even if nondeductible costs are not of sufficient magnitude to encourage investors to avoid longer-term investments at higher capital gains tax rates, they will generally reduce the magnitude tax effects on investment length, with resulting implications for realizations.

6. Implications

The time value of money alone appears to produce few if any incentives for investors to respond to higher capital gains tax rates by reducing capital gains realizations. Higher capital gains tax rates discourage longer investments, thereby incentivizing earlier realizations; the arbitrariness of investment order means that tax-induced longer investments need not be associated with later realizations; and important nondeductible investment costs can make investors prefer shorter accumulations at higher tax rates. Taken together, these factors make it unlikely that higher capital gains tax rates will be strongly associated with reduced realizations.

The empirical literature offers a different conclusion, consistently reporting that capital gains realizations decline significantly at higher tax rates. Reconciling these empirical findings with the implications of a model with simple and rather stylized features requires adding considerations, prominent among them the possibility of anticipated tax rate changes. Investors who expect lower future capital gains tax rates have incentives to delay realizations, particularly if current rates are high; and they have the opposite incentives if tax rates are low and expected to rise in the future. Many taxpayers can reasonably anticipate reduced future capital gains tax rates, as incomes, and therefore marginal tax rates, tend to decline at older ages; and capital gains taxes are forgiven on assets held until death. As a result, high tax rates today encourage at least some investors to delay realizations in anticipation of lower tax rates available in the future.

Capital gains tax rates will change because an investor's situation changes or the legislature enacts statutory changes in tax parameters. Long-run mean reversion in legislated tax rates makes low tax rates today apt to be followed by higher tax rates in the future, and high tax rates today followed by lower rates in the future. This dynamic gives taxpayers incentives to

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[3] In this context it is noteworthy that, in the United States, the 2017 tax act rendered investment expenses incurred outside of a trade or business to be non-deductible. Examples include expenses paid to investment advisory services, banks, and other professionals. These expenses were deductible under IRC §212 prior to 2018, with the §1.212 regulations generally permitting these expenses to be deducted against ordinary income.

delay realizations when rates are high and accelerate realizations when rates are low. One consequence is that it can be difficult for governments to collect significantly greater tax revenue with higher capital gains tax rates; whereas lower capital gains tax rates spread considerable joy among capital-owning taxpayers while generating relatively modest tax revenue reductions.

Governments eager to collect greater revenue from capital gains taxes may find that an effective strategy is to accompany higher capital gains tax rates with credible commitments not to reduce tax rates in the future. Given the difficulty of committing future governments, this is easier said than done. Legislative changes such as replacing the current treatment of capital gains at death with an alternative that does not entail a much lower tax rate on accrued gains would remove an obvious incentive to avoid lifetime realizations, particularly if taxpayers have reason to believe that such a change would not be reversed by a subsequent government. Another possibility is to adopt a dual income tax system based on the Nordic model (e.g., Sørensen, 2007) that combines a flat tax rate on all capital income, including capital gains, with a highly progressive tax schedule for all other income. The flat tax rate on capital income does not vary – and therefore does not decline – with changes in individual circumstances, provided that taxpayers are entitled to carry any excess capital losses back against taxable capital income in prior years or forward against future capital income. Any measures designed to encourage realizations must, however, confront the reality that taxpayer expectations include the possibility that subsequent governments might adopt very different legislation.

7. Conclusion

The taxation of capital gains on realization rather than accrual affects incentives to invest and incentives to realize subsequent investment gains, but not necessarily in the way that these incentives are commonly understood. In the absence of expected future tax rate changes, higher tax rates might encourage or discourage delayed realizations, since it is possible for earlier realizations to deliver greater investment value. As a result, there are broad ranges of circumstances in which higher capital gains tax rates will be associated with earlier realizations of greater aggregate present value. The extensive empirical evidence that higher capital gains tax rates discourage realizations therefore likely represents a mixture of the effects of transitory and permanent effects of tax changes, with investor expectations of future tax changes playing an

important role in determining their behavior. The absence of strong directional implications in simple models suggests that the behavioral effects of potential capital gains tax reforms may depend critically on how the reforms influence investor expectations of future tax rates.

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