The Effects of Capital Gains Rate Uncertainty on Realization

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The tax rates on capital gains have varied widely in recent years, ranging between 15 percent and nearly 30 percent in the years since 1980. Taxpayers should expect rates to vary in the years ahead both in light of that history and the differing tax rate preferences among coalitions likely to control legislative veto-gates over time. The expected variance in tax rates can have significant effects on the behavior of asset holders, sometimes incentivizing them to defer realization of gain and other times causing them to accelerate such realization. This paper is the first to model the effect of such tax rate uncertainty on the realization incentives of asset holders. It finds the effects of uncertainty on incentives to be potentially large. As the capital gains rate rises to the upper end of the likely distribution of rates, this produces significant incentive to defer until rates fall. When capital gains rates are near the bottom end of the distribution, rate uncertainty may cause taxpayers to accelerate gains and forego the advantage of deferral. There are several implications of such analysis. First, rate uncertainty, if substantial enough, may alleviate the lock-in effect of the realization rule when rates are low, and do the opposite when rates are high. Second, as a descriptive matter, estimates of the elasticity of capital gains realizations should be sensitive to this effect, and this means that there could be significant inaccuracies extrapolating the elasticity of capital gains realizations at one rate to another. Third, as a normative matter, this analysis highlights in a new way the challenges of taxing gains subject to a realization rule and suggests that some policy solutions for addressing distortions created by that rule while still retaining it—such as imposing deferral charges—may not work as well as expected.

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I. Introduction

Behavior in response to tax rates can be affected not only by the tax rates now in place but expectations as to what those tax rates might be in the future. This article focuses on a particular type of behavior that may be sensitive to future rate uncertainty: the decision to realize gains or losses on property.

In the United States, as in many other countries, the realization rule applies to property transactions—gains or losses on property are only includible in income when those gains or losses have been realized, as opposed to when they accrue. This gives taxpayers a significant degree of control over when they include gains or losses in their income.

The realization rule has spawned an extensive literature. This includes on the "lock-in" effect—how people will tend to defer gain to reduce the value of their tax liability in net present value and to take advantage of step up in basis at death (e.g., Landsman and Shackelford, 1995). Scholars have noted the inefficiency that can result due to this incentive (e.g., Hendershott, Toder, and Won, 1991). Another strain of the literature has examined the sensitivity of realization behavior to changes in the tax rate (e.g., Dowd, McClelland, and Muthitacharoen, 2015).

This article is the first to examine the possible effects of capital gains rate uncertainty on realization behavior. Capital gains rates have varied significantly; since 1980, they have ranged between 15 percent and nearly 30 percent. Currently, the top federal capital gains rate stands at about 25 percent—taking into account the effect of all relevant provisions—and there are active efforts by the now-Republican majority to cut the rate, even as Democrats have proposed rate increases. Others in the academic literature have previously noted that capital gains tax rate uncertainty could affect realization behavior (e.g., Auerbach, 1988, 605), and the popular media has reported times at which people were either accelerating or deferring gains in response to possible imminent changes in tax rates, including most recently in 2017 as Congress considered a variety of tax measures (Ehrenfreund and Paletta, 2017). But, the magnitude of the effect and its possible implications have never been fully analyzed.

We find that capital gains rate uncertainty can create significant financial incentives to change the timing of realization. For instance, as tax rate rise to the upper end of the likely distribution of such rates, this produces significant incentive to defer until rates fall. By waiting to sell assets, taxpayers are not only getting the time value of deferring gains but also playing a favorable lottery for lower rates. At the top of the rate distribution, uncertainty and time-value considerations push in the same direction—towards deferring realization.

When capital gains rates are near the bottom end of the distribution, rate uncertainty may cause taxpayers to accelerate gains and forego the advantage of deferral. Rate uncertainty and the time value effect point in opposite directions. The relative magnitude of these effects depends on a number of factors, including the investment time horizon, the degree of risk aversion, and the likelihood of future rate changes.

These findings have a number of implications.

First, as a descriptive matter, this suggests that the effect of the realization rule on taxpayer behavior is more complicated than previously understood. At high rates, this tends to aggravate the "lock in" effect. However, at low rates, it works in the opposite direction to reduce the distortions of the realization rule and, in fact, potentially generate a different distortion—that of selling the asset earlier than an investor otherwise would absent the effect of taxes.

Second, this raises concerns about current methods for extrapolating the sensitivity of capital gains realizations to changes in the tax rate at a given level. Elasticities measured at one rate level may not extrapolate to another rate level without taking into account the effects of future tax rate uncertainty—which calculations so far have not done. In our models of rational investors who incorporate rate uncertainty into their decision-making, we find that the elasticity of capital gain realizations may vary substantially across the rate distribution—with the greatest elasticity in the middle of the rate distribution and lower elasticity towards either end of the rate distribution. The intuition is that the middle of the rate distribution represents a "tipping point," where the influence of deferral and rate uncertainty are closest to equipoise. At the top and the bottom of the rate distribution, small rate changes do not have as large an effect on the decision to realize gains.

Third, this has implications for policies aimed at addressing the distortions created by the realization rule. Two broad families of reforms have been proposed to try to alleviate these distortions: (1) taxing gains regularly and at current rates—thus, not allowing a choice of tax rates—using a form of mark-to-market system (e.g, Glogower, 2016; Miller, 2008); (2) taxing gains only at realization and using tax rates at that time, but using systems that reduce or eliminate the time value of money benefit from deferring gains (e.g., Shakow, 1986, 1223). Importantly, only the first family of reforms would also reduce the distortions generated by rate uncertainty. The second family would not, since the tax rate would still be based on that at the time of realization. There may still be other reasons, such as administrative ease, to pursue the second family of reforms, but this is an important factor to consider.

Finally, some of the insights on the possible role of tax rate uncertainty apply to other areas. The basic dynamic described here is relevant anytime people or entities have the ability to adjust behavior so as to adjust the year and rate at which taxation occurs. For instance, the recent build-up in unrepatriated corporate profits overseas reflects this basic dynamic as corporations wait for an expected lower tax rate at which to subject those gains to taxation.

II. Capital Gains Rate Uncertainty

A. Realization and Rate Uncertainty

The "realization" rule—the rule that gains on property are not subject to tax until a gain is realized—"is the foundational timing rule of our tax system," and it has been in place from the beginning of the income tax (Schizer, 1998, 1551). The rule gives discretion to property owners as to when to pay tax on accrued gains since taxation only occurs upon realization, often in a sale of the property.

The tax rates that apply to these property transactions have varied over time. Most gains on property transactions are subject to preferential capital gains rates that apply to "capital assets" held over one year. The top effective capital gains rate on most long-term gains now stands at roughly 25 percent. This includes the regular capital gains income tax rate of 20 percent, the 3.8 percent surtax on unearned income added in the Affordable Care Act, and the effect of the income-based limitation on itemized deductions. Since 1980, that rate has ranged from a low of about 15 percent in the wake of the 2003 tax cuts to a high of just over 29 percent from 1993 to 1996, combining both the statutory capital gains rate and the effect of the income-based limitation on itemized deductions.

In the period since 1980, there have been a total of ten changes to the effective capital gains rate (including both the statutory rate and the effect of other provisions) exceeding a shift of 0.1 percentage point—or a change in the rate more than once every four years. The table below shows the distribution. Five of those changes were less than 1 percentage point (ranging between 0.2 and 0.9 percentage points) and due to the effects of the income-based limitation on itemized deductions that effectively imposes an additional tax on capital gains and other types of income. Five of those changes were five percentage points or larger and reflect a combination of changes in the statutory capital gains rate, introduction of a surtax on unearned income in 2013, and the limitation on itemized deductions (Department of the Treasury, 2016).

Table 1: Distribution of Capital Gains Rate Changes Since 1980

% Change (+/-)	Number of Changes	Year of Change and Direction
0-1%	5	1991 (+), 1993 (+), 2006 (-), 2006 (-), 2008 (-), 2010 (-)
5%	1	2003 (-)
8%	3	1981 (-), 1987 (+), 1997 (-)
10%	1	2013 (+)
Total	10	

Source: Authors' calculations based on historical data from the Department of Treasury.

This article explores how the combination of the realization rule and rate uncertainty can generate significant distortions in realization behavior—sometimes causing property holders to dispose of property earlier than they otherwise would and sometimes the opposite.

B. Literature on Rate Uncertainty

There is an extensive literature on overall economic policy uncertainty and economic effects (e.g., Baker, Bloom, and Davis, 2016), as well as the specific role of tax uncertainty (Oh and

Tausanovitch, 2016). The literature on tax uncertainty has largely considered how tax rate uncertainty might affect saving, investment, and production (e.g., Hassett and Metcalf, 1999; Zangari, Caiumi, and Hemmelgarn, 2017). There has, as yet, not been a thorough consideration of the effects of tax rate uncertainty on realization behavior and how the incentives interact with the better-studied effects from time value of money and step-up in basis at death.

The possible effects of tax rate uncertainty on realization behavior have not gone unnoticed, but without thorough consideration of the potential magnitude and direction of the effects. In discussing the effects of tax rate uncertainty on capital gains realizations, Alan Auerbach wrote "one would expect the degree of uncertainty about such tax rates to matter…since holding a capital gain is like buying an option based on future tax rates," (Auerbach, 1988, 605), but, in that study, Auerbach couldn't test the effects of uncertainty on realization behavior, even as he explored other effects of taxation on realization. Others too have noted the effects of uncertainty on behaviors similar to realizing capital gains. For instance, in the context of U.S. corporations repatriating foreign earnings, scholars have noted how deferring the income essentially provides a real option, with the value of that option "increasing in the uncertainty associated with future tax rate changes and future profitability" [(Dyreng, Markle, and Medrano, 2016)]; the authors though do not try to quantify the value of that option.

This article builds off this prior literature as the first to try to quantify the magnitude of financial incentives created by capital gains tax rate uncertainty and the possible effects on capital gains realizations.

III. Quantifying Effects of Rate Uncertainty

A. Simplified Two-Period Framework

Rate uncertainty affects the decision whether to realize a gain presently or not as it can generate a financial incentive to either defer the gain or realize it. This basic intuition can be illustrated with a stylized example.

In a two-period world, a taxpayer is deciding whether to hold or sell an asset with a built-in gain in the first year In the second year, the taxpayer will sell the asset in any case. The asset is worth $100 at the beginning of the first year and, as is approximately the case on average in the United States, unrealized gains are equal to 25 percent of the total value. Further assume that capital gains tax rates can range from 15 percent to 28 percent—the range of the last forty years in the statutory capital gains rate, and that the rate in the first year and the rate in the second year are independent.[1] Finally, assume that this and other assets make a 5 percent rate of return and that there is no risk aversion. A number of these assumptions will be varied in later modeling.

The incentive effects in that case are relatively intuitive. The expected value of the tax rate in the second year is halfway in between the low and high rates of 15 and 28, or 21.5 percent. Thus, rate uncertainty will tend to push toward selling in the first year if the rate is below the

[1] Irrespective of the rate in the first year, there is an equal chance of the rate being any rate from 15 to 28 percent.

21.5 percent and will tend to push toward holding if the rate is above that. There is then also the time value of money benefit of deferring gain, which would tend to push toward holding.

In that case, the decision whether to hold or sell the asset in the first year is described by the following equation. The asset should be sold for an investment in an alternative asset under the following condition:

$$E[v(1+r_c)(1-t_2)+bt_2]<E[(v(1-t_1)+bt_1)(1+r_a-r_a t_2)]$$

v=FMV of the asset; r_c= return on current asset; t_1=tax rate in the first period; t_2=tax rate in the second period; r_a= pretax return on alternative asset; b=basis.

The taxpayer calculates the expected value of holding and selling over all of the possible second-period tax rates. Table 2 illustrates.

The rightmost column in the table shows whether a taxpayer would sell or hold assuming the alternative asset that the taxpayer could purchase pays the same rate of return as the initial one being held. At low rates, there is a tax incentive to sell the current asset, and, at high rates, a tax incentive to hold the asset rather than sell. The dividing line is between the tax rates of 20 and 21 percent.

The second column from the right further shows the source and magnitude of the distortion. It does this by calculating the return premium that must be offered by an alternative asset for the taxpayer to be indifferent between holding the current asset and selling in favor of the alternative asset. In a world without tax (or at least a tax regime using mark-to-market rather than the realization rule), taxpayers would sell and invest in an alternative asset if that alternative offered a higher rate of return. That is not the case once tax incentives are considered, and this column shows us how distorted taxpayer behavior is at various tax rates.

For instance, at a 28 percent rate, the alternative asset would have to pay a rate of return that is 2.60 percentage points higher than the current asset (assumed to be paying a 5 percent rate of return) for the taxpayer to be indifferent between selling and buying. At low tax rates, the effect works in the opposite direction, and the alternative asset would have to pay a lower rate of return than the current one for the taxpayer to be indifferent. (This assumes that the taxpayer could not simply sell the current asset and repurchase it; thus, the assumption is that, if the taxpayer sells, then he is limited to the alternative asset.)

This reflects the combined effect of uncertainty and the time value of money. The table roughly decomposes the magnitude of the two effects. It does this by calculating the same rate premium under two different assumptions: The first assumption is that there is no time value of money benefit from deferring a tax liability (with the government essentially imposing an interest charge on the deferred tax liability), but that there is still rate uncertainty. The second assumption is that there is no rate uncertainty and that rates will be unchanged in the second year, but that there is the time value of money benefit from deferring gain. The decomposition is rough since the two effects interact to a modest degree.

Table 2: Rate Premium (Alternative Versus Current Asset) Required for Taxpayer to Be Indifferent Between Selling and Holding				
	Rate Premium			Sell or Hold If No Rate Premium
Initial Tax Rate	Effect of Rate Uncertainty Alone	Effect of Time Value of Money Alone	Combined Effect	
15	-2.24%	0.19%	-1.96%	Sell
16	-1.90%	0.21%	-1.62%	Sell
17	-1.56%	0.22%	-1.27%	Sell
18	-1.21%	0.24%	-0.93%	Sell
19	-0.87%	0.25%	-0.59%	Sell
20	-0.52%	0.26%	-0.24%	Sell
21	-0.17%	0.28%	0.11%	Hold
22	0.18%	0.29%	0.46%	Hold
23	0.53%	0.31%	0.81%	Hold
24	0.88%	0.32%	1.17%	Hold
25	1.24%	0.33%	1.52%	Hold
26	1.59%	0.35%	1.88%	Hold
27	1.95%	0.36%	2.24%	Hold
28	2.31%	0.38%	2.60%	Hold

As expected, at the lowest rates, rate uncertainty generates a penalty for holding—and an alternative asset could in fact pay a lower rate of return on a pre-tax basis and the taxpayer would still switch assets. That penalty is offset to some degree by the time value of money benefit from holding for another year (and deferring the tax on the gain by a year), but, at the lowest rates, the effects of rate uncertainty outweigh considerably. This generates the incentive to sell. Rate uncertainty and the time-value of deferring are in tension at the bottom of the rate distribution.

At higher rates, both the time-value of money and rate uncertainty work in the same direction. Rate uncertainty reinforces the time-value considerations at the top of the rate distribution. By waiting, the taxpayer defers the recognition of gain and is likely to face a lower tax rate when he sells in the second year.

This simple framework is of course highly stylized. The point is to show how rate uncertainty can generate significant financial incentives and large ones relative to the traditional time value of money benefit from deferring gain. This means that the distortions created by the realization rule can depend significantly on where the current tax rate falls within the distribution of future rates.

B. Expanding the Model

In the toy example, it appears that uncertainty is more important than time-value of money when determining the distortions created by the realization rule. However, the toy model makes two assumptions that overemphasize the effect of uncertainty relative to the effect of time-value of money. There is substantial rate uncertainty (i.e., there is no status quo bias) and there is only a one-year time horizon.

The two-period model can be expanded to begin to illustrate the effects of rate uncertainty more realistically. Below, we further build out the model considering rate inertia, heterogeneous time horizons, the ability to foresee rate changes, risk aversion, and heterogeneous asset returns and built-in-gain.

1. Rate Inertia

The model can be made more realistic by better reflecting the inertia in tax rates from year-to-year. As described earlier, the effective capital gains rate has stayed the same in 72 percent of years since 1980. Further, in the 28 percent of years with a rate change, there was variation in size with five changes to the top capital gains rate of between 0-1%, one change of 5%, three changes of 8%, and one change of 10%. Looking forward, we can use these transition probabilities to estimate the effect of rate inertia on realization. This iteration of the toy model assumes a 72 percent chance of the rate staying the same, and, if there is a rate change, then drawing from the distribution described above consistent with the rate changes since 1980.[2]

Table 3 below shows the penalty or benefit from holding for an additional year under these assumptions. In that case, the effects of rate uncertainty are still significant relative to the effects of time value of money, but are much smaller than in the previous stylized example. The asset holder then has an incentive to sell if the rate in the first period is between 15 and 19 percent, and hold if the rate is 20 percent or higher.

This can be compared with Table 2. The time value of money is unaffected by the change in future rate uncertainty. But, the effects from rate uncertainty are much smaller in Table 3 than Table 2. Status quo bias substantially reduces the expected penalty of future rate uncertainty when rates are low and reduces the expected benefit of future rate uncertainty when rates are high. Deferral becomes a relatively more important consideration when rates are sticky.[3]

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[2] Upward and downward changes in rates are equally likely unless the change would take the capital gains rate outside of the range of possible rates. If the change would take the rate outside of the range then the rate change only occurs in one direction.

[3] This makes intuitive sense. As the status quo bias gets larger (as rates are stickier), the detriment or benefit due to rate uncertainty becomes smaller and smaller. In the limit where there

Table 3: Rate Premium (Alternative Versus Current Asset) Required for Taxpayer to Be Indifferent Between Selling and Holding with Rate Inertia				
	Rate Premium			Sell or Hold If No Rate Premium
Initial Tax Rate	Effect of Rate Uncertainty Alone	Effect of Time Value of Money Alone	Combined Effect	
15	-0.37%	0.19%	-0.18%	Sell
16	-0.34%	0.21%	-0.13%	Sell
17	-0.34%	0.22%	-0.12%	Sell
18	-0.35%	0.24%	-0.11%	Sell
19	-0.28%	0.25%	-0.03%	Sell
20	-0.23%	0.26%	0.03%	Hold
21	-0.01%	0.28%	0.26%	Hold
22	0.02%	0.29%	0.31%	Hold
23	0.25%	0.31%	0.55%	Hold
24	0.31%	0.32%	0.63%	Hold
25	0.38%	0.33%	0.72%	Hold
26	0.39%	0.35%	0.74%	Hold
27	0.40%	0.36%	0.76%	Hold
28	0.45%	0.38%	0.83%	Hold

is no rate uncertainty at all, there would be no detriment or benefit due to rate uncertainty, and the taxpayer would always defer in the toy model.

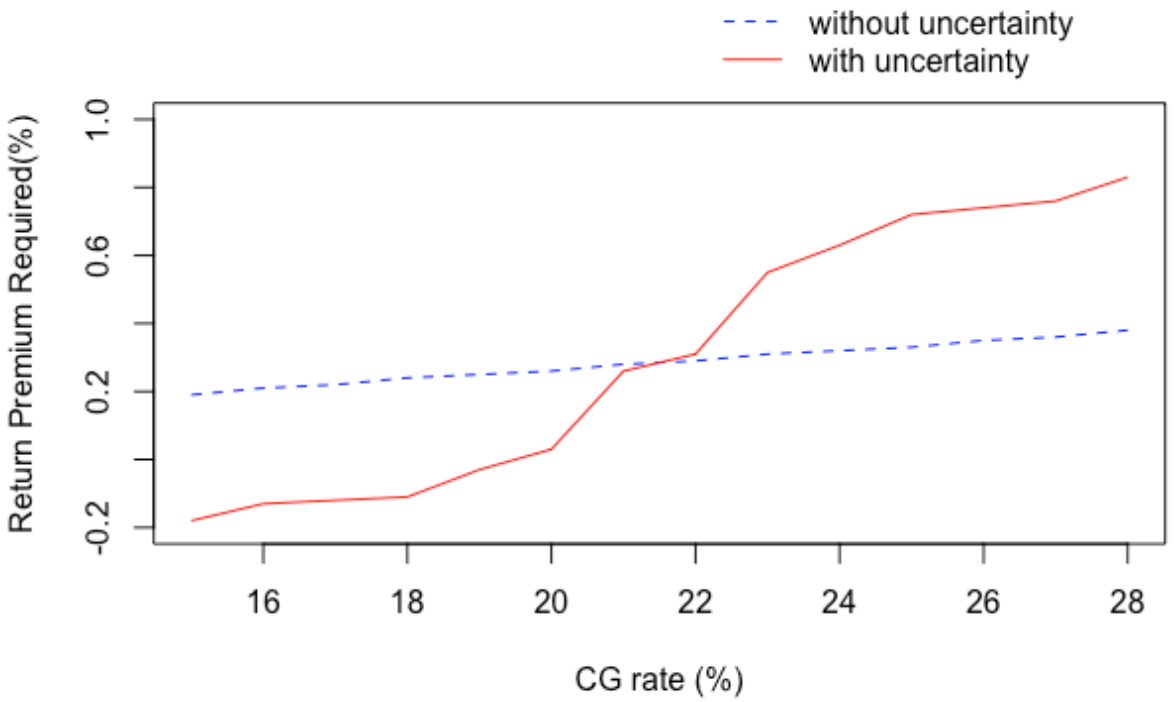

Figure 1: Return Required for Taxpayer to Sell with Rate Inertia

Figure 1 provides an alternative way to visualize the effect of rate uncertainty on realization. The blue-dotted line shows the rate premium required for the taxpayer to sell the asset if tax rates are fixed. This line is relatively flat. The rate premium required rises modestly as the capital gains rate increases. The solid-red line shows the rate premium required if there is rate uncertainty. This curve has a more dramatic shape. The effect of rate uncertainty varies as one moves along the rate distribution.

The return premium required for taxpayers to sell is a reasonable proxy for the distortion created by the realization rule. As in Table 2, rate uncertainty generally reduces that distortion at low capital gains rates, as it offsets the deferral incentive created by the time value of money. In fact, at tax rates ranging from 15% to 19%, the combined effect generates a small distortion by encouraging taxpayers to sell assets even if the alternative would pay a slightly lower rate of return.

When rates are high, the effects of rate uncertainty magnify the distortion created by the time-value-of-money benefit from deferring gain. If the capital gains rate is 28%, the taxpayer requires a return premium of 0.83% in order to trigger the gain and switch investments. However, rate inertia does reduce the effect of rate uncertainty. With rate inertia (Table 3), the taxpayer requires a return premium of 0.83% to sell. Without rate inertia (Table 2), the taxpayer requires a return premium of 2.6%. Rate inertia reduces the value of playing the rate lottery in hopes of a lower capital gains rate in the next year.

2. Longer Time Horizons

The results are sensitive to the time horizon involved. The longer is the time horizon, the greater is the incentive to hold an asset as a result of the uncertainty of tax rates. The basic intuition is that it becomes more probable that there will be an intervening year in which the tax rate will be lower or at least equal to the current one that applies, and the asset holder will have the option of selling in that low-rate year. The effect of uncertainty then tends to strengthen lock in—adding to the already existing incentive to hold assets due to the ability to defer tax liability.

Here, we explore the effects of several different time horizons: one year (analyzed in the prior examples), four years, and twenty years. The concept of the "time horizon" is stylized. It is supposed to represent the point at which the investment will be liquidated, whether for consumption or other purposes. For the most part, people's time horizons will not end in this cliff-like way, and the factors defining the time horizon will vary, from retirement to other needs for liquidity to no longer wanting to be an active manager of a given asset (i.e. owner of a business). In Section 3, we make more realistic assumptions by calculating the aggregate effect on taxpayer behavior by assuming a heterogeneous population of taxpayers with different levels of built-in-gain and diverse investment horizons.

The model, as before, assumes that there is rate inertia. With a multi-year model, the decision-making framework grows more complicated. The value of holding depends on expected decisions in future years as to whether to hold or sell.

Consider the three-period problem in which the taxpayer must make two decisions, whether to hold or sell at the beginning of the first year and the second year. In each year the taxpayer faces uncertain future capital gains rates. We solve for the taxpayer's decisions by starting with the decisions in year two. These decisions are identical to the two-period model discussed earlier. We can solve for the taxpayer's decisions in year two based on the expected distribution of year-three rates when the taxpayer has to sell and recognize any remaining gain. This in turn allows us to solve for the taxpayer's year-two expected utility conditional on the year-two capital gains rate.

The year-two expected utilities allow us to solve for the taxpayer's decisions in the first year. This is because the year-one decisions depend on the year-one rate, the expected distribution of year-two rates, and the expected utility conditional on that distribution.

This same approach can be used for longer time horizons. If the investment horizon is n-periods, we start with the decisions and expected utilities in period n. We then solve for the decisions and expected utilities in period n-1. In turn, these can be used to solve for the decisions and expected utilities in period n-2 until we reach the first period. By working backwards, we can solve for the hold-sell decisions of taxpayers facing rate uncertainty over several periods.

As the investment horizon gets longer, the deferral advantage increases. At the same time, the effect of uncertainty also shifts. There is a higher possibility of the taxpayer enjoying a very low capital gains rate at some point before they are forced to sell the asset. One way to see the interaction of these two effects is to focus on the return premium required for taxpayers to trigger

gain in their assets and switch to an alternative asset. Table 4 provides the return premium required for taxpayers with various investments horizons. Figure 2a and Figure 2b plot the return premium required for a 4-year and 2-year investment horizon respectively.

Table 4: Return Premium Required to Sell, Longer Investment Horizons

	4-year Horizon		20-year Horizon	
Year 1 Capital Gains Rate	Without Uncertainty	With Uncertainty	Without Uncertainty	With Uncertainty
15	0.19%	0.02%	0.13%	0.11%
16	0.20%	0.06%	0.14%	0.12%
17	0.21%	0.08%	0.15%	0.14%
18	0.22%	0.09%	0.16%	0.15%
19	0.24%	0.12%	0.17%	0.17%
20	0.25%	0.17%	0.17%	0.19%
21	0.26%	0.30%	0.18%	0.22%
22	0.27%	0.35%	0.19%	0.25%
23	0.29%	0.52%	0.20%	0.31%
24	0.30%	0.59%	0.21%	0.33%
25	0.31%	0.66%	0.22%	0.36%
26	0.33%	0.68%	0.23%	0.36%
27	0.34%	0.70%	0.24%	0.37%
28	0.35%	0.74%	0.25%	0.38%

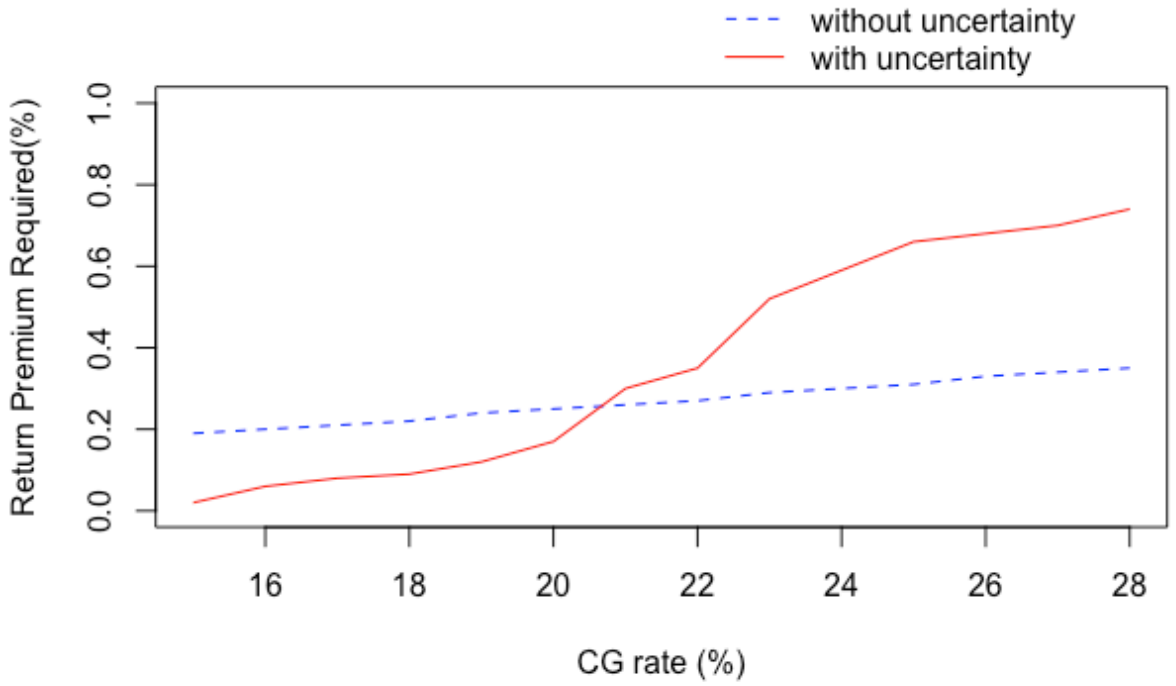

Figure 2a: 4-Year Investment Horizon – Return Required to Sell

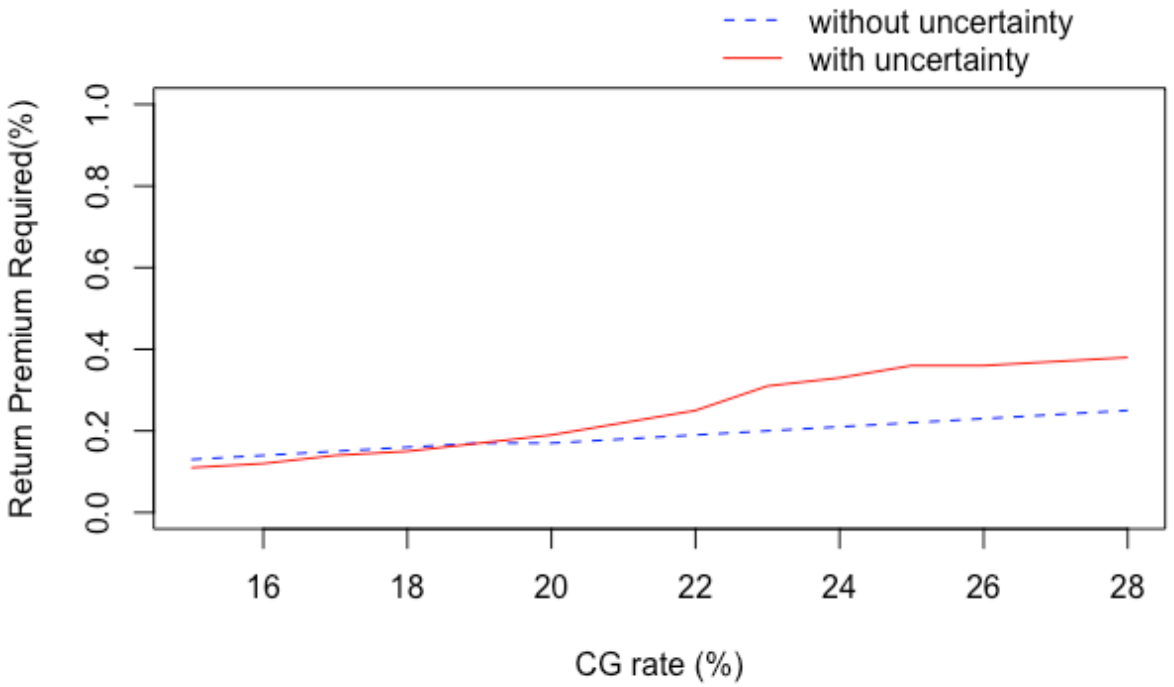

Figure 2b: 20-Year Investment Horizon – Return Required to Sell

Lengthening the investment horizon has two effects. First, at low capital gains rates, it increases the rate of return required on the alternative asset required for the taxpayer to realize the gain. If the current capital gains rate is 15%, a taxpayer with a 1-year investment horizon will sell the asset and trigger the gain even if the alternative asset offers no return premium. By contrast, a taxpayer with a 20-year horizon will only sell the asset and switch to alternative if the alternative has a return premium of 0.11% or greater.

Second, a longer investment horizon reduces the rate of return required on the alternative asset if the current tax rate is relatively high. The last row in the table focuses on a capital gains rate of 28%. A taxpayer with a 1-year horizon will require a 1.1% premium to switch to an alternative investment. By contrast, a taxpayer with a 20-year horizon will require only a 0.38% premium to switch. This is because the investor with the longer time horizon will enjoy the return premium for a longer period of time.

Although not as steep as the curve in Figure 1 (1-year investment horizon), the curve in Figure 2a shows that the effect of rate uncertainty is substantial on the investor with a four-year investment horizon. Uncertainty encourages realization at low rates and discourages realization at high rates. Figure 2b shows a slightly different effect of uncertainty for taxpayers with longer time horizons. Rate uncertainty still discourages realization at high rates. However, at low rates, rate uncertainty does not significantly incentivize realization - the dashed and solid lines track each other. The intuition is that taxpayers do not need to realize gains at the low rate currently because they can wait on rates to come back down even if they go up. At high rates, by contrast, taxpayers know that there is a substantial probability that the rate will be lower at some point

within their investment horizon – and, thus, rate uncertainty continues to generate a significant financial incentive to defer realizing the gain.

3. Risk Aversion

To this point, the model has focused on the decisions of a risk-neutral taxpayer interested in maximizing their expected return. The model can be adapted to incorporate various degrees of taxpayer risk aversion. We employ the exponential utility function, which is indexed by the constant a. When a=0, the taxpayer is risk-neutral. When a>0, the taxpayer is risk-averse. Higher values of a indicate higher levels of risk aversion.

$u(c) = (1-e^{-ac})/c$ for $a \neq 0$; c for a=0

Table 5 shows the rate premium required by taxpayers with a one-year investment horizon.[4] Risk-averse taxpayers are slightly more likely to sell the asset than the risk-neutral taxpayer - the return premium required for them to sell their assets decreases. However, the effect is relatively small. There are two reasons why. First, even though risk averse taxpayers are more likely to realize gains when facing rate uncertainty, the status quo bias is substantial—capital gains rates are much more likely to stay the same than to change. Thus, the advantage of deferral will often be more substantial than the effect of rate uncertainty on even a risk-averse taxpayer.[5] Second, selling the asset in year 1 does not remove all uncertainty for the risk-averse taxpayer. The taxpayer is still exposed to final period rate uncertainty when the asset is ultimately liquidated, and any gain that accrued between year 1 and the investment horizon is taxed.

Table 5: Return Premium Required to Sell, Risk Aversion

Year 1 Capital Gains Rate	Risk Neutral	a=2	a=10
15	-0.18%	-0.19%	-0.22%
16	-0.13%	-0.14%	-0.17%
17	-0.12%	-0.13%	-0.16%
18	-0.11%	-0.12%	-0.16%
19	-0.03%	-0.04%	-0.07%
20	0.03%	0.02%	-0.01%
21	0.26%	0.26%	0.23%
22	0.31%	0.31%	0.28%
23	0.55%	0.54%	0.51%
24	0.63%	0.62%	0.59%
25	0.72%	0.71%	0.67%
26	0.74%	0.73%	0.69%
27	0.76%	0.75%	0.71%

[4] Once we include risk aversion, decisions in the model are no longer scale-invariant. Here we assume that the basis is 0.75 and the fair market value of the asset is 1.

[5] If we increase the probability of a rate change, risk aversion has a much more substantial effect on taxpayer decisions.

28	0.83%	0.82%	0.79%

4. Ability to Foresee Rate Changes

The modeling so far has assumed that rate changes cannot be foreseen. However, based on past history, it is likely that rate changes for the immediate future (i.e. within a year) will be foreseen at least to some degree. Rate changes take time to legislate. Attempts at such legislation tend to be first prefaced by political campaigns where rate changes are proposed. Finally, when the legislation is actually enacted, the rate changes have often taken effect in the following year, giving asset holders an opportunity to sell and take advantage of prior rates if they so choose.

An ability to foresee rate changes has several effects. First, in this situation, there is no longer an incentive to sell an asset as a result of rate uncertainty before a rate increase is expected to occur—the lower rate can always be taken advantage of at that point. The taxpayer can simply wait (and take advantage of the time-value of deferring the tax liability) until the last moment when rates are due to increase. Second, there is an incentive to sell if the rate for the next year is expected to increase, though the strength of that incentive will depend on the existing rate and the investment horizon of the taxpayer; the longer the horizon, the greater the chance that the rate increase may subsequently be reversed.

Table 6 illustrates. It assumes a three-year time horizon, and shows the incentive to hold or sell in the first year under several conditions:[6] First, it shows the incentive when rate changes for the next year are not yet known. Second, it shows the incentive when the rate changes for the next year are known for three different conditions: a rate increase, decrease, and no rate change. We focus on a simple example where the possible rates are limited to 15%, 20%, and 25%.

Table 6a: Cannot Sell Immediately Before a Rate Change	
Rate (%)	Decision
15	Sell
20	Hold
25	Hold

Table 6b: Can Sell Immediately Before a Rate Change	
Rate Increase (%)	
15 → 20	Sell
15 → 25	Sell
20 → 25	Hold
Rate Decrease (%)	
25 → 20	Hold
25 → 15	Hold

[6] In this example, the basis is 0.1 and the fair market value of the asset is initially 1. The status quo bias is 80% - there is a 10% of switching to either of the other two rates in each period.

20 → 15	Hold
Rate Unchanged	
15	Hold
20	Hold
25	Hold

Consider first Table 6a, which summarizes the decision of a taxpayer who cannot sell immediately before a rate change. The taxpayer faces the same type of uncertainty as in the original toy model. The taxpayer has an incentive to sell in the first year if the rate is 15% to avoid the possibility of future rate increases.

If the taxpayer has the opportunity to sell immediately before any rate change occurs, decisions change markedly in two ways. First, the taxpayer in the example is only incentivized to sell immediately before a rate increase. If the rate is currently 15%, and the taxpayer knows that the rate in the next year will increase to 20% or 25%, the taxpayer will trigger the capital gains at the lower rate.

Second, in contrast to Table 6a, the taxpayer will not trigger capital gains if rates will remain unchanged or if rates will be reduced. The taxpayer is secure knowing that they can take advantage of deferral until a future rate increase is legislated (if ever). This is true even if the taxpayer can take advantage of the lowest possible rate of 15%.

This version of the model captures an important intuition from the literature. Anticipated rate changes both up and down can create a temporal shift in realizations. When there is an anticipated increase in capital gains rates, there is a measurable increase in realized gains in the year before the rate change occurs. In 1986 there was a sharp increase in realized gains in large part because the capital gains rate was set to increase to 28% in 1987.

Table 7a and 7b show what return premium is required for a taxpayer to sell the asset and switch to an alternative. In this simple example, the taxpayer requires substantial return premium in order to sell his asset unless the rate is about to increase. It is right before a rate increase that a taxpayer is most incentivized to sell. We can see the difference in behavior by focusing on Table 7a and the final few cells of Table 7b (in which the rate stays unchanged). In Table 7a, the taxpayer will sell if the rate is 15% even if there is no return premium. In contrast, a taxpayer that can anticipate rate changes will not sell even if the rate is at 15% unless the alternative asset offers a substantial return premium (at least 0.9%).

Thus, the realization rule distorts behavior even more if taxpayers know that they can trigger gains immediately before any future rate increases.

Table 7a: Cannot Sell Immediately Before a Rate Change	
Rate (%)	Return Premium Required to Sell
15	-0.2%
20	1.3%
25	3.5%

Table 7b: Can Sell Immediately Before a Rate Change	
Rate Increase (%)	Return Premium Required to Sell
15 → 20	-0.8%
15 → 25	-1.7%
20 → 25	0.6%
Rate Decrease (%)	
25 → 20	0.9%
25 → 15	0.9%
20 → 15	1.8%
Rate Unchanged	
15	0.9%
20	1.8%
25	3.5%

IV. Elasticity of Capital Gains Realizations

This insight—that rate uncertainty could have significant incentive effects—has potentially important implications for how tax rate changes affect the level of capital gains realizations. The elasticity of capital gains realizations measures the percent change in capital gains realizations divided by the percent change in the tax rate. Economists have, for years, studied this elasticity and arrived at a variety of results. As discussed in the next section, the elasticity has important implications for the revenue that would be raised or lost from changing capital gains rates and also the efficiency effects of those changes.

However, despite the many years of study, the empirical work so far has not explicitly considered the role of rate uncertainty on the elasticity of capital gains realizations. To be sure, some of these studies would naturally have incorporated the effect of uncertainty at the time. However, analyses extrapolating the elasticity of capital gains realizations from historical experience has not seriously considered how tax rate uncertainty might affect those extrapolations.

To begin to illustrate how these effects might work, we model how tax rate uncertainty might affect the elasticity of capital gains realizations across a range of tax rates. We model the effects from 15 percent to 28 percent, again reflecting the range of statutory capital gains rates over the last several decades.

We assume a distribution of asset holders—varying characteristics across several dimensions. First, we assume that asset holders have a range of investment horizons. We vary the horizon from zero to twenty years. Second, we assume that the return that asset holders currently earn on their investments varies between four and five-percent. The taxpayers all have the opportunity to switch into an alternative asset that returns five percent. Third, we assume variance in the amount of gain in the assets. We assume that the gain varies from 99 percent to none of the value of the underlying asset. In each case, we assume a constant distribution across the range of characteristics.

Absent such variation, changes in the amount of realizations would be highly discontinuous. If the population were entirely homogeneous, the elasticity would be zero except at the point at which the change in the tax rate flipped asset holders from choosing to sell the asset or vice versa. We of course observe a much more continuous pattern in realization behavior, reflecting a variation in characteristics across asset holders.

We also assume a baseline of realizations that are unaffected by rate changes. These may include high-frequency traders focused on short-term factors other than tax rates, traders who simply are not tracking tax rate changes, investors who are realizing gains to use capital losses, and realizations triggered at death. We set the baseline so that elasticity estimates are roughly in the range of those estimated in the literature, though there has been significant variance in those estimates.

For instance, analysts from the Joint Committee on Taxation and the Congressional Budget Office estimated that the long-run elasticity of capital gains realizations was -0.72 looking at the period from 1999 to 2008 and based on two rate changes at the federal level in this period as well as state-level tax rate variation (Dowd, McClelland, and Muthitacharoen, 2015). Other major studies in recent decades find a permanent elasticity as low as -0.18 (Burman and Randolph, 1994) and as high as -1.72, though that same study found a much lower elasticity (of -0.34) in an alternative specification (Auerbach and Siegel, 2000). Our estimates are roughly centered in this range, though the level is not of substantial importance to our analysis. Rather, our point is to illustrate how uncertainty could affect the pattern of realization elasticity across a range of tax rates.

Our model incorporates the effects of uncertainty and estimates elasticities across different tax rates. Because we are running a computer simulation, we can explicitly calculate the elasticity of realized gains at every possible capital gains rate. To be clear, our model is estimating long-run elasticity in anticipation of future rate changes rather than short-run or transitory elasticities when rate changes are known.

Figures 3a and 3b graph the results, showing the pattern of elasticities across the rates. Figure 3a uses the version of our model assumes that taxpayers are not given the opportunity to sell immediately before any rate changes. Figure 3b assumes that taxpayers can trigger gains immediately before or after a rate change. In each figure, we plot elasticities for two different levels of uncertainty with regard to future rate changes: without uncertainty (the tax rate will stay the same) and with uncertainty consistent with rate changes since 1980.

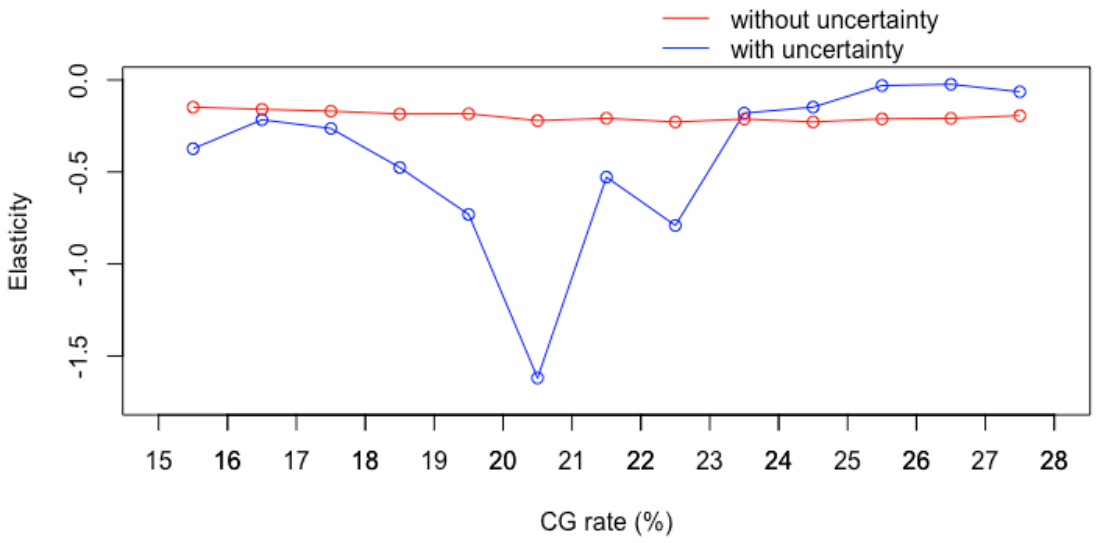

Figure 3a: Elasticities When Taxpayers Cannot Trigger Gains Before a Rate Change

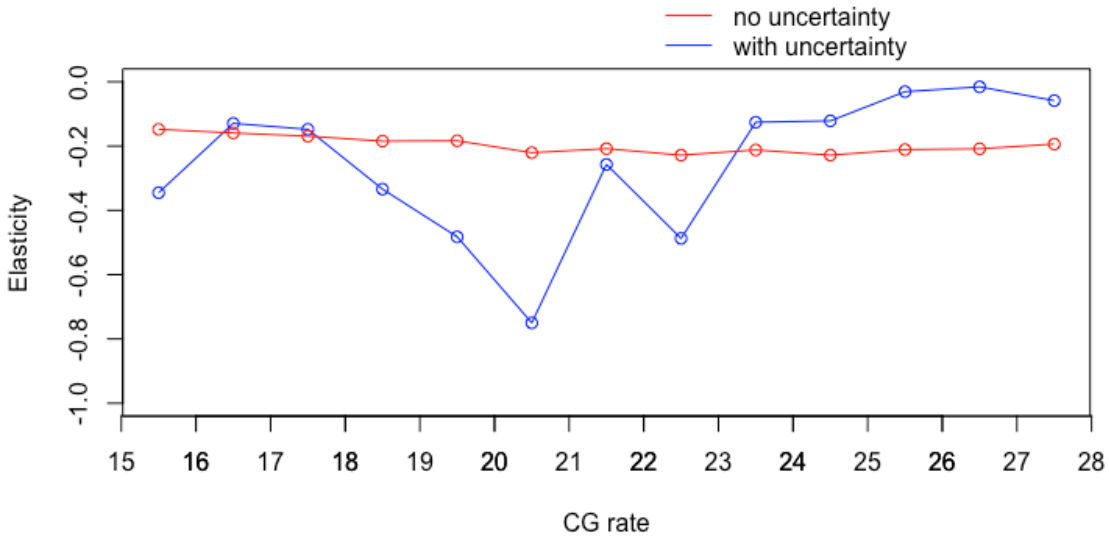

Figure 3b: Elasticities When Taxpayers Can Trigger Gains Before Rate Change

The pattern of elasticities becomes U-shaped with uncertainty introduced. There are smaller elasticities at the top and bottom of the rate distribution and larger (more negative) elasticities in the middle. The U-shaped pattern results from the middle of the rate distribution representing a tipping point in terms of future tax rates. At the very middle of the rate distribution, the expected value of future rate changes is close to zero—there is a roughly equal chance for rates to rise or fall. However, at the rates just below the middle, the sign of expected future rate changes becomes positive, since the rate—at that point—is below average. The opposite is true for rates just above the middle. This leads to larger changes in realization behavior due to rate changes around that tipping point than at the more extreme ends of the rate distribution.

The pattern of elasticities is also somewhat uneven and does not form a smooth "U." That uneven pattern results from how we assign probabilities of rate changes based on the distribution of rate changes since 1980. The probabilities are somewhat discontinuous since we assume that any change that would go "out of range" (the range of 15 to 28 percent) would not occur. Thus, some rate changes become possible in discontinuous fashion especially in the middle of the rate range. As a sensitivity analysis, we have analyzed the pattern of elasticities assuming a smoother pattern of possible rate changes, and the "U" pattern remains.

Elasticity studies so far have not been designed to measure whether elasticity varies in this way due to rate uncertainty. The effects shown here should be seen as illustrative of the kinds of effects on elasticity that would result if people are sensitive to the financial incentives created by long-run rate uncertainty. For example, if a study estimated separate elasticities for three different ranges of federal rates: low (15-20%), medium (20-25%), and high (25-30%.) Such an empirical study would allow us to verify whether the predicted effects of rate uncertainty actually influence the measure of elasticity in the expected fashion.

It is interesting to consider the results of a recent CBO study measuring elasticities from 2001-2008 (Dowd et al., 2012). The paper provided a point estimate of -.792. However (as a robustness check), they repeated their study focusing on several sub-periods. We also include the data from Auerbach & Siegel (2000) which used a similar methodology to measure permanent elasticity using data from 1986-1993.

Table 8: Reported Elasticity Measures

Permanent Elasticity	Federal Capital Gains Rate	Year	Source
-0.34 (0.13)	20-28%	1986-1993	Auerbach & Siegel
-0.91 (0.25)	20%	2000-2001	Dowd et al.
-1.00 (0.42)	20-15%	2002-2003	Dowd et al.
-1.41 (0.29)	15%	2004-2005	Dowd et al.
-0.36 (0.14)	15%	2006-2007	Dowd et al.

With the exception of the elasticity measure from the 2004-2005 subperiod, the other measures of permanent elasticity follow the expected pattern.[7] Elasticities are low at 15%. They are relatively higher at 20% and then are much lower at 28%.[8] This is preliminary and speculative, but encouraging nonetheless.[9]

[7] Note that the estimate of transitory elasticity for the 2004-2005 subperiod has the wrong sign. There may be something strange going on with that particular subperiod.

[8] It should be noted that Dowd et al. include additional variables in their regressions. When they apply the Auerbach and Siegel methodology to their data, they get even larger permanent elasticities than those reported in their paper. Thus, Table 8 may underreport the difference in elasticities at high rates and low rates.

[9] This provides an alternative explanation for why studies that have focused on different subperiods have arrived at elasticity estimate that are significantly different from each other. For

It is worthwhile to note several limitations of the model presented. First, we are only focused on the long-run elasticity. We do not consider short-run or transitory elasticities. The literature shows that (1) when a rate increase is imminent, many taxpayers trigger gains and (2) when taxpayers have a temporary dip in income that results in a transitory reduction in their capital gains rate, realizations also increase. Second, the model only focuses on the top capital gains rate. Third, the model assumes a relatively simplified universe of built-in-gain assets, and does not consider the influence of strategic behavior in triggering gains to match realized losses. Fourth, the model assumes that all taxpayers are rational and have complete information in incorporating rate uncertainty into their decision-making. We have attempted to deal with the third and fourth issues by deflating the elasticity measures assuming an arbitrary number of realized gains in each year by taxpayers that are not rate sensitive.

However, the goal of the model is not to estimate the elasticity of capital gains in the United States or any other country. Rather the goal is to use a stylized model to show how elasticity might change across capital gains rates due to rate uncertainty. Taxpayers face a very different probability distribution of future relative rates when the current rate is 15% than when the rate is 28%. This difference should be expected to have a substantial effect on measured elasticities.

V. Policy Implications

A. Revenue and Efficiency of Capital Gains Taxation

The analysis here has possible implications for the revenue and efficiency of capital gains taxation.

First, rate uncertainty generates incentives that distort the decision whether to sell or hold an asset. The overall efficiency implications of this are complicated and interact with other distortions produced by the tax system. As has been explored in previous literature, the tax system tends to encourage people to hold assets both due to the value of deferring tax liability and due to step-up in basis at death (e.g., Landsman and Shackelford, 1995). At times, rate uncertainty will tend to exacerbate these effects. This will especially be true at tax rates at the higher end of the range. As shown in the modeling above, there will be an additional incentive to hold at that point awaiting a lower tax rate.

However, tax rate uncertainty may offset the tax incentives to continue holding assets and even prompt realizations that would otherwise not occur in the absence of taxation. These incentives to accelerate realizations would occur for instance at low tax rates and if taxpayers believe they may not have enough forewarning to sell in time to avoid a future enacted rate increase. They would also occur when tax rate increases are expected shortly and to take advantage of a current, low rate.

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example, Bogart & Gentry (1995) estimates an elasticity of -1.500 using data from 1979-1985 but only an elasticity of -0.854 using data from 1987-1990. The capital gains rate was much higher in the rate distribution in the latter time period.

Second, these results have implications for revenue generation. The results suggest that revenue estimates that extrapolate elasticity as measured at one rate and uses these estimates for significantly different rates may be inaccurate. For small changes in the rate, realizations could potentially be especially sensitive toward the middle of the distribution of possible tax rates, and revenue from tax increases in this range could under-perform as compared to what otherwise would be expected to the extent the effect of rate uncertainty were not taken into account.

These efficiency and revenue effects are dependent on the political context and the degree of uncertainty that results. If uncertainty falls generally, these effects probably become less significant. Further, taxpayer responses to rates will change as the *range* of possible rates changes. The discussion in this paper was anchored to a distribution of possible rates of 15 percent to 28 percent, the range of federal statutory capital gains rates observed in the United States since 1980. However, if we look at the range of rates for the three decades immediately preceding those, the range of capital gains rates was much higher, between 20 percent and 40 percent. This has important policy implications. For example a rate of 25 percent would be relatively high in the distribution of rates since 1980 but would be relatively low in the distribution of rates from 1950-1980. This paper has emphasized understanding the capital gains rate within the context of likely future rates. That distribution of likely future rates has been treated as fixed and exogenous, but it need not be so. Oh & Tausanovitch (2016) use role call voting data to argue that political preferences for capital gains rates have been relatively fixed since 1986. However, it is possible that rate preferences will change again in the future, contracting, expanding, or shifting the range of possible rates.

Take the legislative machinations and revenue effects in 2017. Federal revenues in the first part of the year disappointed as compared to expectations. While the exact sources are not known, one reasonable theory is that people were deferring realizations given increased legislative uncertainty and a greater likelihood of a rate cut (Ehrenfreund and Paletta, 2017). However, defeat of tax legislation to reduce the rate might unwind those deferrals and have lasting effects—reducing uncertainty and increasing the expected value of future capital gains rates, with attendant effects on long-term realization behavior.

B. Reforms to the Realization Rule

There have been calls for reform to the realization rule, and this paper highlights how the realization rule introduces an additional source of distortion as compared to those normally discussed—that of the effects of rate uncertainty. In this way, it suggests an additional benefit of reforming the realization rule. However, one way of reforming realization would address the distortions in realization behavior generated by rate uncertainty; another way would not.

In reforming realization, there are at least two ways for determining the appropriate tax rate to apply to the gain. One way would tax accrued gains at rates in place in the years in which gains accrued, using an annual mark-to-market system or some average of rates over the period. The liability might then be deferred, with a charge applied for such deferral. However, the tax rate applied to the gain would be set in the previous years (e.g., Glogower, 2016; Miller, 2008; Auerbach, 1991). This approach tends to be recommended for publicly-traded assets, and some would apply a version to non-publicly traded assets. A second approach would use the tax rate

in the year in which the gain is realized but apply some penalty for having deferred paying taxes as the gain accrued. This has been suggested by some for non-publicly traded assets (e.g., Shakow, 1986, 1223).

However, while both approaches could mitigate or eliminate the incentive resulting from the time-value-of-money benefit from deferring gain, only the first would address distortions created by rate uncertainty. The key insight is that the second type of reform would not eliminate the incentives created by future tax rate uncertainty since the systems would continue to tax gain at the rate in place at the time that gain is realized. Thus, rate uncertainty is a reason to use a system that imposes tax based on past tax rates, whether via mark-to-market taxation (particularly for publicly traded assets) or some averaging of those previous tax rates (particularly for non-publicly traded assets).

C. Other Tax Policies and Rate Uncertainty

Some of the lessons of this analysis should apply beyond capital gains. The basic model here is relevant anytime the tax system gives taxpayers a choice as to the year in which income will be taxed by re-timing an activity. Of course, some activities are likely to be more sensitive to the effects of rate uncertainty than others.

One other activity that illustrates the potential power of rate uncertainty in affecting such behavior is the choice by U.S. corporations whether to repatriate profits earned overseas. For certain profits on international operations of U.S. subsidiaries, the profits only face U.S. taxation when they are considered "repatriated" to the U.S. parent corporation; the U.S. tax liability is otherwise deferred. However, corporations for the most part do not reduce the value of the tax liability owed to the U.S. government by deferring the liability—so long as the funds are eventually repatriated. This is because the liability grows with the amount of deferred earnings, which continue to grow as they are invested (Hartman, 1985). Nonetheless, in recent years, unrepatriated earnings have built up to trillions of dollars (Joint Committee on Taxation, 2016), and one likely impetus is rate uncertainty.

The large build up in unrepatriated earnings occurred in the wake of the 2004 repatriation holiday that allowed corporations to repatriate earnings at a special low rate in that one year. While it was a one-time holiday, it generated uncertainty about future tax rates on unrepatriated earnings, and the existing tax rate has been seen by many as the upper end of the likely range. The result is a build up in unrepatriated earnings—very much akin to holding onto a capital asset and waiting to realize a gain at a lower tax rate (Brennan, 2010).

This is an illustration that the basic concepts explored here apply beyond and to any situation in which taxpayers can adjust activity to choose what year's tax rate applies to a gain. In that case, uncertainty about tax rates in future years will have important incentive effects on behavior today and whether or not to recognize the gain.

VI. Conclusion

The realization-rule's effects on taxpayer behavior has been the subject of considerable study, but, for the most part, previous work has not considered the effects of long-term rate uncertainty

on realization behavior. This article suggests that the effects could be important and might create significant financial incentives that interact in complicated ways with other tax-generated distortions, such as the time-value-of-money benefit from deferring gain. The analysis in this article is largely theoretical using simulations of possible taxpayer behavior. And, while previous empirical work suggests that elasticities of capital gains might vary significantly over time—as is predicted by the analysis in this paper—that evidence is only suggestive, and future work could help illuminate the power of tax rate uncertainty by looking at realization behavior across different time periods and at different tax rates. In the meantime, there is reason to take the issue of uncertainty seriously, both in analyzing realization behavior and in considering policy changes to capital gains rates and realization rules.

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