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THE BUNCHING OF CAPITAL GAINS REALIZATIONS

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We use a unique data set of capital gains transactions to investigate the behavior of taxpayers with respect to the preferential tax rate for long-term capital gains. Our data allow us to examine the shifting of gains across time periods but eliminate the effect of the large pool of accrued gains that mechanically enlarge previous estimates. We adapt the bunching methodology developed by Kleven and Wasseem for rate changes over incomes to the drop in the capital gains tax when an asset has been held for more than one year. We find strong evidence that taxpayers respond to the preferential rate by reducing the realizations of gains in the weeks leading up to the point when the preferential rate applies. However, the magnitude of the transitory elasticity is small relative to prior estimates: we estimate a short-run gains elasticity of –0.47. We also estimate a quasi-permanent gains elasticity of –0.79.

Keywords: capital gains, tax elasticity of capital gains, investor behavior, disposition effect

JEL Codes: H24, G41, G11

I. INTRODUCTION

Both the Tax Reform Act of 1986 signed into law by President Ronald Reagan and the American Taxpayer Relief Act of 2012 signed into law by President Barack Obama increased the tax rate on realized capital gains. In 1987, the taxation of capital gains was dramatically increased for many taxpayers from a top statutory rate of 20 percent in 1986 to 28 percent for 1987. In anticipation of the increased tax rate, realizations surged 60 percent in tax year 1986. As Figure 1 makes clear, 1986 stands out because of the increased realizations over trend. A similar, but smaller, increase in realizations of more than 40 percent can be seen in 2012 in anticipation of the increase in the maximum federal tax rate on long-term gains from 15 percent in 2012 to the approximately 24 percent that would apply in 2013.

Predicting the effect of a change in the capital gains tax rate depends crucially on understanding those short-run changes as well as the changes in the long run. Using annual tax return data, researchers have estimated the permanent or persistent tax elasticity of capital gains, with Dowd, McClelland, and Muthitacharoen (2015) (DMM

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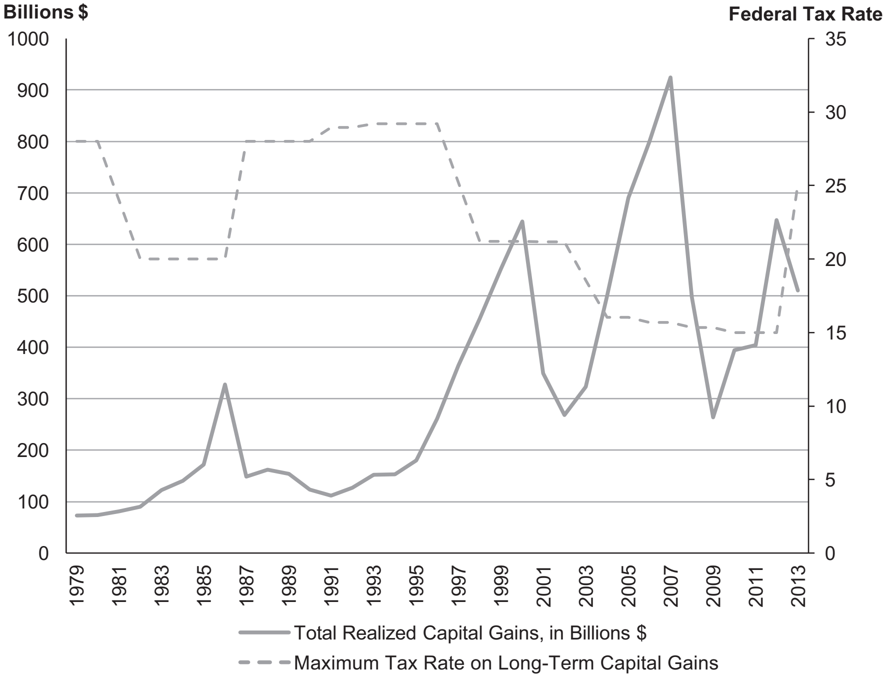
Figure 1

Realized Capital Gains and Federal Tax Rates, 1979–2013



Source: Department of Treasury (2016).

hereafter) estimating it to be approximately –0.7. But the 1986 and 2012 spikes represent a more immediate response as taxpayers adjust the timing of their realizations to the timing of the rate change. In effect, the spikes are realizations that occur to take advantage of what has become a temporarily low tax rate. Those realizations are taken from large pools of accrued gains, some that, absent a tax rate change, may not have been realized for many years, and some that may merely represent assets sold and immediately repurchased in order to lock in the lower tax rate. Because those pools are much larger than the gains realized in a given year, comparing gains drawn from those pools to gains realized in a given year exaggerates the short-run impact of tax changes.[1]

To estimate how an announced change in capital gains tax will change federal revenue over a 10-year period, we must understand both the permanent response to a change in the tax rate and the immediate, short-run response to the now temporary rate. The

[1] Ideally, we would analyze taxpayer behavior by comparing the amount of realized gains to the total value of accrued gains. Unfortunately, generally, we do not know the value of accrued gains for taxpayers. Reese (1998) overcomes this deficiency by using sales of stock that occur around the one-year mark after an initial public offering.

existing literature has measured the transitory elasticity without controlling for the significant differences in accrued gains either across individuals or in different states of the economy. It also includes gains that, absent a change, may have been held for many years. As a result, even a perfectly accurate transitory measure can vary over time.

In this paper, we limit the influence of this large and varying pool of accrued gains by examining behavior over a very short time horizon. Specifically, we analyze the timing of realizations within two years after purchase. If an asset is held for less than a year before sale, gains from the sale are taxed as ordinary income, but if the asset has been held for more than a year before sale, gains are taxed at a preferential rate. We, therefore, expect relatively few realizations held for just less than a year and a surge of realizations for assets held for just more than a year. Although we are unaware of previous attempts to measure these elasticities, they are most similar to the "short-run elasticity" defined in Gravelle (2010) as the "short-term response to a permanent change" in tax rates. Our measure abstracts from both the varying large pool of accrued gains and the shifting of gains from very distant realizations into the current period by looking at the time shifting of realizations from a fixed amount of accrued gain. We, therefore, have a better measure of the value of gains accelerated or decelerated from one calendar year to the other in the face of an announced change in the capital gains tax rate.

To analyze this behavior, we apply the bunching method of Kleven and Waseem (2013) to daily transaction-level data on capital gains realizations aggregated to a weekly holding period. Unlike the typical use of the bunching method, in our study, the notch occurs at a point in time rather than at a particular level of income. We estimate the number of sales that would have taken place at or beyond the first week the long-term rate applies by fitting a fifth-order polynomial to sales but removing the effect of sales in a window around the one-year mark. We also estimate a measure of the elasticity of long-run average gains with respect to tax rates.

Our results show that taxpayers delay their realizations of gains to take advantage of the preferential rate, with a sharp increase in gains the first week in which the long-term rate is available. Surprisingly, our elasticity estimates are relatively low. For example, a 10 percent reduction in tax rates for high-income taxpayers (who one might expect to be the most responsive) leads to a 2.5 percent increase in sales and 7.3 percent increase in realized gains shifted to just beyond the one-year holding period. We then investigate whether there are frictions in taxpayer responses that contribute to our low estimates of these elasticities. In particular, we examine two groups of high-income taxpayers under the assumption that they are financially sophisticated. We look at taxpayers who engage in substantial trading activity under the assumption that they are more intimately aware of the tax rules. We also restrict our examination to corporate stock for which there should be little in the way of frictions. Our results suggest that liquidity frictions do not contribute to our low estimates but that taxpayer financial sophistication may be important. This last result is consistent with results by Dhar and Zhu (2006) on the heterogeneity of investor disposition effects. Finally, we examine the pattern of losses and gains and show that those taxpayers with year-end losses are less sensitive to tax rates than those with net gains at year's end.

Our paper contributes to two different empirical strands of the economics and finance literature on taxpayer and investor behavior as well as employing a novel bunching estimator strategy. First, we provide additional evidence on the tax elasticity of gains, and in particular on the short-run elasticity. Because we have eliminated the large pools of accrued gains, we believe that our estimates are closer to what we would expect to find if we had information on all of the accrued gains for estimating these elasticities. Second, we provide additional evidence on investor behavior and their disposition of losses versus gains. Researchers have documented the seemingly irrational behavior of investors to stick with their losses longer than they should and sell their gains earlier than they should (Dhar and Zhu, 2006; Odean, 1998; Shefrin and Statman, 1985). This apparent irrational trading strategy is often referred to as the disposition effect. Relatedly, Poterba (1987) reported that taxpayers do not optimize the sale of their assets in order to minimize their taxes and be in a net loss position, as theory would predict. Auerbach, Burman, and Siegel (2000) use more recent data to similarly show that taxpayers do not always minimize their taxes. They also show that a relatively few taxpayers with high incomes or certain assets are more likely than others to minimize their taxes by being in a net loss position. We find continued evidence that taxpayers do not optimize the sales of their losses. We also contribute to the literature on bunching estimators by applying the estimator to the case in which tax rates vary over time, rather than across income.

The paper proceeds as follows. In Section II, we discuss the literature on the tax elasticity of capital gains, highlighting how our estimates fit in that literature. In Section III, we present summary information on our data, provide graphical evidence of bunching, and describe our estimating methodology. In Section IV, we estimate several different elasticities. In Section V, we perform several sensitivity tests and investigate apparent transaction frictions. In Section VI, we conclude.

II. TAX ELASTICITY OF CAPITAL GAINS

When thinking about taxpayer responses to changes in the tax rate on capital gains, much of the tax profession's thinking is influenced by the events surrounding the Tax Reform Act of 1986. Between 1985 and 1986, there was an almost doubling in capital gains realizations as taxpayers realized gains in 1986 to avoid the anticipated increase in the capital gains tax rate for 1987 and thereafter. This massive unlocking of realizations in 1986 is often pointed to as the poster child for transitory effects. Once taxpayers knew that the tax rate in the future was going to be persistently higher, they viewed the current tax rate as temporarily lower and responded with significant realizations.

Early studies estimated a combined elasticity with estimates often exceeding 1 (Feldstein, Slemrod, and Yitzhaki, 1980). Research through the 1980s and 1990s included time-series estimates and increasingly cross-sectional or panel data. Research in these later studies typically broke the elasticity into a temporary response and a permanent response. Burman and Randolph (1994) argued that the wide disparity in estimated elasticities between time-series analysis and cross-sectional panel studies was the different treatment of transitory and permanent effects. Using panel data, they estimate a permanent elasticity near zero and a transitory elasticity near 6. More recently, DMM argue that their specification estimates the permanent or persistent elasticity with much more precision than the transitory elasticity. In their specification, the persistent elasticity is measured as a change in the tax rate that is expected to persist into the next few years, while the transitory elasticity is the effect of a change in the tax rate that is expected to disappear in the following year. DMM estimate the persistent and transitory elasticities for the period between 1999 and 2008 to be –0.72 and –1.19, respectively. Their estimate of the transitory elasticity is much lower than prior estimates and is not stable across a variety of specifications.

Two recent papers examine the change in realizations in 2012 in response to the 2013 increase in tax rates: Saez (2017) and Auten, Splinter, and Nelson (2016). Both studies find transitory elasticities of shifting well in excess of 1, with particularly strong responses at the top of the income distribution of over 3 for the top 0.1 percent of taxpayers by income. As in 1986, the changes implemented in 2013 were anticipated, allowing taxpayers to realize gains on assets in 2012 that may have been held for many years.

Gravelle (2010) defines two types of transitory elasticities. The first is similar to those estimated by Saez (2017) and Auten, Splinter, and Nelson (2016) as measures of "the response to a temporary tax increase or decrease." The second type is a short-run elasticity that is the "short-term response to a permanent change." It is important to disentangle the two effects, because once a previously unanticipated law raising tax rates has passed, the existing rate becomes a transitory rate. The rush to sell assets that may have been held indefinitely, or to simply sell and re-purchase assets, is a response to that transitory rate. That rush exaggerates the short-run response of taxpayers rebalancing their holding period or shifting realizations from one period to the next.

Here, we estimate elasticities that solely measure the shifting of realizations from one period to the next in response to a permanent difference in tax rates. There are several aspects to our approach that make it well suited to estimating the short-run elasticity. First, at the time of investment, the taxpayer is aware of the rate that is applicable for assets held for less than a year and those that are held for over a year. So, as in the 1986 reform, the rate change is fully anticipated. However, unlike the 1986 and 2012 changes, the rational taxpayer should design a portfolio that takes these rate differences into account when initially investing in capital assets. Second, unlike the rate changes that are applicable to assets possibly held for many years, our estimate applies only to assets held less than a year. This eliminates the variability caused by long-held accrued gains. In addition, short-term gains will very likely be held for only a short time after the lower long-term rate applies rather than be put off into the indefinite future. Finally, there is no incentive to sell assets simply to realize a gain and re-purchase the asset.

III. DATA AND BUNCHING OF REALIZATIONS

The basic unit of observation for our analysis is a single transaction. The data are capital gains realizations for directly held assets reported on Form 8949 for tax year 2012 compiled by the Statistics of Income (SOI) division of the Internal Revenue Service.[2] Taxpayers are included in the sample if they are also included in the individual income tax sample, a stratified random sample of taxpayers that oversamples high-income taxpayers.[3]

Taxpayers must report the purchase and sale price as well as the date of acquisition and disposition on Form 8949 for each asset sold during the year. We match these data to the taxpayer's Form 1040 to include information regarding marital status, income, size of household, and state of residence. The SOI Form 1040 data include information about the age of the primary and secondary taxpayer obtained from Social Security records.

Because many states also have income taxes and tax capital gains, the divergence between the ordinary tax rate on short-term capital gains and the long-term capital gains rates could be substantially different than the federal rate difference. To better control for these divergences, we calculate the combined federal and state tax rates using the taxable income recorded on the 1040 and the applicable federal and state statutory tax rate for that taxpayers filing status.

The data on transactions from Form 8949 start with over 4 million transactions, representing $386 billion in gains. We place several restrictions on the data. First, we drop approximately 120,000 observations that have a zero or negative basis. Next, we drop 417,043 observations that have a holding period of less than 24 days and 1.4 million observations that have a holding period in excess of 742 days.[4] This leaves 2.4 million transactions and $45 billion in gains. Next, to address possible end-of-year effects, all transactions from the first week of January (85,475 observations representing $1.9 billion in gains) and the last two weeks of December 2012 (122,707 observations representing $4.1 billion in gains) are dropped. We drop several strange executive compensation records. Finally, we drop observations for which we do not observe an acquisition date, a disposition date, the basis, or sales price. All of these restrictions leave us with an estimation sample of 2.1 million transactions representing $39.4 billion in gains.

Table 1 shows some summary statistics for the remaining sample of returns. The first column reports the unweighted sample statistics, and the second column shows the weighted statistics. In general, because the sample design oversamples high-income taxpayers, the weighted statistics result in lower average tax rates and higher population weighted numbers of transactions and dollars of gains and losses. State tax rates tend to be less progressive than the federal rate structure, and as a result, the reduction in state rates for the weighted sample is less pronounced. Concentrating on the weighted sample for the transactions panel, transactions sold for a capital gain make up 61 percent

[2] Indirectly held assets are those held by others on behalf of the taxpayer. Mutual funds, partnerships, and S corporations are examples of entities that hold assets on behalf of others.

[3] See Statistics of Income (2014) for a description of the 2012 individual income sample, and Wilson and Liddel (2016) for a detailed description and summary statistics for the SOI Sale of Capital Assets study.

[4] We drop transactions that are held for a very short period of time first because these are not likely to be transactions that are shifted to the one-year holding period, and second the extreme decline in aggregate gains during the first few weeks is not well estimated using the method of Kleven and Wasseem (2013).

Table 1

Summary Statistics Sale of Capital Assets, 2012

	Unweighted	Weighted
Average tax rates (percentage point)		
Federal ordinary tax rate	31.3	24.5
Federal capital gains tax rate	13.1	10.2
State ordinary tax rate	4.1	3.3
State capital gains tax rate	3.9	3.2
Number of transactions (millions)	2.1	76.8
Gains transactions	1.2	46.9
Loss transactions	0.9	30.0
Short transactions	1.3	49.8
Long transactions	0.8	27.1
AGI > $1 million	1.5	10.1
Corporate transactions (millions)	1.6	44.7
Gains transactions	0.9	26.1
Loss transactions	0.7	18.6
Tax exempt bonds (millions)	0.022	1.5
Gains transactions	0.020	1.4
Loss transactions	0.002	0.13
Total gains (billions $)	5.25	39.4
Short gains	1.96	19.1
Long gains	3.29	20.3
AGI > $1 million	4.68	14.4
Total losses (billions $)	–3.27	–29.3
Short losses	–2.11	–18.4
Long losses	–1.17	–10.9
AGI > $1 million	–2.23	–7.63
Corporate gains (billions $)	3.50	25.50
Short gains	1.2	12.1
Long gains	2.3	13.3
AGI > $1 million	3.15	9.56
Tax exempt bonds (billions $)	0.04	0.47
Short gains	0.02	0.18
Long gains	0.02	0.29
AGI > $1 million	0.03	0.11

Source: Authors' calculations from Statistics of Income (2016) data.

of the transactions (Gains Transactions/Total = 46.9/76.8) and those sold after holding for less than a year make up 65 percent of the transactions (Short-term Transactions/Total = 49.8/76.8). Taxpayers with adjusted gross income (AGI) in excess of $1 million made 13 percent of the transactions. Finally, sales of corporate equity made up 58 percent of the total transactions.

There were almost 50 million short-term transactions and nearly 30 million long-term transactions. However, long-term gains were larger than short-term gains on average ($749 compared to $383), resulting in approximately the same amount of total gains for both short- and long-term transactions. Capital gains are even more concentrated at the top of the income distribution. Despite representing only 13 percent of the trades, 37 percent of the capital gains were attributable to taxpayers with AGI in excess of $1 million. Capital losses are much more concentrated in short-term holding periods, with 63 percent of the losses accruing to assets held for less than a year. As with gains, a substantial portion of losses accrue to taxpayers with AGI in excess of $1 million.

A. Sales and Gains

In this section, we plot sales and capital gains in event time.[5] To compare the response of sales and gains to the long-term tax rate, we plot both weekly gains and weekly sales divided by the amounts realized or sold in week –1, the final week in which short-term rates apply (Figure 2). In this manner, the curves for both gains and sales equal unity in week –1 and the values in week 1 represent the proportionate increases in the week the long-term rate first applies. Aggregating sales to a weekly level, total sales and total gains fall as taxpayers hold assets for longer periods. During the 53rd week, or week 1 in event time, the long-term tax rate on gains applies and there is a spike in both sales and gains. Subsequently, sales and gains continue to decline and ultimately level off, although average gains after week 1 in event time are roughly 80 percent larger than those before week 1.

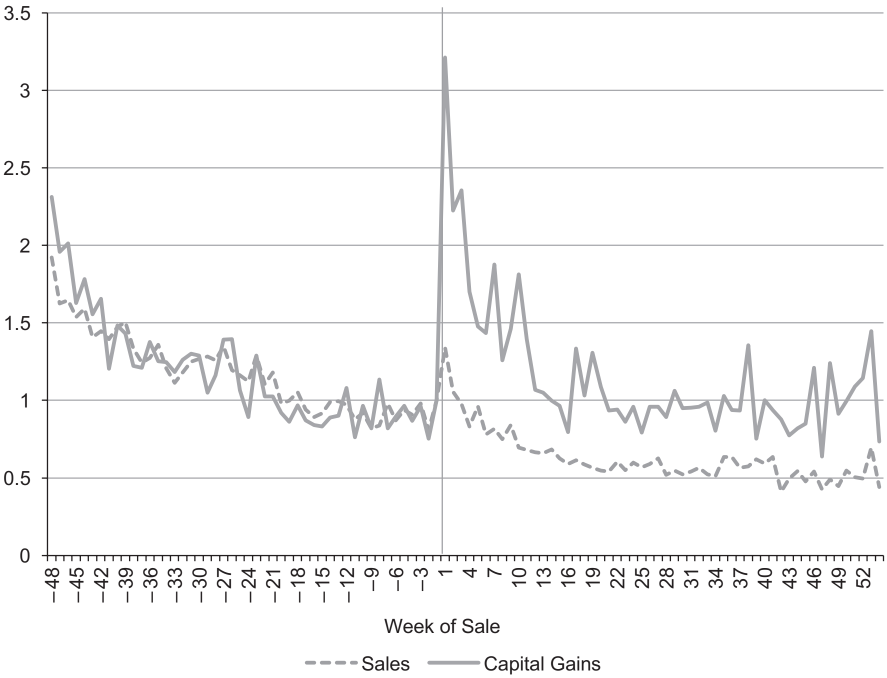
Figure 2 clearly shows that in the weeks during which the short-term rates apply, gains and sales track each other very closely, up to week –1, with a correlation coefficient of 0.93. After assets have been held long enough to qualify for long-term rates, sales surge by 34 percent. Gains spike up much more sharply than sales, increasing by 220 percent, implying that gains per sale are much larger in week 1 than in prior weeks. Subsequently, gains and sales fall off and, after several weeks, again follow a common pattern, although gains are much higher than are relative sales. The correlation coefficient in the second half of this series falls to 0.83, due in good part to the greater volatility of gains after week 1.

The tight relationship between gains and sales in the weeks of short-term rates also suggests that average gains per week are roughly constant. This is visible in Figure 3, in which average gains per week are plotted. When short-term rates apply, average gains

[5] We define event time to mean the holding period of the asset rather than the date during the calendar year that the asset was sold.

Figure 2

Capital Gains Transactions: Sales and Gains Relative to Week –1, 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period. The data are normalized to equal one in week –1.
Source: Authors' calculations from Statistics of Income (2016) data.

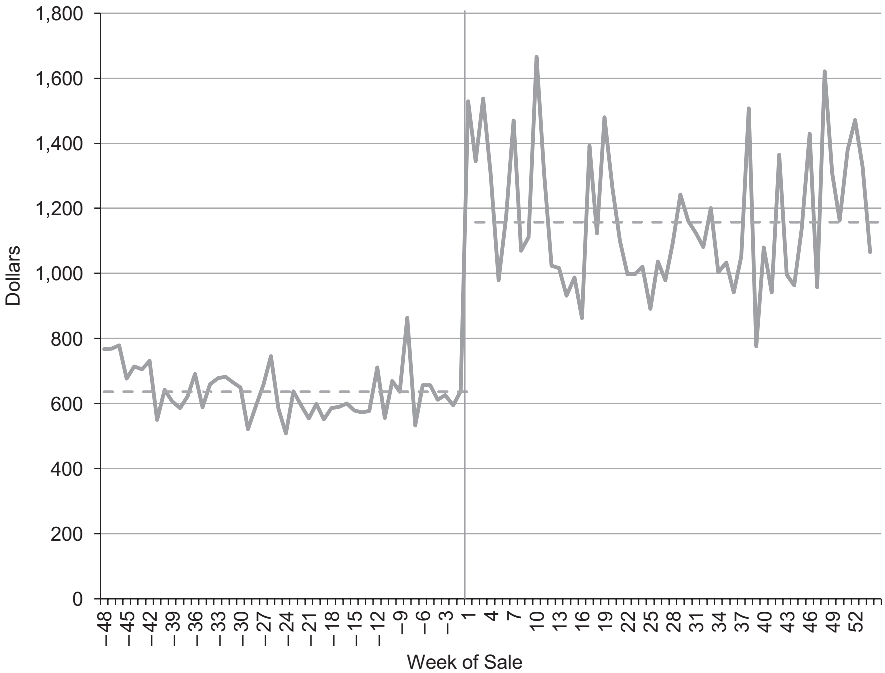
vary around an overall mean of \$638 with a standard deviation of \$75. When long-term tax rates apply, average weekly gains vary around an overall mean of \$1,157 with a much larger standard deviation of \$212. The relative constancy of average weekly gains can be reconciled with the 220 percent spike in gains seen in Figures 4 and 5 by noting that in week 1 sales increased 34 percent, the overall mean increased by 80 percent, and the average weekly gains in week 1 were 32 percent above the overall mean ($1.34 \times 1.80 \times 1.32 \approx 3.20$).

B. Losses

The ability to reduce taxable gains by realizing losses provides an incentive to match losses and gains. The rules are as follows: Short-term losses are subtracted from short-term gains and long-term losses are subtracted from long-term gains. If there is a net

Figure 3

Capital Gains Transactions: Average Weekly Gains, 2012



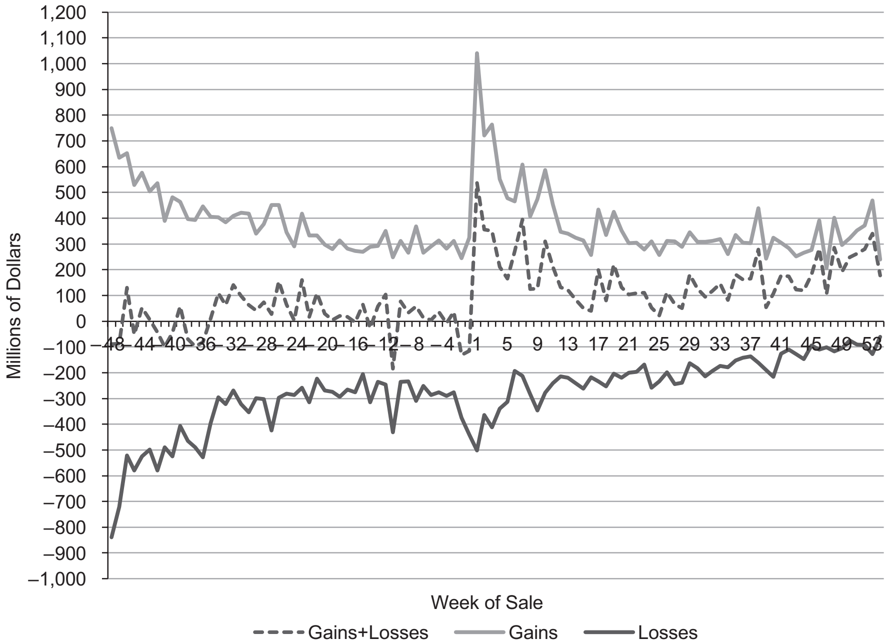
Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

short-term loss, it is first subtracted from net long-term gains. If there is a net long-term loss, it is first subtracted from net short-term gains. If net losses exceed net gains, up to $3,000 of losses can be used to offset ordinary income. If there are both net short-term and net long-term losses, short-term losses are first used to offset up to $3,000 of ordinary income and long-term losses can be used for any remaining offset. Beyond the $3,000, net short-term losses are carried over into the following year to offset future short-term gains, just as net long-term losses are carried over into the following year to offset future long-term gains.

In Figure 4, losses and gains appear to be symmetric up to week –1. Just as gains exceed $700 million in week –47, declining to about $300 million in week –1, losses exceed $800 million in week –47 and decline to about $400 million in week –1. Consequently, the sum of losses and gains hovers around $14 million over those weeks. In weeks –2 to 1, losses increase sharply as gains spike upward in week 1. The increase in losses in weeks –2 to –1 is explained by implication (3) in Appendix A: it is better

Figure 4

Gains, Losses, and the Sum of Gains and Losses, 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

for taxpayers to realize short-term losses and long-term gains. The surprising spike in losses in week 1 is possibly due to taxpayers matching of gains and losses. Beyond week 1, the losses and gains do not seem to closely track each other: gains stabilize around week 22, while losses decline until they reach about $100 million in week 54.

The spike in losses realized in week 1 is also at odds with the evidence in Reese (1998). The rational investor strategy is to sell losses early and as short term to offset short-term gains. Reese (1998) uses the Center for Research in Security Prices data on market prices and volume of the sales of stocks with an initial public offering a year prior and finds evidence that investors followed an optimal strategy.[6] However, other research finds evidence that investors do not follow tax minimizing strategies. Shefrin

[6] Arguably, the investors purchasing stock at initial public offerings are likely to be far more sophisticated investors than the general public. Consequently, parsing the results by the degree of investor sophistication may be important in understanding the responses to the lower preferential rate.

and Statman (1985) argue that investors may be influenced by four different behavioral factors: (1) prospect theory, (2) mental accounting, (3) regret aversion, and (4) self-control.[7] Each of these behaviors are at odds with an optimal investment strategy. Shefrin and Statman suggest that taxpayers may enforce selling losses (self-control) by selling losses at the end of the tax year in December. Odean (1998), using brokerage data, finds that investors are more willing to sell their losses in December than the rest of the year. To test whether our observed losses sold just after the one-year holding period are the result of December sales, we restrict the losses in week 1 in our data to exclude January and December. As a result of this restriction, losses sold in week 1 decline by only 16 percent, suggesting that the preponderance of sales of losses in week 1 are not due to self-control enforcement. Odean also tests whether more sophisticated investors (defined as those investors in the 90th percentile by frequency of trading) are less prone to the disposition effect. Odean finds that the magnitude of the disposition effect is smaller for frequent traders than infrequent traders, but it is still significant. Similarly, in our data, frequent traders make up 56 percent of the gains realized in week 1 and 38 percent of the losses realized in week 1.

Counterfactual Estimate

To calculate short-run elasticities, we need to estimate the number of sales and value of capital gains that would have been sold or realized in the absence of the preferential rate. We estimate this counterfactual distribution with the method in Kleven and Waseem (2013). We use the same method for both sales and gains, but here describe it in terms of sales. The method fits a fifth-order polynomial to the natural log of sales but includes a dummy variable for each week in a window around the first week for which the long-run tax rates apply. Time is measured as the number of weeks at which the long-run tax rate applies (starting with week 1) or the number of weeks before the rate applies (ending with week –1). We estimate

$$(1)\quad \ln(S_t)=\sum_{i=0}^{5}\beta_i t^i+\sum_{i=lb}^{ub}\gamma_i I(t=i)+v_i,$$

where S_t is the sales in week t, lb and ub are the lower bound and upper bound of the window around the first week of long-term tax rates, and $I(\cdot)$ is an indicator function equal to 1 when the relationship holds and 0 otherwise. In essence, we are applying the Kleven and Waseem method to an aggregate hazard function. However, we cannot estimate a survivor function because we do not observe total asset purchases. Consequently, our dependent variable is not the share of assets that have not been sold.

[7] Prospect theory asserts that investors are risk seeking when they have a loss and risk averse when they have a gain. Mental accounting builds on the prospect theory and posits that investors do not consider the entire portfolio when considering whether to sell a loss. Regret aversion occurs if an investor does not want to recognize that they made a mistake and were wrong about the investment. Finally, self-control is really the absence of self-control to make sure that the investor sells their losses.

The counterfactual distribution is estimated as the predicted value from the estimated polynomial in Equation (1), omitting the effect of the dummy variables. Equation (2) is the predicted counterfactual estimate:

(2) $$\widehat{S}_t = \exp\left(\sum_{i=0}^{5} \widehat{\beta}_i t^i\right).$$

It follows the trend of sales over time but predicts sales in the window during which sales are moved from short-term to long-term status using information on sales outside the window. The change in sales in week *t* induced by the tax change is $\widehat{S}_t - S_t$, and the total change in sales is the sum across all weeks.

To define the window, we assume that short-term gains deferred to take advantage of the long-term tax rate are realized in week 1 or soon after rather than many months later. We, therefore, set the upper bound to week 8.[8] The lower bound is initially set to five weeks before the long-run tax rate applies, and we proceed as follows: the model in Equation (1) is estimated and the counterfactual distribution in Equation (2) is calculated. The absolute value of the total change in sales up to week –1 is calculated by Equation (2a):

(2a) $$\left|\sum_{t=-5}^{-1} S_t - \widehat{S}_t\right|.$$

Equation (2a) is compared to the total change in sales from week 1 forward, as calculated in Equation (2b):

(2b) $$\sum_{t=1}^{8} S_t - \widehat{S}_t.$$

If the total change in sales up to week –1 is less than the sales after week 1, the lower bound is reduced by one week and the process is repeated. To enact a stopping rule for the process, we compare the total change in sales from the lower bound up to week –1 to the total change from week 1 to the upper bound. When the total change in sales from the lower bound up to week –1 equals or exceeds the total change from week 1 to the upper bound, the process stops.

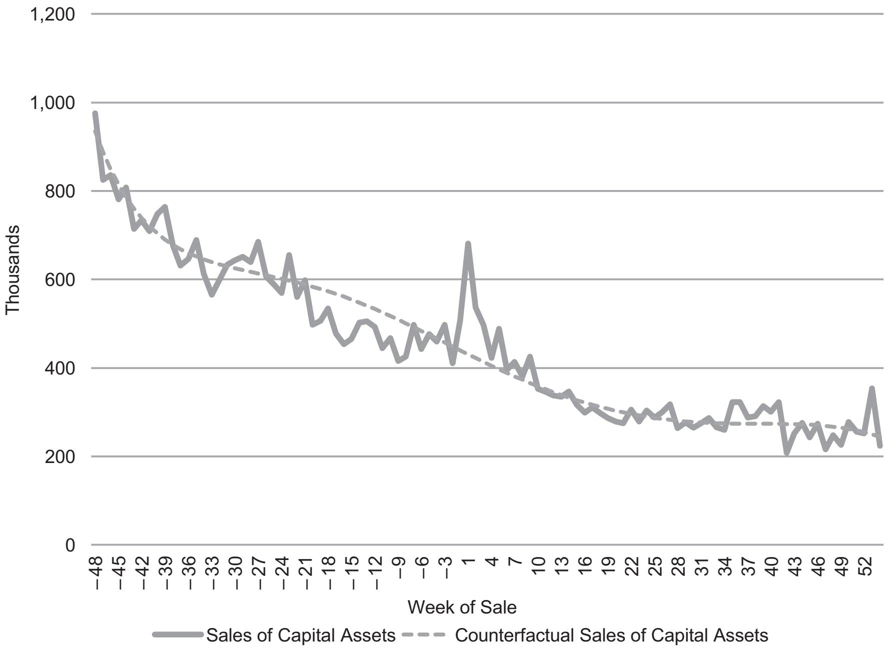
The results for sales are shown in Figure 5. At week –48, there are nearly 1 million sales of capital assets. As the holding period increases, total sales decrease to just over 410,000 sales two weeks before the long-term rates apply. Some of the decline is due to taxpayers delaying sales until the long-term rate applies, although it appears that most sales are not delayed. In fact, the decline in sales appears to level off at about week –10. Predicted sales follow actual sales quite closely until week –24, at which point actual sales drop off below the counterfactual sales. The gap closes again near week –1 as actual sales level off.

One remarkable aspect of Figure 5 is the number of sales occurring at the short-term rate, just weeks before the long-term rate applies. It seems reasonable to believe that most taxpayers, having waited for 50 weeks, would be willing to wait two more weeks

[8] We test for the sensitivity of the elasticity estimates to this bound by increasing and decreasing the upper bound. The estimated elasticities are qualitatively similar to our baseline estimate reported in Table 2.

Figure 5

Capital Gains Transactions: Sales of Capital Assets in 2012, with Estimated Counterfactual Sales



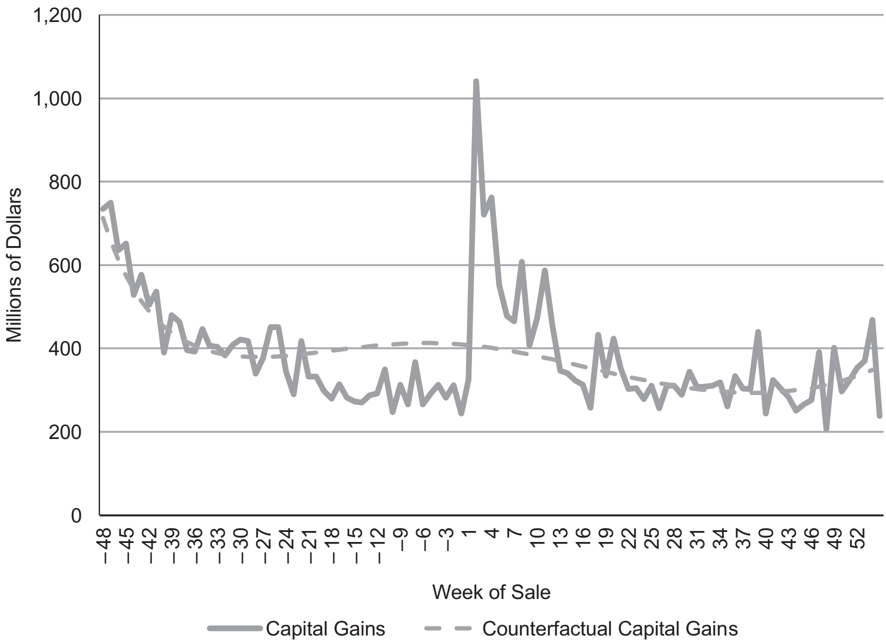
Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

to substantially reduce the tax rate on realized gains. Yet, in week –2, there are over 400,000 sales, and in week –1, there are over 500,000 sales. This is unexpected because an investor selling an asset in week –2 would have a higher after-tax gain at that point only if the potential gain fell by at least 20 percent in the next two weeks. Although a decline that sharp is possible, it would be rather unusual. For example, the Standard & Poor's 500 rose 10 percent over the course of the year 2012 and never experienced a two-week decline greater than 13 percent. Alternatively, taxpayers may be so confident in their abilities to spot appreciating assets that they believe the increased taxes are worth paying in order to make alternative investments.

The holding period pattern for capital gains realizations from the sale of assets follows a similar but more striking pattern, shown in Figure 6. Gains in week –48 are $710 million and, after increasing slightly in week –47 to $750 million, decline over time until event time week –1, when they are $244 million. In the first week in which the long-term rates apply, the gains increase to over $1 billion. Gains then decline

Figure 6

Capital Gains Transactions: Gains from Sales, with Estimated Counterfactual Gains



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

and the decline flattens out at about week 22, when they are $303 million. Similar to sales, predicted gains follow actual gains until week –21. Unlike sales, predicted gains show an increase in weeks approaching week 1. Possible sources of this counterintuitive result are the use of a fifth-order polynomial and the use of eight weeks to define the upper bound. Below, we test the sensitivity of our elasticity calculations to those choices.

As with sales, there are a surprising number of gains just prior to the weeks in which the long-term rate applies. A similar issue occurs in other studies of bunching at kink points and notches, and the lack of a sharp decline has been attributed to frictions (Kleven, 2016). Friction does not appear to be the source of sales in our case. We show this by plotting gains from the sale of corporate stocks in Figure 7. Sales of these assets should have little friction, yet there are substantial gains realized just short of the drop in rates. As we discussed above, some of this may be due to taxpayers having losses available to offset the short-term capital gain.

Figure 7

Capital Gains Transactions: Gains from Sale of Corporate Stocks, 2012

Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

ELASTICITY ANALYSIS AND RESULTS

In this section, we use the counterfactual sales and gains described in the previous section to estimate short-run elasticities of sales and gains, respectively. The difference between actual sales realized and the counterfactual sales that would have taken place without the long-term rate is those that occur only because of the preferential rate. Comparing the percent increase in gains to the percent decrease in rates then yields our elasticity measure. When estimating the elasticity, we only count actual and counterfactual sales inside the window around week 1. We also use the relationship between the average short- and long-term gains depicted in Figure 3 to calculate a quasi-permanent elasticity. Unlike previous research, we find that the short-run gains elasticity is lower than the long-run elasticity.

We first calculate the short-run elasticity of sales, which estimates the change in the probability of sale from a decrease in the preferential tax rate τ_L. For sales in week t, this elasticity is

$$(3) \quad \eta^S = -\frac{dS}{d\tau_L}\frac{\tau_L}{S}.$$

We estimate this with

$$(4) \quad \widehat{\eta^S} = -\frac{\sum_{t=lb}^{-1} \Delta\#(\textit{short-term sales})_t}{\sum_{t=lb}^{-1}(\textit{potential\# short-term sales})_t}\frac{\sum_{t=lb}^{ub}\tau_{S,t}}{\sum_{t=lb}^{ub}(\tau_{S,t}-\tau_{L,t})}.$$

The potential number of short-term sales is the number of sales that would take place if $\tau_L = \tau_S$. Removing the time subscript and considering only the sales in the window, Equation (4) can be simplified as

$$(5)\quad \widehat{\eta^S} = -\frac{\Delta\#(\textit{short-term sales})}{\tau_S - \tau_L}\frac{\tau_S}{\#(\textit{short-term sales})}.$$

This elasticity is similar to a cross-price elasticity, and a reduction in the tax rate on long-term capital gains should decrease the number of short-term sales.

We can also calculate an elasticity with respect to capital gains realizations. Equation (6) shows the simplified version of the calculation for the tax elasticity of capital gains realizations where we have removed the time subscript:[9]

$$(6)\quad \widehat{\eta^g} = -\frac{\Delta(\textit{short-term gains})}{\tau_S - \tau_L}\frac{\tau_S}{(\textit{potential short-term gains})}$$

Rather than summing across all t, we only include weeks for which short-term gains are deferred. The model in Appendix A predicts that if all taxpayers faced the same discount rates and rates of return, there would be some waiting period m prior to which short-term gains were realized and beyond which no short-term gains at all were realized. If discount rates and rates of return are randomly distributed, there will be a distribution of waiting periods and some maximum time beyond which no taxpayer will wait.

Table 2 reports the short-run elasticities for sales and gains. Column (1) reports the short-run sales elasticity described in Equation (5). The first row of the table reports that this elasticity for all gains transactions is –0.13 and a standard error of 0.108. The low elasticity results from the large number of sales just before the rate decrease and the relatively small number of sales just after that decrease. The relatively large standard errors reflect the sensitivity of the estimates to the stopping rule used for determining the lower bound of the shifting window.[10] Most of the sales elasticity estimates described in the next section share this feature. Gains, column (2), are more responsive with an elasticity of –0.47 and a standard error of 0.04. The second row reports elasticities for the sale of corporate stock. Although Figure 7 shows that there are many realizations just short of week 1, the estimated elasticities are nevertheless higher than those for all assets.

The estimates in columns (1) and (2) are significantly lower than other estimates, such as those reported by either Saez (2017) or Auten, Splinter, and Nelson (2016). The elasticities that we estimate are with respect to short-term capital gains realizations that will either be realized today or in several weeks. Thus, they are based on the accrued

9. An analogous equation where we swap out "short" for "long" would allow us to calculate the tax elasticity of long-term capital gains realization, $\widehat{\eta_t^{lg}}$. However, since by construction we require that the change in short-term gains equals the change in long-term gains and measure the percent change relative to the potential short-term gains that we estimate would have been realized without a preferential rate, the estimated elasticity would be identical.

10. We use the same baseline with an upper bound of week 8 and a fifth-order polynomial for both sales and gains. As shown in our sensitivity analysis in Table 4, a more flexible polynomial, or a lower upper bound, results in more precise estimates of sales. To a lesser degree, the large standard errors also reflect the fact that our bootstrapped standard errors were created by clustering at the taxpayer level. If, instead, we simply sample transactions without clustering, the elasticity of sales is significant at the 5 percent level but not the 1 percent level.

Table 2
Estimated Tax Elasticities

	(1) Short-Run Elasticity of Sales	(2) Short-Run Elasticity of Gains	(3) Quasi-Permanent Elasticity (Omitting Window)	(4) Quasi-Permanent Elasticity (Including Window)
Baseline sample	–0.129	–0.468	–0.794	–0.867
	(0.108)	(0.040)	(0.064)	(0.054)
Corporate stock	–0.185	–0.549	–0.857	–0.921
	(0.038)	(0.046)	(0.077)	(0.064)

Source: Authors' calculations from Statistics of Income (2016) data. Bootstrapped standard errors are reported in parentheses.

gains in recently purchased assets. In contrast, the transitory elasticities estimated by the 2013 rate increase potentially bring in many years of accrued gains. Accrued gains are many multiples larger than long-term capital gains realizations and so using them as a base would lead to substantially smaller elasticities.[11]

Although we focus on estimating the short-run elasticity in this paper, we can use the data represented in Figure 3, which compares average gains, to calculate a quasi-permanent elasticity. It is permanent in the sense that it represents the difference in average gains associated with different tax rates, rather than how gains respond to changes, permanent or otherwise, in rates. However, it only represents the difference in gains around the change in rates and says less about the average gains of assets held for substantially longer periods.

We calculate this elasticity in columns (3) and (4). The average combined federal and state tax rate for weeks –48 to –21 is 0.274, and for weeks 9–54, it is 0.136. The average gain in the early period is \$660, while it is \$1,140 in the later period. The arc elasticity calculated excluding the transactions in the shifting window is, therefore,

$$\frac{660 - 1{,}140}{\frac{660 + 1{,}140}{2}} \times \frac{\frac{0.274 + 0.136}{2}}{0.274 - 0.136} \approx -0.79.$$

That estimate is qualitatively similar to the persistent elasticity estimate of –0.72 in DMM. Column (4) reports the results when we include the transactions in the shifting window. As noted, the average weekly gains in week 1 are 32 percent above the average

[11] The Federal Reserve Board estimates that the personal sector had financial assets worth approximately \$54 trillion in 2012 (Table L.6 Derivation of Measures of Personal Savings). The SOI reports that total taxable net capital gains realizations in 2011 and 2012 were \$403 and \$645 billion, respectively, representing approximately 1 percent of financial assets.

over weeks 1–54. This measure of the quasi-permanent elasticity is, therefore, somewhat inflated by this difference. This calculation may be too high because it includes the re-timed gains shifted in response to the tax rate reduction for assets held for a year.

V. SENSITIVITY ANALYSES

The surprisingly large amount of gains realized the week before long-run rates apply is similar to the clustering found in studies of other taxpayer behavior. In those papers, the existence of economic activity on the "short" side of a notch or kink has been attributed to frictions. In our study, this could lead to lower elasticity estimates than have been found previously. Because we observe sales just prior to the rate change of all capital assets, even for the relatively frictionless corporate stock, we explore several alternative explanations.[12] We also test the sensitivity of our elasticities to two econometric specifications. We present the resulting elasticities in tables, with supporting figures in Appendix B.

A. Taxpayers Offset Gains with Losses

Some taxpayers might be less responsive to the rate changes because they have a capital loss or a business loss that can be used to offset any short-term gain, effectively reducing their marginal tax rate on capital gains to zero.[13] Because these losses reduce the effective marginal tax rate to zero, taxpayers have no incentive to delay realizations until the tax rate drops. To examine the effect these taxpayers had on our elasticity estimates and the realization of gains just prior to the decline in rates, we separately analyze those with overall net losses in excess of $3,000 in 2012 and those with overall net gains in 2012.

Table 3 shows that the elasticity of sales for those with net losses greater than $3,000 is close to the elasticity in the overall sample. The elasticity of sales is actually lower for taxpayers with net gains at the end of the year than for those with net losses greater than $3,000, although both estimates have large standard errors and the difference is not statistically significant. However, the elasticity of gains for those with a net gain at year's end is nearly two-thirds larger than the elasticity for those with net losses greater than $3,000, and this difference is statistically significant at the 1 percent level. Moreover, the quasi-permanent elasticity for those with a net gain is nearly four times larger than that for those with net losses greater than $3,000. The reason for this difference is clearly shown in Figure B2 of Appendix B, which compares the average gain for those with an overall net gain to those with an overall loss greater than $3,000. Thus, it appears that part of the reason for low estimated elasticities is the presence of losses for some taxpayers.

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[12] Investors might have contracts to deliver product, or equity, in a year's time and hedge their risk by purchasing a put or call option (the option to buy or sell at a specific price at a future date). However, these options represent only about 10 percent of the sales that occur in the two weeks prior to the drop in tax rates.

[13] See Appendix A, Equation (A8).

Table 3

Sensitivity of Estimates to Alternative Assumptions about Taxpayer Behavior

	Short-Run Elasticity of Sales	Short-Run Elasticity of Gains	Quasi-Permanent Elasticity (Omitting Window)	Quasi-Permanent Elasticity (Including Window)
Taxpayers with net losses > $3,000	–0.121 (0.070)	–0.326 (0.053)	–0.264 (0.101)	–0.379 (0.082)
Taxpayers with net gains at end of year	–0.098 (0.084)	–0.541 (0.053)	–0.996 (0.093)	–1.065 (0.075)
No “day traders”	–0.088 (0.139)	–0.479 (0.048)	–0.889 (0.070)	–0.936 (0.060)
Day traders	–0.137 (0.051)	–0.428 (0.060)	–0.328 (0.150)	–0.554 (0.114)
Infrequent traders	–0.098 (0.073)	–0.576 (0.067)	–1.197 (0.082)	–1.228 (0.074)
Frequent traders	–0.142 (0.044)	–0.412 (0.035)	–0.605 (0.087)	–0.752 (0.064)
AGI > $500,000	–0.209 (0.018)	–0.634 (0.053)	–0.905 (0.073)	–0.997 (0.058)
AGI > $1,000,000	–0.253 (0.017)	–0.725 (0.062)	–0.889 (0.092)	–1.015 (0.077)
Realized a gain in weeks 1–7	–0.129 (0.079)	–0.468 (0.037)	–0.792 (0.068)	–0.867 (0.057)
First quarter gains	–0.247 (0.047)	–0.590 (0.110)	–0.471 (0.108)	–0.587 (0.095)
Fourth quarter gains	–0.123 (0.034)	–0.517 (0.057)	–1.323 (0.101)	–1.276 (0.085)
First three quarters of 2012	–0.148 (0.109)	–0.435 (0.070)	–0.632 (0.081)	–0.736 (0.065)

Source: Authors’ calculations from Statistics of Income (2016) data. Bootstrapped standard errors are reported in parentheses.

Those with overall net losses have a much smaller spike in gains in week 1, indicating that they are shifting fewer gains into week 1 than those in a net gain position at year's end.[14] Yet, gains for those with net losses greater than $3,000 were actually lower in the weeks leading up to the tax change and essentially identical in the final three weeks. The difference in elasticities suggests that at least some taxpayers do respond to tax rates, yet there are still substantial amounts of gains realized just before tax rates fall.

B. Taxpayer Confusion about Rates

Poterba (1987) and Auerbach, Burman, and Siegel (2000) show that taxpayers rarely minimize their taxes by using capital losses to offset their gains and some of their ordinary income. Dhar and Zhu (2006) and Odean (1998) show that there is substantial heterogeneity in the degree to which individual investors make optimal portfolio decisions. In particular, they show that higher income, professional, and experienced investors are less likely to keep stocks with a loss than other investors and, therefore, are less likely to exhibit the disposition effect. We explore a similar possibility here that some taxpayers realize gains just before the decline in tax rates because they do not understand the tax schedule. We test this three ways. First, we estimate elasticities for those with an AGI of at least $500 thousand and at least $1 million (under the assumption that taxpayers with very large incomes can afford investment managers) and compare them with the estimates for the overall sample. Second, under the assumption that day traders are less-savvy investors, we split the sample into those taxpayers who made 16 or more transactions of assets held for fewer than 24 days and those that made fewer transactions.[15] Third, Dhar and Zhu (2006) show that investors with more transactions (either short or long) are more sophisticated and less prone to the disposition effect. To investigate this possibility, we also split the sample into infrequent traders, who are in the 1st–9th decile by number of transactions, and frequent traders, who are in the 10th decile. Finally, we estimate elasticities of gains of those who realized a gain in event weeks 1–7, under the assumption that they are more likely to understand the tax implications of selling an asset that has been held for more than one year.

The results in Table 3 show that the elasticity of both sales and gains is larger for those with an AGI of at least $500 thousand and even larger for those with an AGI of at least $1 million. These are consistent with the results of Auerbach, Burman, and Siegel (2000) and Dhar and Zhu (2006) that higher income taxpayers or investors appear to be either more tax savvy or less prone to the disposition effect. Additionally, Saez (2017) finds that higher income taxpayers appear to have a much higher shifting elasticity. Although our results suggest that these taxpayers are more sophisticated about taxation, Figure

[14] The existence of any spike at all may be due to the shifting of gains by taxpayers who did not recognize they would have overall net losses by the end of the year. See Appendix B, Figure B1.

[15] We chose 16 because it represents the 90th percentile in the distribution of transactions by taxpayers for assets held for less than 24 days.

B3 in Appendix B shows that both groups still realize a substantial amount of gains just prior to the decline in tax rates. So, while taxpayers with higher incomes appear to be savvier, they, like other taxpayers, also do not appear to fully optimize their sales. Indeed, almost a third of the losses realized in week 1 are by taxpayers with incomes in excess of $500 thousand.

Turning to our measure of less sophisticated investors, consistent with our priors, the short-run elasticities of day traders are lower, although statistically insignificantly different from the elasticity of non–day traders. The quasi-permanent elasticities of day traders are lower, likely because the sample consists of taxpayers with very short time horizons, whereas, we surmise, the non–day traders employ a buy and hold strategy more often. As a consequence, they are less likely to sell in the weeks just prior to the one-year holding period.

Using Dhar and Zhu's measure of a sophisticated investor, we find that infrequent traders have a higher short-run elasticity for gains than frequent traders, although neither difference is statistically significant at the 5 percent point. So, while frequent traders may be less prone to the disposition effect, they do not appear to be more tax savvy. The quasi-permanent elasticities of frequent traders are also substantially lower than those of infrequent traders. However, that may reflect the fact that for a given amount of assets, investors that respond to the tax incentives by holding assets for longer periods of time naturally trade less frequently.[16]

C. Last Minute Sales to Avoid 2013 Tax Increase

The tax cuts that were enacted in 2001 and 2003, and subsequently extended through tax year 2012, reduced ordinary tax rates and the preferential rate on capital gains and dividends. The top ordinary rate for 2012 was 35 percent and the top capital gains rate was 15 percent.[17] These rates were scheduled to increase at the end of 2012 to 39.6 percent and 20 percent, respectively. It is possible that the large amount of sales and gains in the weeks prior to the drop in tax rates is caused by taxpayers rushing to realize gains at the end of 2012 before the anticipated higher rates took place. Short-term elasticities may drop if gains on assets held for slightly less than a year are realized in the final weeks of 2012. Long-term elasticities may increase if assets that were held for more than a year with the intention of being held for many more years are instead sold in the final weeks of 2012. To explore this, we compare gains realized in the first three quarters to those realized in the last quarter (not including the last two weeks of the calendar year). To reduce the possibility that anticipation of events in the fourth quarter (such as the presidential election) affects our comparison, we also compare gains made in the first quarter to those made in the fourth quarter.

[16] Consistent with the estimated elasticities being insignificantly different from our baseline estimates, Figures B4–B6 in Appendix B do not show a substantial drop in gains just prior to week 1.

[17] In addition to the anticipated capital gains tax rate changes for 2013, Public Law 111-152 enacted in 2010 imposed a 3.8 percent net investment income tax for high-income taxpayers. This tax was legislated to go into effect for taxable years beginning after December 31, 2012.

Overall, we find little evidence that short-term elasticities were affected. We find evidence that quasi-permanent elasticities in the fourth quarter were affected, although the elasticities in the first three quarters are qualitatively similar to the year-long elasticities. As shown in Table 3, the short-run elasticities of sales in the fourth quarter are nearly identical to the elasticity calculated on the first three quarters, while the short-run elasticity of gains is slightly larger in the fourth quarter.[18] Comparing the first and fourth quarter results, we see that the first quarter sales elasticity is twice the fourth quarter elasticity. The difference between the short-run sales elasticity in the first quarter and the first three quarters may be due to additional anticipatory shifting in the third quarter. Alternatively, the first quarter elasticity may be unusually high for other reasons. The quasi-permanent elasticities in the fourth quarter are much larger than those in the first quarter. The reason for this difference becomes clear from reviewing the averages. In the first quarter, average short-term gains (omitting the window) were $756, while average long-term gains (omitting the window) were $1,064; gains increased by 33 percent. In the fourth quarter, those averages were $525 and $1,319, respectively; gains increased by 86 percent.[19] The much larger quasi-permanent elasticity for fourth quarter gains suggests that some of the quasi-permanent response was in anticipation of the 2013 rate increases. If so, estimates of the quasi-permanent elasticity for the first three quarters more accurately reflect investor behavior.

D. Sensitivity of Results to the Choice of Polynomial and Upper Bound of Window

Because the order of polynomial and the upper bound of the window are somewhat arbitrary, we test the sensitivity of our estimated elasticities to those choices. The results are reported in Table 4. We vary the upper bound from week 4 up through week 12 but find no significant differences in the estimated elasticities.[20] Gelman and Imbens (2018) argue that higher order polynomials should not be used for bunching estimators because doing so results in imprecise and incorrect results. To address this concern, we vary the order of the polynomial used to estimate counterfactual gains from the third order up through the seventh order. Elasticity estimates based on third-order polynomials are distinctly lower than those of higher order. There is little variation in estimates using fourth-order or higher polynomials. The standard errors for the elasticity of sales are noticeably lower when calculated using sixth- and seventh-order polynomials. Overall, the choice of upper bound on the window or the use of polynomials of order four or higher has little effect on our estimates.

[18] A visual inspection of the panels of Figure B6 in Appendix B shows that substantial gains just prior to week 1 are evident in both the first and last quarters of 2012.

[19] Both of these calculations divide the difference between short- and long-term gains by the average of short- and long-term gains.

[20] Some of the standard errors become quite large as the number of weeks increases. Also, using an upper bound of week 6 or less results in statistically significant estimates of the short-run elasticity of sales.

Table 4

Sensitivity of Estimates to Alternative Econometric Specifications

	Short-Run Elasticity of Sales	Short-Run Elasticity of Gains	Quasi-Permanent Elasticity (Omitting Window)	Quasi-Permanent Elasticity (Including Window)
Upper bound				
Week 4	–0.113	–0.451	–0.810	–0.867
	(0.015)	(0.039)	(0.064)	(0.057)
Week 6	–0.124	–0.453	–0.809	–0.867
	(0.046)	(0.036)	(0.061)	(0.054)
Baseline				
Week 8	–0.129	–0.468	–0.794	–0.867
	(0.108)	(0.040)	(0.064)	(0.054)
Week 10	–0.113	–0.460	–0.751	–0.867
	(0.199)	(0.059)	(0.078)	(0.055)
Week 12	–0.113	–0.451	–0.745	–0.867
	(0.282)	(25.530)	(0.079)	(0.056)
Polynomial order				
3rd order	–0.079	–0.318	–0.747	–0.867
	(0.382)	(0.027)	(0.084)	(0.057)
4th order	–0.123	–0.417	–0.86	–0.867
	(0.131)	(0.074)	(0.088)	(0.057)
Baseline				
5th order	–0.129	–0.468	–0.794	–0.867
	(0.108)	(0.040)	(0.064)	(0.054)
6th order	–0.120	–0.468	–0.799	–0.867
	(0.086)	(0.046)	(0.077)	(0.057)
7th order	–0.159	–0.461	–0.799	–0.867
	(0.019)	(0.041)	(0.068)	(0.056)

Source: Authors' calculations from Statistics of Income (2016) data. Bootstrapped standard errors are reported in parentheses.

CONCLUSION

We use a data set of capital gains transactions to investigate the behavior of taxpayers with respect to the preferential tax rate for long-term capital gains. We find strong evidence that taxpayers respond to the preferential rate by reducing the realizations of gains in the weeks leading up to the point when that rate applies. We estimate a short-run gains elasticity of –0.47 and a short-run sales elasticity of –0.13, although the latter estimate's significance is highly dependent on the specification. We also estimate a quasi-permanent gains elasticity of –0.79. The short-run elasticities are substantially lower in absolute value than some other transitory estimates.

We believe this occurs because our estimates are capturing the shifting of accrued short-term gains rather than the realization of assets held for potentially long periods of time. By focusing on how taxpayers shift a fixed amount of accrued gains over time, our measure abstracts from both the varying large pool of accrued gains and the shifting of realizations from distant time periods into the current period. We, therefore, have a better measure of the value of gains accelerated or decelerated from one calendar year to the other in the face of an announced change in the capital gains tax rate.

Another source for the low short-run elasticity is the surprising amount of gains realized in the weeks immediately prior to that point. We investigate a number of alternative explanations for the apparent low elasticity, including anticipatory tax effects as well as taxpayer and investor sophistication. Similar to Saez (2017) and Auten, Splinter, and Nelson (2016), we find that high-income taxpayers are more responsive with a short-run gains elasticity of –0.725 and a quasi-permanent elasticity of –0.89. We also find evidence that taxpayers in an overall loss position are less sensitive to the preferential rate.

Perplexingly, taxpayers do not appear to engage in tax minimizing sales of assets on either side of the one-year holding that marks the change in tax rates. The small magnitude of the estimated short-run elasticities is caused by at least some taxpayers who realize gains just prior to the one-year holding period, a distinctly inferior tax minimization strategy. We investigate several potential reasons for this behavior, including a number of suggestions from the literature on the disposition effect. Following that literature, we find evidence that frequent traders are less responsive than infrequent traders and that higher income taxpayers are more responsive. However, none of our findings completely rationalizes taxpayer behavior. In another surprising finding, taxpayers also appear to sell losses just after the preferential rate applies. Finally, this last observation does not appear to be due to at least one of the disposition effect behaviors (self-control) suggested by Hersh and Statman (1985), nor does restricting our analysis to "sophisticated investors" (those with frequent trades or high income) resolve the puzzle.

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DISCLOSURE

The authors do not have any financial arrangements that might give rise to conflicts of interest with respect to the research reported in this paper.

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APPENDIX A

Constantinides (1983) describes a complex model of investor behavior. In this appendix, our more limited goal is to describe a theory of how tax rates affect the length of time a rational taxpaying investor will defer the sale of assets. How much is deferred depends not only on the difference between short- and long-term tax rates, but also on the (expected) rates of return of the investments and the taxpayer's discount rate. We ignore transaction costs and assume that at each point in time the rate of return and the discount rate are fixed and known. Because the rates of return are known, the effect of risk is subsumed under the discount rate.

A1. Sales with Short-Term Tax Rates

To isolate the effects of discount rates and rates of return on investor behavior, we first analyze investor decisions when only ordinary tax rates apply. Each week, taxpayers evaluate their portfolios and can choose to continue holding their assets or to sell an existing asset and use the resulting funds to purchase another asset or use them in some other way. For simplicity, we consider a taxpayer in week t holding one asset with selling price P_t that was purchased in week 0 for price B. Without loss of generality, we set $B = 1$ so that P_t may be thought of as P_t/B.

If the taxpayer sells at time t, the after-tax price is

(A1a) $$P_t^S = P_t - \tau_S(P_t - 1)$$

or

(A1b) $$P_t^S = P_t(1 - \tau_S) + \tau_S,$$

where the tax τ_S is the short-term rate equal to the tax rate on ordinary income. The 1 in Equation (A1a) represents the subtraction of the basis so that only gains are taxed, which appears as τ_S in Equation (A1b). If $P_t > 1$ when the taxpayer sells the asset, the taxpayer realizes a gain and incurs a tax liability of $\tau_S(P_t - 1)$. If $P_t < 1$ when the asset is sold, the taxpayer realizes a loss.

Rather than sell the asset, the taxpayer can choose to hold it for a period, represented by m, and then sell. If the pre-tax rate of return while holding the asset is r, at time $t + m$, the pre-tax price of the asset P_{t+m} is $(1 + r)^m P_t$. The after-tax price is then

(A2) $$P^S_{t+m} = (1+r)^m P_t\,(1-\tau_S) + \tau_S = (1+r)^m P_t - \tau_S((1+r)^m P_t - 1).$$

At time t, if the taxpayer decides between selling immediately or waiting m periods, she compares the after-tax price at t in Equation (A1) to the after-tax present discounted value of selling at $t + m$:

(A3a) $$PDV_t(P^S_{t+m}) = \frac{1}{(1+d)^m} P^S_{t+m}$$

or

(A3b) $$PDV_t(P^S_{t+m}) = \left[\frac{1+r}{1+d}\right]^m [P_t(1-\tau_S)] + \frac{\tau_S}{(1+d)^m},$$

where d is the discount rate assumed to be positive. That discount rate represents the next best use of the funds embedded in the asset. That could be an alternative investment or simple consumption, and the discount rate can be greater than, equal to, or less than the rate of return.[21] She will sell the asset at time t if

(A4a) $$\left[\frac{1+r}{1+d}\right]^m [P_t(1-\tau_S)] + \frac{\tau_S}{(1+d)^m} < P_t(1-\tau_S) + \tau_S$$

or

(A4b) $$PDV_t(P^S_{t+m}) < P^S_t.$$

From Equation (A4), we have the following implications:

(1) If $d > r$, the return from immediately selling the asset is greater than the present discounted value of selling the asset at any future date. This follows from the fact that for all positive m, $[(1 + r)/(1 + d)]^m$ is less than 1 and $\tau_S/(1 + d)^m$ is less than τ_S.

(2) The taxpayer will prefer to immediately sell the asset even if $r > d$, if r is not too much larger than d. It is clear that if r is equal to d, the taxpayer is better off immediately selling the asset to recover the untaxed basis τ_S. By continuity, the same logic applies for some r that is only slightly larger than d. In other words, because the present discounted value of not being taxed on the basis at $t + m$ is less than the value at t, the taxpayer will only wait if the rate of return on the asset is sufficiently larger than the discount rate.

[21] Here, we assume that taxes are paid when the gain is realized rather than in the following year.

By implications (1) and (2), taxpayers defer sale into the future if the rate of return is sufficiently high. But they can be induced to wait even with a low rate of return if the after-tax rate of return is sufficiently high. This can occur if the tax rate in the future is lower than the tax rate at time *t*.

A2. Sales with Short-Term Tax Rates and Long-Term Tax Rates

Under present law, the capital gains from the sale of assets held for at least a year and a day are taxed at a preferential rate τ_L.[22] If we assume that the short-term tax applies at time *t* and that the rate decline occurs at $T = t + m$, the taxpayer compares the value of selling the asset P_t^s to the present discounted value of holding the asset until *T*. The taxpayer sells at *T* if

$$\text{(A5)} \quad P_t(1-\tau_S)+\tau_S < \left[\frac{1+r}{1+d}\right]^m [P_t(1-\tau_L)] + \frac{\tau_L}{(1+d)^m}.$$

The only difference between Equations (A4) and (A5) is the lower preferential tax rate on long-term capital gains. As in Equation (4), this inequality may be satisfied if $r > d$. However, it may also hold when $r < d$ as long as τ_L is sufficiently lower than τ_S. Estimating the elasticity of capital gains taxes involves estimating the number of sales for which the investor defers sale only because of the lower tax rate on long-term gains. That occurs when

$$\text{(A6)} \quad PDV_t(P_{t+m}^S) < P_t^S < PDV_t(P_{t+m}^L),$$

where P_{t+m}^L is the price at $t + m$ and after long-term tax rate τ_L. The model now implies the following:

(3) As *t* approaches *T*, *m* approaches 0 and the right-hand side of Equation (A5) approaches $P_t(1 - \tau_L) + \tau_L$. Comparing this expression with the left-hand side of Equation (A5), if P_t is greater than 1, meaning the asset is sold for more than its basis, the long-term rate is preferable. But, for any positive *m*, there exists a discount rate high enough to encourage an immediate sale at the short-term rate. If P_t is less than 1, so that the asset is sold at a loss, the short-run rate is preferable. As *t* draws closer to *T*, for any given discount rate, taxpayers will tend to harvest losses at the short-run rate but sell assets with capital gains at the long-run rate. This result occurs because the taxpayer prefers to recover their basis at the higher tax rate, τ_S.

(4) If $d > r$ and there is some time t^* and waiting time m^*, $t^* + m^* = T$, such that the taxpayer is indifferent between immediate sale and selling in m^* periods, then for all periods between t^* and *T* the taxpayer will wait to sell the asset at the long-term rate, while for all periods before t^* the taxpayer will sell immediately. That is clearly true when $d > r$ because the right-hand side of Equation (A5) declines monotonically in *m*. Thus, if Equation (A5) holds with equality for some m^*, for all $m < m^*$, the right-hand side exceeds the left-hand side and vice versa for all $m > m^*$.

[22] The federal tax rate on capital gains held for at least a year in 2012 was taxed at a maximum rate of 15 percent, while ordinary income had a maximum statutory tax rate of 35 percent.

From implication (3), we would expect that there are few gains realized on assets held just less than one year. Implications (3) and (4) describe the key idea that taxpayers will only shift realizations a finite amount of time. This is a short-run response to changes in tax rates rather than the sale of assets purchased years in the past. For given tax rates, the length of time taxpayers will wait varies with d and r.

So far, we have considered the tax effect of a single sale. In fact, before calculating taxes, the taxpayer subtracts total losses from total gains from all sales that year. If the taxpayer's short-term losses are greater than her short-term gains, she may subtract her net short-term losses from any long-term gains. If the losses exceed the gains, up to $3,000 of losses can be used to offset ordinary income. Losses in excess of $3,000 can be carried forward into future years.

If the taxpayer also has a short-term loss K_t, the taxable capital gain can be reduced by that loss. Then Equation (A1b) becomes

$$\text{(A7)} \quad P_t^* = \begin{cases} P_t(1-\tau_S)+\tau_S(K_t+1) & \text{if } K_t < P_t - 1 \\ P_t & \text{if } K_t \geq P_t - 1 \end{cases}$$

and Equation (A3b) becomes

$$\text{(A8)} \quad PDV_t(P_{t+m}^*) = \begin{cases} \left[\dfrac{1+r}{1+d}\right]^m [P_t(1-\tau_S)] + \dfrac{\tau_S(K_t+1)}{(1+d)^m} & \text{if } K_t < P_t - 1 \\ \left[\dfrac{1+r}{1+d}\right]^m \times P_t & \text{if } K_t \geq P_t - 1 \end{cases}.$$

This leads to two more inferences:

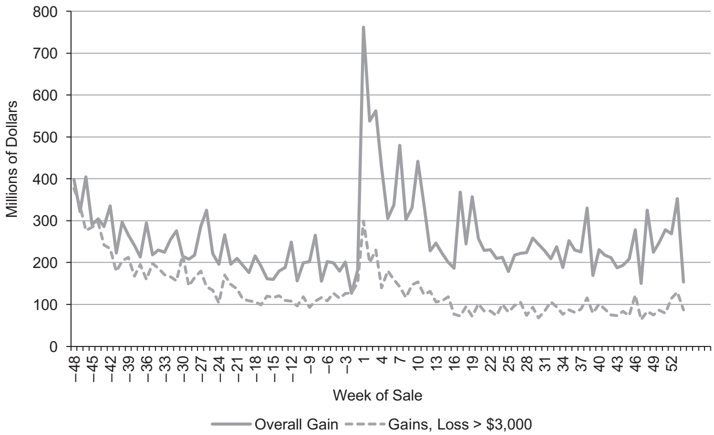
(5) If K_t is less than $P_t - 1$, the loss reduces the tax on capital gains but does not eliminate it. In that case, the decision-making calculus for selling or waiting is similar: because the present discounted value of the basis and tax loss at $t + m$ is less than the value at t, the taxpayer will only wait if the rate of return on the asset is substantially larger than the discount rate.

(6) If K_t is at least equal to $P_t - 1$, the tax is eliminated and so it plays no role in the decision to sell or hold. The taxpayer will then continue to hold the asset if the rate of return r exceeds the discount rate d.

APPENDIX B

Figure B1

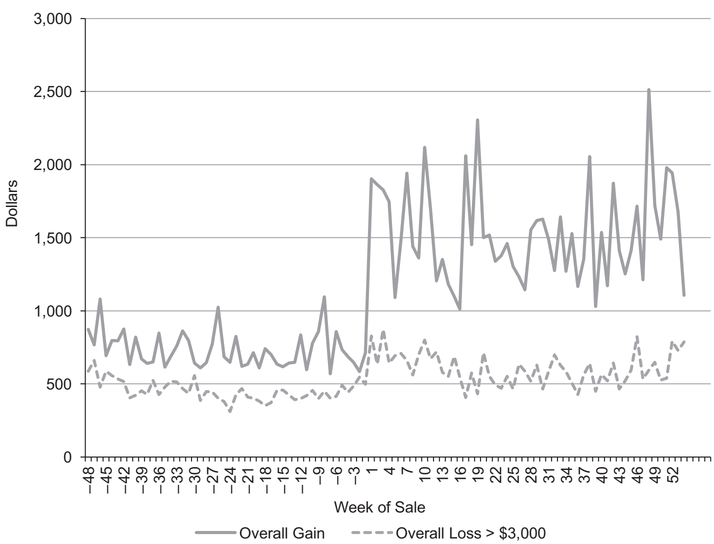
Capital Gains Transactions: Gains in 2012 by Taxpayers Realizing Overall Gains or Losses Greater than $3,000



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

Figure B2

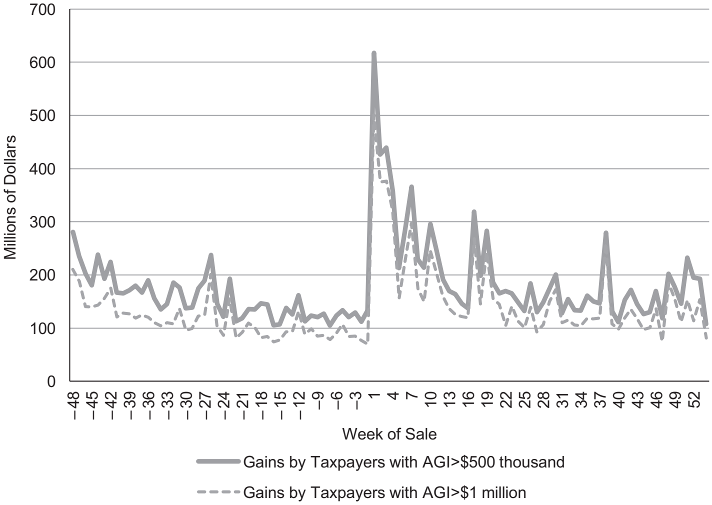
Capital Gains Transactions: Average Weekly Gains by Taxpayers Realizing Overall Gains or Losses Greater than $3,000 in 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

Figure B3

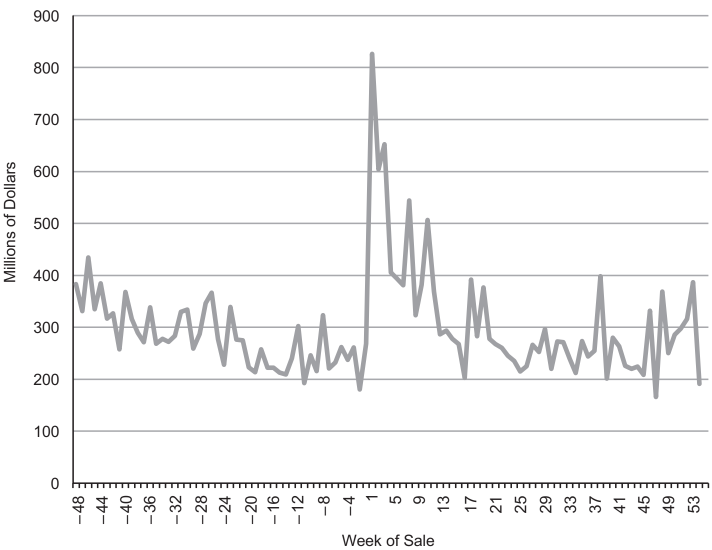
Capital Gains Transactions: Gains by Income Class, 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period. The data are normalized to equal one in week –1.
Source: Authors' calculations from Statistics of Income (2016) data.

Figure B4

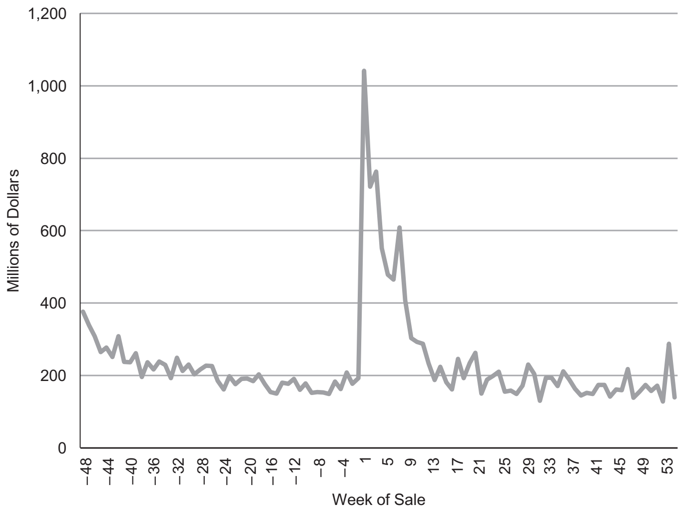
Capital Gains Transactions: Gains in 2012, Eliminate Day Traders



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

Figure B5

Capital Gains Transactions: Gains in 2012 by Taxpayers Who Realized a Gain in Weeks 1–7

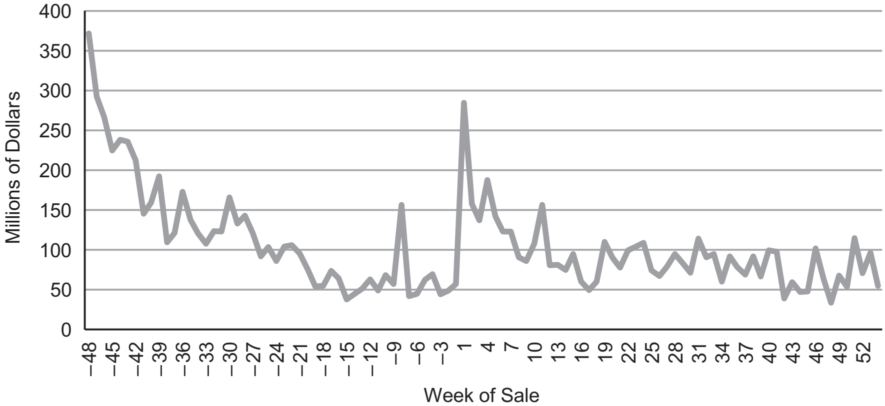


Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors calculations from Statistics of Income (2016) data.

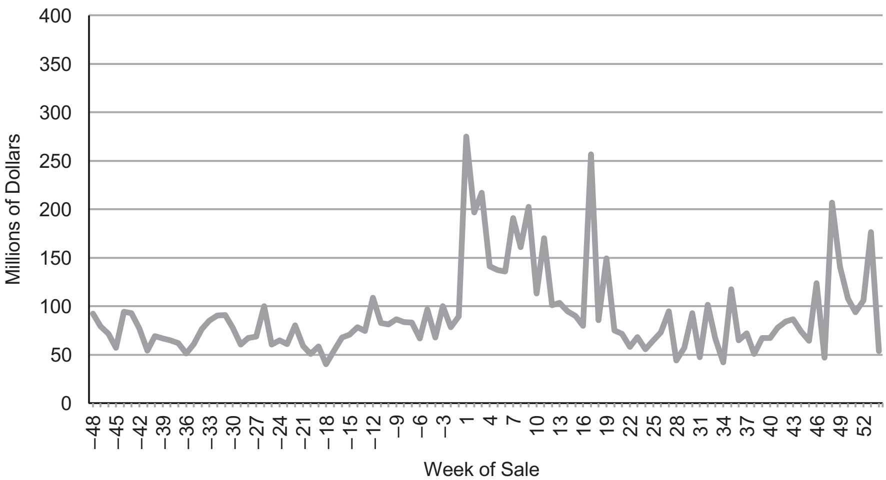
Figure B6

Capital Gains Transactions: Gains in the First and Fourth Quarters of 2012

Panel A: Gains in the First Quarter of 2012



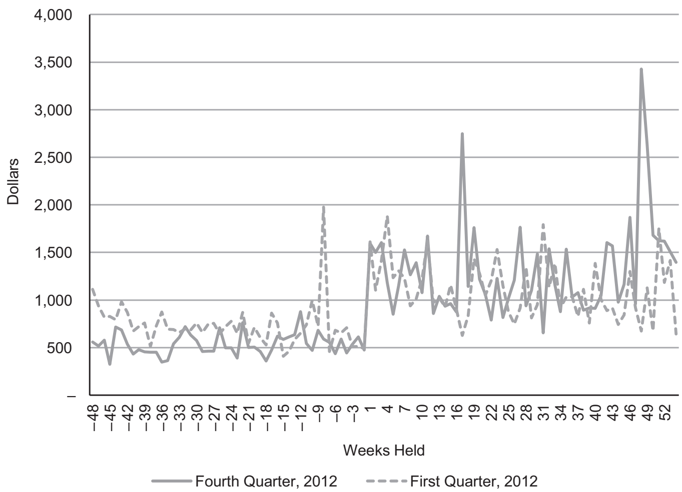
Panel B: Gains in the Fourth Quarter of 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.

Figure B7

Capital Gains Transactions: Average Weekly Gains by Taxpayers Realizing Gains in the First and Fourth Quarters of 2012



Note: The horizontal axis is the number of weeks before and after the one-year holding period.
Source: Authors' calculations from Statistics of Income (2016) data.