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The behavior heuristics responsible for formation and liquidation of tax holding accounts

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Abstract

This article proposes the *tax liquidation hypothesis*, a predictable pattern of behavior regarding individuals' decisions to create and subsequently to liquidate "Cash Holding" accounts when facing tax liabilities. Previous research on tax related trading has focused on minimizing the individual tax burden by holding winners and selling losers. This behavior, described as "optimal tax trading" suggests that individuals should sell stocks that have lost value in the short-term while holding onto stocks that have gained value until the stocks can be sold at the preferential long-term capital gains rate. This article proposes the *tax liquidation hypothesis* based on investor behavioral biases and the current tax environment. Individual investors will hold "cash" accounts that are consistent with their preferences for risk and return. The cash account holdings may differ across individuals, but the pattern and hypotheses regarding formation and liquidation of these accounts for tax reasons should be consistent with the model proposed by this article.

1. Introduction

This article examines the behavioral biases that lead individuals to create accounts with specific characteristics when facing sizeable tax liabilities and the subsequent behavior to liquidate these accounts at the time of tax filing. We call the pattern of selection and subsequent liquidation because of prevalent behavior heuristics the *tax liquidation hypothesis.* According to Constantinides (1983), an investor who engages in optimal tax trading will hold a "cash account" for the purpose of tracking his or her net liability due at tax filing. Every transaction, with taxable implications, will have an effect on the balance of this

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account, with subsequent gains causing an increase in holdings, while losses, which can be used to offset prior gains, will cause a decrease to net holdings. This behavior, described as "optimal tax trading" by Constantinides (1983), focuses on minimizing the individual tax burden by holding winners and selling losers; individuals should sell stocks that have lost value in the short-term while, holding onto stocks that have gained value until the stocks can be sold at the preferential long-term capital gains rate.

Behavioral research across disciplines has shown that individuals do not behave rationally or act in such a way that always maximizes their own self-interest. Shefrin and Statman (1985) explain the *disposition effect* as the suboptimal investor behavior of selling winners too soon and holding on to losers too long. The primary explanations for the disposition effect are *prospect theory* as proposed by the novel prize-winning research of Kahneman and Tversky (1979) and *mental accounting* as proposed by Thaler (1980), collectively referred to as PTMA. Under the PTMA framework, individuals exhibit *loss aversion*, an asymmetric response to losses and gains of equal sizes, and focus too narrowly on individual security results as opposed to portfolio results. These biases influence investors to behave in a manner that violates optimal tax trading as described by Constantinides (1983), and creates sizable tax liability due at filing.

Following the creation of a tax liability, as a result of portfolio turnover, an individual must make a decision on where to hold the proceeds until tax filing. It is likely that the choice of holding account varies according to individual risk preferences, investment horizon, financial sophistication, wealth, income, and relative magnitude of potential tax liability. Furthermore, the behavioral biases present will also vary by individual as well as magnitude, but the extant literature suggests we may be able to detect evidence of this behavior in assets with specific characteristics. This article holistically examines behavioral biases as they pertain to asset selection and explores the potential effects these biases may have on security returns. The *tax liquidation hypothesis* proposes that the behavioral heuristics that have been shown to exist will lead to a consistently identifiable pattern in certain asset classes. Confirmation of this hypothesis will require identification of likely holding accounts as well as a statistically significant relationship between return and volume characteristics and the deterministic variables.

The intent of this research is to link the rules governing U.S. tax filing, and optimal tax trading with the behavioral characteristics that influence the individual selection of "tax holding accounts." Section 1 identifies the rules governing tax filing. Section 2 reviews the theoretical optimal tax minimization strategy. Section 3 briefly explains optimal tax trading. Section 4 proposes the behavioral biases that cause investors to deviate away from optimal tax trading as well as the heuristics that influence cash account selection and liquidation. Section 5 presents the hypotheses, summarizes the data and methodology, identifies real asset classes that closely fit the desired characteristics and a brief empirical examination. Section 6 concludes.

2. Tax timing

The U.S. tax codes governing capital gains and losses provide value to an investor who is tax savvy and engages in optimal tax timing as described by Constantinides (1983, 1984). These rules are summarized by Brickley, Manaster, and Schallheim (1991) as follows:

1. Capital gains and losses are recognized for tax purposes when they are realized, not as they occur.
2. The tax rate is higher for short-term capital gains and losses than for long-term capital gains.
3. (Offset Rule) If there are net short-term losses, they must be used to offset net long-term gains before any tax rate is applied. Such offsets reduce the tax advantage associated with short-term losses that otherwise could be deducted directly from taxable income.
4. (Wash Sale Rule) Losses for tax purposes are not allowed if an asset is sold for a loss and repurchased within 30 days.
5. ($3,000 Limit Rule) Capital losses can be used to deduct a maximum of $3,000 taxable income in any year. Losses greater than $3,000 can be carried forward indefinitely.
6. (Safe Harbor Rule) To avoid penalty a taxpayer must make minimum estimated tax payments equal to either 100% (110% for high income individuals) of the previous year's tax liability, or 90% of the current year's tax liability.[1]

From (2) and (3) it is clear that it is optimal to realize losses in the short run which are subject to the higher rates; from (6) it should be clear that it is optimal to prepay 100%[2] in years with unanticipated liability and 90% otherwise. In years when there are large uncovered capital gains (gains not covered by losses) the remainder of the tax liability comes due in April. Net short term capital losses offset long term capital gains on a dollar for dollar basis. Therefore, an increase in the capital gains tax rate increases the amount of taxes that capital losses can offset (Constantinides and Scholes, 1980). Capital gains tax rates also determine the amount of money to be set aside in a holding account for the purposes of paying the aforementioned liability.

It is also worth noting that high net worth individuals must make estimated tax payments on a quarterly (monthly) basis in accordance with the rules for Safe Harbor. A rational investor expecting to have gains in the current year that are larger than the previous year's gains will opt to pay quarterly payments equal to 100% of the previous year's tax liability. Alternatively, an investor who expects to have gains that are less than the prior year's gains will opt to make payments equal to 90% of the current year's tax liability. No rational investor will opt to pay the full amount of taxes, in essence prepaying taxes not due until the following year. This would violate time value of money as the investor would forego any possibility of earning additional income. Furthermore, the interest penalty on untimely payments compels investors to make estimated payments; therefore, foregoing the option to delay all payments until the following tax year of concern.[3] Thus, the *tax liquidation hypothesis* proposes that the effect is larger in years when there is unanticipated tax liability.

3. Theoretical optimal tax trading

Consider an investor whose liquid wealth, w, is fully invested in two assets A and B. He purchased both assets at the start of the calendar year and has a one-year investment horizon. He is rational and trades according to the strategy described in Constantinides (1983, 1984).

Under this scenario, the investor realizes capital losses in the short term, "the loss-realization option" (Brickley, Manaster, and Schallheim 1991), and defers capital gains to the long term, at which time he realizes his capital gains to reestablish the short-term status, "the restart option" (Dammon, Dunn, and Spatt 1989). At the end of the calendar year the asset *A* has gained $1,000 while asset *B* has lost $1,000. The investor would realize asset *B* on the last day of the year and postpone the realization of asset *A* until the start of the next calendar year. The loss in asset *B*, commensurate with the investor's marginal tax rate, can be used to offset ordinary income; the gain, which was not realized in the same calendar year, has created a tax liability for the following year commensurate with the long-term capital gains rate. The investor then determines where and how to hold his realized capital gain in a "cash account" with additional capital gains and losses adjusting the level of cash set aside for tax purposes at any given time.[4]

Without making generalizations about the investor's risk preferences we can infer two things: First, time value of money forces the investor to reinvest his cash account. Second, if he has already engaged in optimal tax selling, there is a positive benefit for him reinvesting in assets where he will be able to use additional tax loss selling. Constantinides (1983) estimates the value of the tax-timing option as a fraction of each dollar invested in a security, if the investor fails to take advantage of capital losses. Therefore, if an investor were to hold his anticipated tax liability in a money market account (with no chance of capital losses), he foregoes any possibility of tax-timing and, therefore, destroys value by not having that option.

4. The cognitive environment

This article seeks to understand the decision-making process of individuals facing a tax liability, the decision to establish a holding account, and the subsequent payment of taxes or liquidation of the holding account. For there to be a *tax liquidiation effect* three cognitive conditions must be satisfied:

1. *Loss Aversion.* Investors must exhibit a pattern consistent with the *Disposition Effect*. The absolute utility of a loss is greater than an equal gain: $v(x) < v(-x)$. Investors are more likely to realize gains than losses, thus creating tax liability.
2. *A holding account that maximizes utility under mental accounting.* Investors choose a vehicle consistent with myopic loss aversion, regret aversion, and problems with self-control.
3. *Liquidation of the holding account.* The 'labeling' of accounts reduces the substitutability between accounts, thereby causing an account created to keep track of tax liability to be the first liquidated for tax payment.

4.1. The failure of rational tax trading under prospect theory and mental accounting

Two fundamental and widely accepted cognitive processes are *loss aversion* and *mental accounting*. Empirical research has shown that individuals behave differently with gains and

losses (Barberis and Xiong, 2009; Frazzini, 2006; Grinblatt and Han, 2005; Tversky and Kahneman, 1979,1992). "Prospect theory," as proposed by Kahneman and Tversky (1979), and "mental accounting," as proposed by Thaler (1980), may explain the *disposition effect*. The *disposition effect* is the investor behavior of selling winners too soon and holding losers too long (Shefrin and Statman 1985). In *prospect theory*, utility is defined by gains and losses relative to a predetermined reference point. The utility function is convex in the area of losses and concave in the area of gains. Benartz and Thaler (1995) point out that empirical estimation of the ratio of the slopes in the two regions are approximately two, indicating that individuals are twice as sensitive to losses compared with gains.

Rational analysis suggests that if an investor needs to raise cash then the logical choice is to sell an asset that has declined in value. *Prospect theory* and *mental accounting*, on the other hand, would suggest that individuals would rather sell an asset that has appreciated in value. These two cognitive biases lead investors to engage in *loss aversion* and *narrow framing*, looking at individual assets irrespective of the overall changes in portfolio value.

Odean (1998), using data that tracked the trades of investors with a large discount brokerage firm, found that individual investors were more likely to sell a stock if it had a gain as opposed to a loss. In a later article, Barber and Odean (2004) find evidence that even tax savvy investors realize gains more frequently than losses. The Odean (1998) and Barber and Odean (2004) findings support *mental accounting* over rational analysis. Furthermore, this finding is evidence that investors, while concerned about tax implications, behave in a manner that would generate sizeable capital gains liabilities.

4.2. Establishing a cash account under mental accounting

Thaler and Johnson (1990) describe the *house money effect*, a behavioral bias whereby money earned is more valuable than money won. The transformation of an investment from paper profits to realized gains seems to be a convenient time to reset the reference point thereby making a distinction between money earned and money won. The implication, for this article, is the implicit method by which an investor selects a reference point. A simple explanation is that an investor has a dynamic reference point that is evaluated over some interval. We suggest that the transformation for paper to real profits will reset the reference point, thereby reducing the house money effect because the money is now "real." The selection of a tax holding account should then independent of prior asset performance; selection will be dependent on individual forward looking preferences.

Benartzi and Thaler (1995) explain that the attractiveness of a risky asset depends on the time horizon of the investor. They refer to the combination of loss aversion and a short holding period as *myopic loss aversion.* They find that loss averse investors choosing between a risky asset (such as stocks) and a less risky asset (such as bonds or treasury bills) are more willing to accept the risky asset as the evaluation period, or horizon, becomes longer. Additionally, using a set of parameters consistent with the representative decision-maker, they find that the evaluation period necessary for an investor to be indifferent between the stocks and bonds is approximately one year. The investor who faces a capital gain liability necessarily has an evaluation period no greater than 16.5 months, and in most cases

less than one year.[5] Therefore, the selection of fixed income, as opposed to equity as an asset class for the cash account seems plausible for reinvesting the expected tax liability.

Narrow framing may echo investors' considerations over non-consumption based utility, such as regret. Regret, as explained by Kahneman and Tversky (1982), "is a special form of frustration in which the event one would change is an action one has either taken or failed to take." The feeling of regret for errors of commission is stronger than for errors of omission. The regret of taking an action, and the choice being incorrect, is worse than failing to take the right action. Therefore, the reinvestment in the holding account is likely to be less risky and more likely to avoid regret in the selection of asset choices. Again this points to bonds that historically have less volatility than stocks.

Under the theoretical behavior of Constantinides (1984) the investor sets aside his capital gains tax liability in an account designated for tax purposes and, therefore, may distinguish between this account and his general investment account, consistent with mental accounting. Moreover, this may be a rational utility maximizing behavior if the investor has problems with self-control. Shefrin and Thaler (1981, 1988) propose that mental accounting is consistent with having a set of rules that may help with problems of self-control. There is a hierarchy of accounts, with certain accounts being "off limits" to avoid temptation. Dividends also help discourage dissaving when self-control is an issue.

Shefrin and Statman (1984) explain that mental accounting may justify an investor's preference for dividends. Dividends help investors segregate gains and losses and thereby increase utility. Barberis and Thaler (2003) show that investor' utility with mental accounting is unambiguously higher with dividends. If we define value derived from income, v, the concavity of the utility function because of risk aversion necessitates $v(2) + v(8) > v(10)$. Regular coupons, such as those in bond funds would satisfy the preference for regular income. Furthermore, regular dividend payments increase utility, compared to an equivalent lump sum, because of the time value of money. Shefrin and Statman (1984) argue that paying a dividend also helps investors avoid regret especially when self-control is low, as may be the case with the *house money effect*. Dividends are preferred to capital because it circumvents the investor having to make a decision that they may later come to regret if the decision is "wrong" that is, if the asset they sold subsequently increases in value.

The behavioral biases discussed up to this point suggest the cash account selected be low risk, dividend paying bond funds. Additionally, the loss realization option discussed earlier implies additional investor utility for selecting closed-end funds were gains can be realized at the investor's discretion and not automatically passed through by the fund manager.

Investors who are the most sensitive to taxes, and therefore, do the most to avoid paying them, have a preference for municipal bonds over corporate bonds ceteris paribus. The argument that rational investors should exhibit a tax-related dividend aversion does not apply to these funds because of the tax-free nature of municipal bonds. The relationship between investor sentiment and the holding of municipal bond funds should be evident. Municipal bond funds pay a tax-free dividend and are consistent with myopic loss aversion, regret aversion, and reduce problems associated with a lack of self-control. Therefore, loss-aversion may be a simple but rational reason for investors to choose municipal bond closed-end funds as their cash account.

4.3. Liquidating the cash account under mental accounting

Shefrin and Statman (1994, 2000) explain "behavioral portfolio theory" as an investor having separate mental accounts for different purposes. This phenomenon is supported by several experimental investigations that show people engage in *narrow framing;* paying attention to individual gains and losses rather than total changes. Thaler (1999) explains the separation of sources and uses of funds into specific accounts as the second component of *mental accounting*. These mental accounts are considered independently and the covariation between the accounts is ignored. According to this narrow framing expenditures are grouped into categories for specific purposes, and investments are categorized similarly.

Badrinath and Lewellen (1991) show most securities with losses are liquidated around the turn-of-the-year; it may be the case that investors are simply less willing to liquidate a stock holding, as opposed to a predesignated cash account, to cover tax liability early in the year. Additionally, if the cash account is simply an accumulation of his gains in individual stocks, his decision of where to hold these gains may be driven by loss aversion or regret aversion.

The choice to liquidate the cash account should be inseparable from liquidating other assets for tax related liquidity reasons. Why then would any asset exhibit a systematic pattern consistent with tax liquidation? The answer proposed in this article is based on the psychological research that has given rise to behavioral finance. Thaler (1999) explains that individuals tend to label accounts according to their usage. Expenditures may be grouped to form budgets while wealth is allocated into accounts. There is a hierarchy of accounts such that individuals are more likely to spend current assets before future assets. A checking account is more likely to be used before an investor dips into a 401(k) (Thaler, 1999). Bracketing expenditures and assets by their uses and sources reduces the substitutability between accounts. People use resources differently depending on the labels that are given to each account. By creating an explicit budget individuals are exerting self-control. However, this means that once an account is established as say, "tax liability," then it will be difficult to repurpose these funds for other uses. The household balance sheet would have a liability for current taxes as well as an asset, the cash account, and the hierarchy would suggest that this is the first place to look before using other sources. Essentially, labels matter.

5. Hypotheses

The *tax-liquidation hypothesis* will present as joint hypotheses of lower returns and increased volume in the month of March. Tax-loss selling by definition reduces the amount of taxes owed in a given year.[6] In years with greater tax-loss selling, it is not necessary to liquidate as much to cover tax liability and therefore higher returns are expected.

Hypothesis 1: There is a positive relationship between March returns and the previous years' tax-loss selling as measured by abnormal volume.

The capital gains tax rate, τ, determines the proportion of capital gains that must be set aside to cover tax liability. Since closed-end funds have a finite number of shares, when the

capital gains tax rate is higher we would expect a greater proportion of the total funds to be held for tax purposes. Therefore, the magnitude of the *tax-liquidation hypothesis* will be greater when the capital gains tax rate is higher.

Hypothesis 2a: March returns will be negatively related to capital gains tax rates.

Hypothesis 2b: March volume measures will be positively related to capital gains tax rates.

Taxes on unanticipated capital gains can be deferred until filing in April. It is in the tax payer's best interest to have this money invested as long as possible. Therefore, the *tax-liquidation hypothesis* will be greater when unanticipated capital gains are larger.

Hypothesis 3a: March returns will be negatively related to unanticipated liability.

Hypothesis 3a: March volume measures will be positively related to unanticipated liability.

5.1. Data

Data on security prices, shares outstanding, monthly volume, and monthly returns (including and excluding dividends) comes from the Center for Research in Security Prices (CRSP) monthly stock files. Data on security prices, shares outstanding, daily volume, and daily returns (including and excluding dividends) comes from the CRSP daily stock files. The sample consists of 168 municipal bond closed-end funds over the 1987 to 2009 time period.[7]

This article also looks at a sample of non-municipal closed end funds that trade in the same CRSP share code(s). CRSP share codes are two digit codes that describe the type of security traded. The securities in this article are limited to share codes 14 and 44. The first digit describes the type of security, 1 indicates Ordinary Common Shares, and 4 indicates SBIs (Shares of Beneficial Interest).[8] The second digit, 4, provides further information that both of these securities are limited to closed-end funds. Approximately 66% of funds have CRSP share code 14, the remainder have CRSP share code 44. The defining characteristic of the funds in CRSP codes 14 and 44 is that they are closed end funds that trade on organized exchanges and have uncharacteristically large dividend yields. The average dividend yield is 9.3% per annum over the sample period. On average 9.8 million shares are traded per month. There is a 61% correlation between the average return for municipals and non-municipals in the sample.

The summary statistics, reported in Table 1, show that the average size in closed end funds has been decreasing through time as the number of funds increased. The change in total value follows the rapid growth and subsequent decline in the number of funds reported in Table 1. Moreover, from Table 1 and Fig. 1, we can see the net asset value of the funds, and the number of existing funds follows a pattern that is consistent with the capital gains tax rate changes.

The variable of interest, $March\_Return_{it}$, is defined as the returns in the month of March for fund *i* in year *t*. The average monthly March return excluding dividends is -1.4% and in

Table 1 Descriptive statistics of fund size by year

Year	5%	25%	Median	75%	95%	Mean
1987	$68,266	$180,000	$251,875	$313,875	$1,481,359	$410,964
1988	$50,000	$94,433	$240,833	$444,375	$1,406,353	$351,008
1989	$34,781	$101,250	$211,606	$395,109	$737,603	$299,479
1990	$33,745	$105,830	$185,084	$409,034	$740,759	$294,847
1991	$42,412	$119,170	$203,199	$422,018	$818,751	$311,860
1992	$46,468	$108,609	$188,891	$338,700	$810,294	$279,736
1993	$39,161	$79,512	$141,678	$285,229	$700,638	$234,365
1994	$29,294	$65,327	$128,305	$246,498	$610,256	$203,789
1995	$26,819	$73,650	$149,245	$265,332	$610,301	$215,759
1996	$32,228	$80,790	$160,369	$281,232	$632,618	$229,490
1997	$34,554	$85,121	$164,304	$288,585	$657,765	$239,926
1998	$37,537	$94,246	$168,768	$300,165	$688,365	$248,664
1999	$34,217	$86,765	$160,008	$269,902	$615,480	$224,753
2000	$29,859	$82,095	$147,874	$246,948	$543,165	$204,512
2001	$33,443	$93,627	$171,670	$275,945	$610,246	$234,330
2002	$35,032	$99,979	$176,518	$302,655	$628,480	$248,285
2003	$34,336	$113,535	$182,016	$307,937	$642,584	$254,163
2004	$34,436	$111,322	$181,125	$306,275	$638,152	$252,013
2005	$38,425	$117,276	$185,543	$316,315	$658,978	$658,978
2006	$39,038	$121,109	$186,940	$327,352	$684,099	$264,883
2007	$40,272	$121,257	$186,687	$313,058	$691,640	$260,130
2008	$37,777	$105,118	$164,066	$281,065	$597,404	$230,771
2009	$31,790	$106,078	$164,320	$278,439	$608,199	$237,400

Notes: This shows the descriptive statistics of market cap for end funds that exist in a given year for which data was available. There are 168 funds and 22 years of data available. Dollar amounts are in 1,000s.

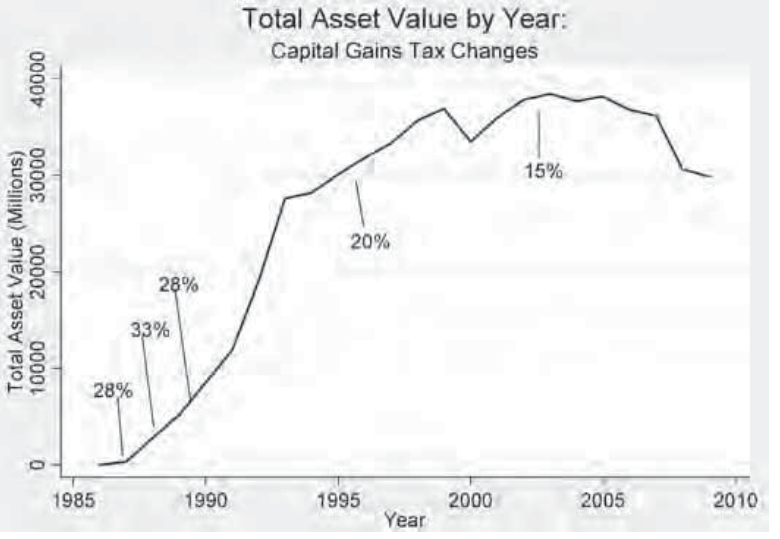

Fig. 1. Total asset value of muni bond closed-end funds by year. The figure shows the cumulative value of all existing municipal bond closed-end funds in the sample with data available during the 1987–2009 time period. The percentages depict the top marginal tax rate for capital gains. Before 1997 capital gains were taxed as ordinary income.

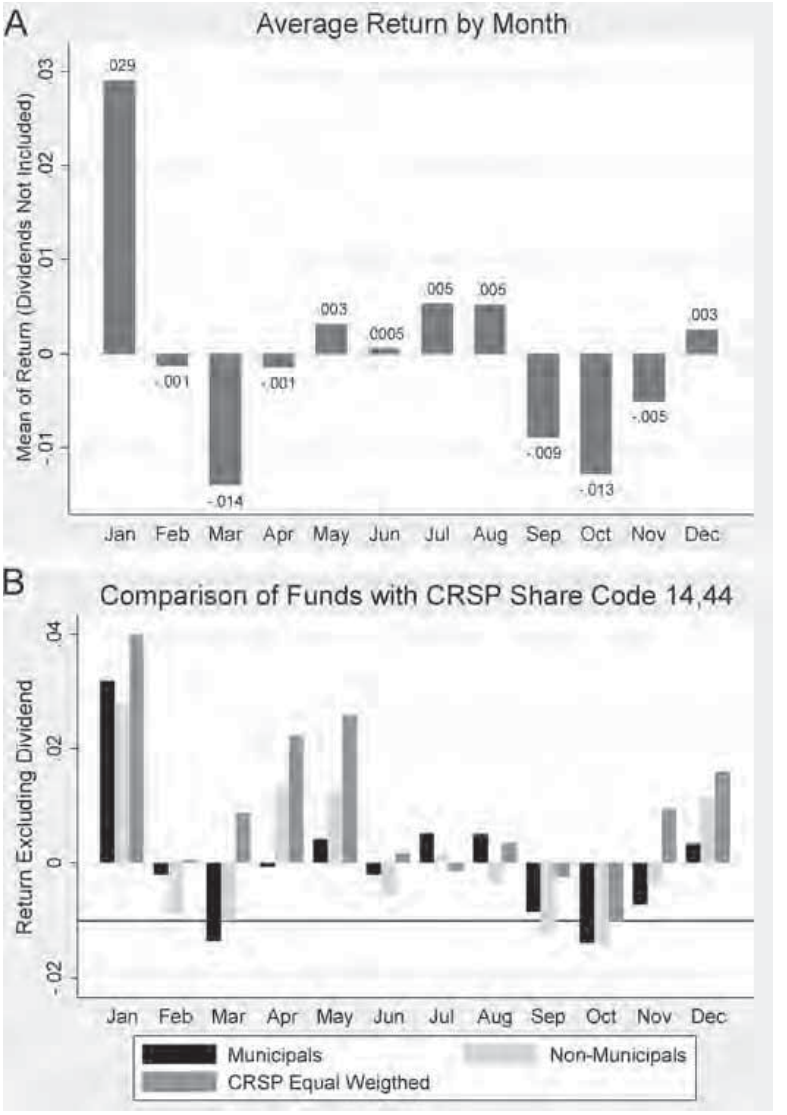

Fig. 2. (A) Average monthly return of the municipal bond funds for the 12 calendar months. The figure shows the average return excluding dividends across all municipal bond closed-end funds with data available for each month during the 1990–2009 time period. (B) Average monthly return of the municipal bond funds, non-municipal funds, and the Center for Research in Security Prices (CRSP) Equal weighted return. This figure shows the average return across all municipal bond and non-municipal closed-end funds with data available for each month during the 1990–2009 time period.

a one-sided *t* test the variable is statistically different from zero. The dependent variable used for the empirical tests is the excess return in March. This is calculated as the current year's March return less the prior year's average monthly return excluding January and March. Fig. 2A shows the average monthly return excluding dividends for each calendar month. The return in January is consistent with the tax-timing explanation given by Starks et al. (2006). Fig. 2B compares the average monthly return for the sample to the average monthly return for all other funds in the same CRSP Share Code and to the monthly return for the CRSP value weighted index.

The primary covariant is a variable that we have constructed using the data from the Internal Revenue Service' Statistics of Income. The variable, *unanticipated liability*, a measure of net capital gains adjusted for capital losses and income tax due at filing.[9] *Unanticipated liability* is calculated as the percentage of gains that would be uncovered by 100% (110%) payments of safe harbor liability under the tax code. Because of the nature of tax filing, unanticipated liability will either be positive or nonexistent. It is for this reason that the variable is bound on the lower side by zero. In the event that capital gains are lower in time period (*t*) than in time period (*t-1*) the rules governing safe harbor would eliminate the possibility of an additional tax liability due in April.

The variable for *Capital gains tax rates* is defined as the prevailing tax rate for long-term capital gains in a given year. The IRS also provided penalty rates for underpayment. The Federal Funds rates come from the Federal Reserve. The capital gains tax rates are available from several websites and were cross checked for accuracy.

Over the sample period the average per capita capital gains for all individuals was approximately $4,000 compared with $25,800 for filers in the top 10%. The unanticipated tax year over year for all filers was 5.6% compared with 10.5% for filers in the top 10%. The approximate tax due at time of filing on a per capita basis was $560 for all filers and $4,600 for filers in the top 10%.

5.2. Methodology

We use panel data and maximum likelihood estimation techniques to show that March abnormal returns are positively related to both the fund's year-end volume and the average volume across funds. Additionally, we propose that the Tax Liquidation Hypothesis is more likely when capital gains tax rates are higher and when there are unanticipated capital gains and dividend income. The Tax Liquidation Hypothesis is a joint hypothesis of lower returns and higher volume in the month of March. For robustness we have two models within each regression. Model I uses turnover and Model I uses volume ratios. The following regression equations are used to examine the Tax Liquidation Hypothesis:

$$\begin{aligned} &March\_Return_{it} - ret_{it-1}^{2;4-12} \\ &\quad = \alpha_0 + \alpha_1 year\_end\_volume\_measure_{it-1} \\ &\qquad + \alpha_2 Average\_year\_end\_volume\_measure_{it} + \alpha_3 capital\_gains\_rate_t \\ &\qquad + \alpha_4 unanticipated\_capital\_gains_t + \mu_i \end{aligned}$$

$$\begin{aligned} &volume\_measure_{it} \\ &\quad = \alpha_{0t} + \alpha_{1t} return_{it}^{c} + \alpha_{2t} return_{it}^{p} + \alpha_3 capital\_gains\_rate_t \\ &\qquad + \alpha_4 unanticipated\_capital\_gains_t + \mu_{it} \end{aligned}$$

Table 2 Panel regression of monthly returns on dummy variables

Monthly return	$=0.001$*(Intercept)*-0.016 *(March)*		
	(0.50)***	(−2.64)***	$R^2_{adjusted} = 0.01$
Monthly return	$= -0.001$*(Intercept)*-0.013 (*March)*		
	(−0.40)	(−2.19)***	$R^2_{adjusted} = 0.01$

Notes: This table presents two regressions of monthly returns. Model (1) presents the regression of monthly returns on a dummy variable for the month of March. Model (2) is similar to the previous model except it drops the month of January. There are 168 funds and 22 years of data. All *t* statistics are based on the panel corrected standard errors (PCSEs), which adjust for contemporaneous correlation, autocorrelation, and heteroskedasticity (*t* statistics in parentheses).

*Indicates statistically significant at the 10% level.

**Indicates statistically significant at the 5% level.

***Indicates statistically significant at the 1% level.

The Hausman specification test rejects the null hypothesis that the efficient estimator is preferred.[10] Therefore, the remainder of the restricted regression models will be run using fixed effects and will control for clustering by year when appropriate.

5.3. The tax liquidation hypothesis in municipal bond closed-end funds

To document the Tax Liquidation Hypothesis in closed-end municipal bond funds the average monthly return is calculated across all funds. Fig. 2 presents the average return by month for all funds.[11] For all years the average in March (not including dividends)[12] for all fund years was (1.4)% compared to an average of (0.1)% for the 10 months of the year not including January. This finding is primarily driven by the years before 2003. In 2003 capital gains tax was limited to a maximum of 15% for long-term gains and 35% for short-term gains. The abnormal return for March for the earlier time period was 1.7% compared with 0.3% in the later time period.

The significant underperformance in March is supported by a simple time-series regression of cross-fund average returns on a March dummy variable. The results in Table 2 show that March has significantly lower returns than the others months. In the first regression the difference is (1.6)% (significant at 1%). The second regression, which excludes the month of January from the estimation shows that the March returns are lower by (1.3)% (significant at the 5% level).

For the negative abnormal returns to be attributable to a price pressure effect the underlying assets cannot be systematically affected by macroeconomic forces. There is an inverse relationship between bond prices and interest rates. Fig. 3 graphs the average Federal Funds Rate adjustment by month. It is clear from Fig. 3 that changes in the short-term interest rate are not clustered in March. If it were the case that macroeconomic forces were the cause of the persistent negative returns in March we would expect to see clustering of rate hikes in March.

The sample funds most likely have a duration which is more sensitive to interest rate changes and therefore a comparison to a vehicle with similar duration is in order. I replicate the Fig. 2 using the return excluding dividends (capital appreciation) for Long Term

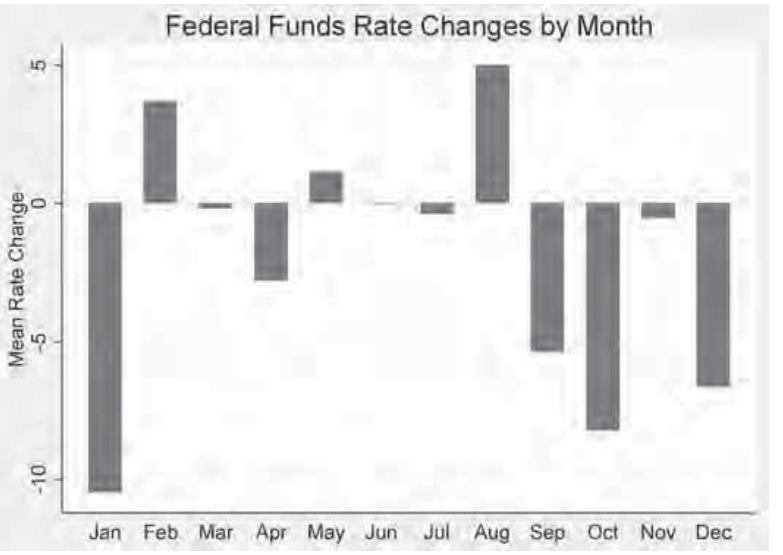

Fig. 3. Average federal funds rate adjustment by month. The figure shows the average monthly for the Federal Funds rate. The years available limit the period for this figure from 1990 to 2008.

Government Bonds. Ibbotson reports the historical monthly capital appreciation for intermediate as well as long term corporate and government bonds. Fig. 4 shows the average monthly returns. There is a similar seasonality that exists in long term government bonds that appears to be unrelated to domestic tax filing.[13]

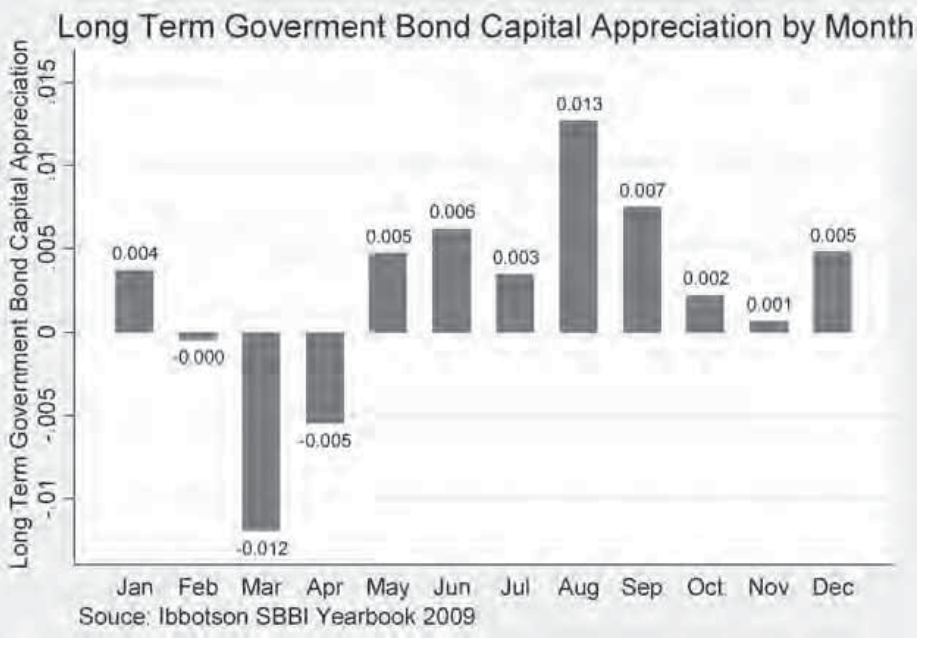

Fig. 4. Long term government bond capital appreciation by month. The figure below depicts the average monthly return for a single bond portfolio with a term of 20 years and a reasonably current coupon.[17]

5.4. March abnormal returns and abnormal year-end volume

The tax-liquidation hypothesis assumes that investors trade according to the optimal tax strategy (Constantinides, 1984), and sell losers to offset the maximum amount of gains. Contrary to the optimal strategy discussed by Constantinides (1984), Badrinath and Lewellen (1991) show that most sales of securities with capital losses take place in November and December. The findings of Bharbra, Dhillon, and Ramirez (1999) give additional support to the year-end tax-loss selling hypothesis.

The current article proposes a positive relationship between March returns and the turn of the year volume measure. The intuition for volume mitigating the Tax Liquidation Hypothesis is that in years when an investor is able to offset more capital gains he reduces his tax liability and is thus required to sell less to cover his tax liability. The volume measures of the current article are defined identically to Starks et al. (2006):

$$turnover_{it} = \frac{average\ November\ and\ December\ trading\ volume\ of\ fund\ i\ in\ year\ t}{Number\ of\ shares\ outstanding\ for\ fund\ i\ at\ the\ beginning\ of\ year\ t}$$

$$vol\_ratio_{it} = \frac{average\ November\ and\ December\ trading\ volume\ of\ fund\ i\ in\ year\ t}{average\ February\ to\ October\ trading\ volume\ of\ fund\ i\ in\ year\ t}$$

The first measure of volume, $turnover_{it}$, equals fund *i's* average volume in November and December normalized by the number of shares outstanding. This measure is used to control for volume traded relative to number of shares across funds. The second measure, vol_ratio_{it}, is used to compare the year-end volume relative to the average monthly volume within a fund. In addition to the two year-end volume measures we calculate the following two March volume measures for each fund:

$$Mar\_turnover_{it} = \frac{March\ trading\ volume\ of\ fund\ i\ in\ year\ t}{Number\ of\ shares\ outstanding\ for\ fund\ i\ at\ the\ beginning\ of\ year\ t}$$

$$Mar\_vol\_ratio_{it} = \frac{average\ November\ and\ December\ trading\ volume\ of\ fund\ i\ in\ year\ t}{average\ February\ to\ October\ trading\ volume\ of\ fund\ i\ in\ year\ t}$$

The march volume measures are defined analogously to the year-end volume measures.

The tax-liquidation hypotheses proposes that we should see higher volume in the month of March relative to the other months. As shown in Fig. 5, March has the highest monthly volume behind the turn-of-the-year effect months (October through January). This is consistent with the hypothesis of increased selling pressure driving down the returns in March.

Fig. 5. Average monthly volume of the municipal bond fund for the 12 calendar months. The figure shows the average volume across all municipal bond closed-end funds with data available for each month during the 1990–2009 time period.

The March volume ratio[14] shows that on average, the volume in March is 10% greater than the average volume for February through October (12% excluding October). The abnormal monthly volume for March is significant at the 1% level. This was verified with a simple cross sectional regression of monthly volume on a dummy variable for March.[15]

The average return for closed-end municipal bond funds in the month of March is negative approximately twice as often as it is positive. As shown in Fig. 6, the average return of closed-end funds in March are negative in 13 out of twenty years. The average return across funds is negative in only 5 of thirty years. In Table 3a the March return is calculated in three separate ways: First for the calendar month, second from March 15th to April 15th, and finally for the seven days after the ex-dividend date to coincide with the theory that an investor should wait as long as possible before liquidating his holdings. The ex-dividend date for the month of April is on average the 13th. Therefore, it is more likely to see the Tax Liquidation Hypothesis in the month of March with liquidation occurring subsequent to the March ex-dividend date. The magnitude of the coefficients for *Turnover* and *Volume_Ratio* decrease as expected. However, the test statistics increase dramatically. Moreover, the R^2 statistic increases substantially when the return period is redefined to coincide with optimal liquidation timing. This suggests that a sizeable proportion, 40% (60%) of the abnormal return in late March (the week after the ex-dividend date) is explained by the model.

Table 3b includes the municipal bond yield change calculated as:

$$\frac{(Yield_{March} - Yield_{Feb})}{1 + Yield_{Feb}}$$

Table 3b shows that the variables for unanticipated liability and capital gains tax rates maintain sign and significance after accounting for the change in yield from the end of February to the end of March. The variable for the yield change, delta, is negative and

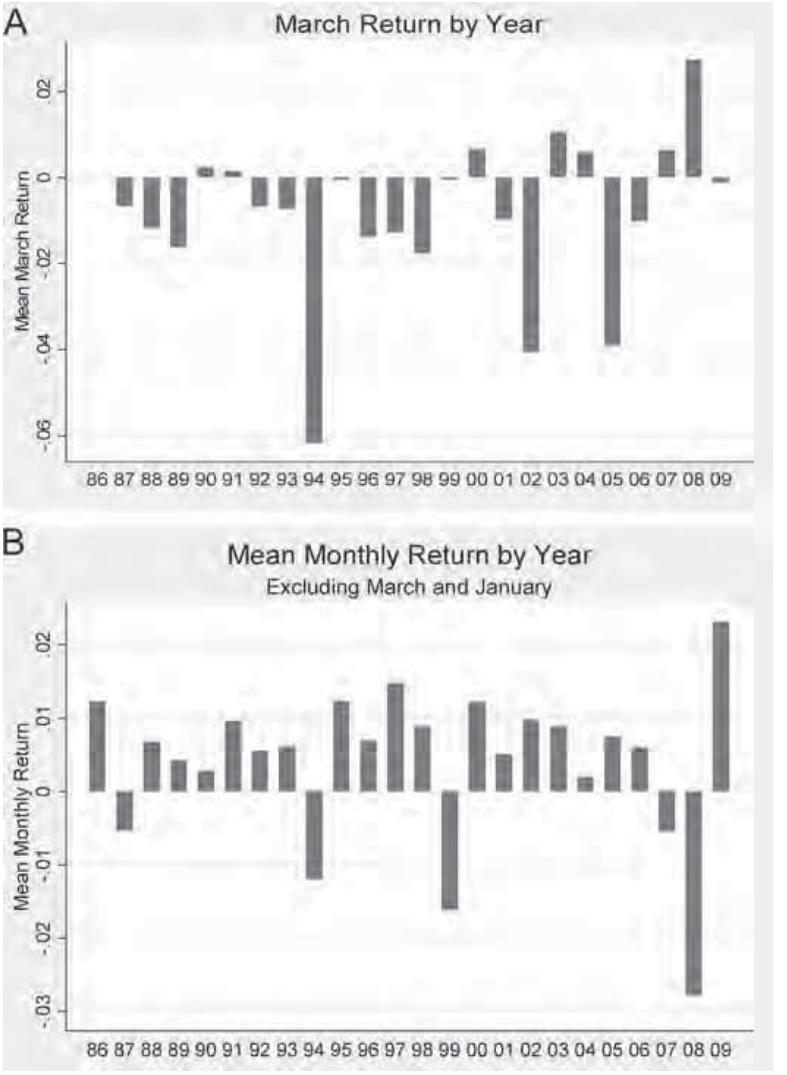

Fig. 6. A mean march return by year. (A) presents the average return excluding dividends for all funds in the sample for the time period of 1990–2009. (B) Average return by year. (B) presents the average return excluding dividends for all funds in the sample for the time period of 1990–2009 excluding the months of January and March.

significant. This is consistent with increases in yield leading to negative capital appreciation.

The tax-liquidation hypothesis further implies that funds that have had positive returns in the previous year should experience significantly less liquidation selling in March. Investors will delay realizing capital gains indefinitely, choosing to first liquidate funds that have performed poorly to take advantage of offsetting capital losses. Table 4 presents the regression of March volume on current and previous year's fund returns. It is reasonable to assume that both the current and prior year return will have an effect on which fund an investor chooses to liquidate.

Table 4 reports the results for March volume measures regressed on contemporaneous and prior year returns, the capital gains tax rate, and unanticipated liability.[16] In Model I, the coefficients for lagged returns are negative and significant at the 1% level. This reveals a

Table 3 A: Panel regression of March returns on volume measures, net capital gains rate, and unanticipated gains

Model (1): Turnover coefficients		Model (2): Vol_ratio coefficients	
Coefficient estimates (t statistics in parentheses) $March\_Return_{it} - ret_{it-1}^{2;4-12}$ $= \alpha_0 + \alpha_1 year\_end\_volume\_measure_{it-1} + \alpha_2 Average\_year\_end\_volume_{it-1}$ $+ \alpha_3 capital\_gains\_rate_t + \alpha_4 unanticipated\_liability_{t-1} + \mu_{it}$			
Panel A1: March monthly returns adjusted for previous Feb., Apr.–Dec. returns on previous year's volume measures, March volume measure, capital gains rate, and unanticipated liability			
Year-end turnover	0.011	Year-end volume ratio	0.006
	(3.40)***		(4.78)***
Average year-end turnover	0.103	Average year-end volume ratio	0.023
	(19.74)***		(14.25)***
Capital gain rate	−0.065	Capital gain rate	−0.046
	(−23.80)***		(−19.49)***
Unanticipated liability	−0.044	Unanticipated liability	−0.043
	(−12.89)***		(−12.05)***
Intercept	0.09	Intercept	0.065
R^2	0.35	R^2	0.36
Panel B: March 15 to April 15 returns adjusted for previous Feb., Apr.–Dec. returns on previous year's volume measures, capital gains rate, and unanticipated liability			
Year-end turnover	0.001	Year-End Volume Ratio	0.008
	(1.43)		(5.71)***
Average year-end turnover	0.020	Average Year-End Volume Ratio	0.023
	(16.46)***		(113.04)***
Capital gain rate	−0.013	Capital Gain Rate	−0.042
	(−4.72)***		(−16.36)***
Unanticipated liability	−0.019	Unanticipated liability	−0.034
	(−4.64)***		(−8.96)***
Intercept	0.105	Intercept	0.075
R^2	0.29	R^2	0.33

negative relationship between March turnover and past fund returns. Additionally, the coefficient of determination shows that the models explain a non-trivial amount of the March volume. The relationship between a fund's return and its liquidating volume is vital to showing that the most likely candidates for liquidation are the poorest performing funds. This is consistent with the optimal tax-timing strategy of Constantinides (1983, 1984). The funds that have performed well over the past year will be the least likely to be sold for liquidity reasons, postponing any net capital gains until it is optimal.

5.5. March abnormal returns, volume, and the capital gains tax rate

The effective capital gains tax rate on an asset depends on the realization of gains and losses on other assets. Constantinides and Scholes (1984) note that the rules in the tax code regarding capital gains and losses make the optimal liquidation policy non-separable across different assets. If an investor is able to offset more ordinary income with capital losses taken

Table 3 (Continued)

Panel C: Seven day return following March ex-dividend date, adjusted for Previous Feb., Apr.–Dec. returns on previous year's volume measures, capital gains rate, and unanticipated liability

Year-end turnover	0.001	Year-end volume ratio	0.005
	(7.54)***		(13.79)***
Average year-end turnover	0.013	Average year-end volume ratio	0.013
	(40.38)***		(27.58)***
Capital gain rate	−0.017	Capital gain rate	−0.009
	(−21.86)***		(−13.57)***
Unanticipated liability	−0.003	Unanticipated liability	−0.000
	(−84.28)***		(−0.35)
Intercept	0.021	Intercept	−0.002
R^2	0.51	R^2	0.53

Notes: This table shows the coefficients from regression of March returns, adjusted by the previous February through December (excluding March) average returns, on volume measures for year-end trading, contemporaneous March volume, the capital gains tax rate, and unanticipated liability. Model (1) measures volume by turnover and Model (2) measures volume by the volume ratio. In Panel A the return is calculated using all trading days in March. In Panel B the return is calculated using only the last 15 trading days of March and the first 15 of April. In Panel C the return is calculated for the week following the ex-dividend date for the fund. There are 168 groups and 22 years of data. All *t* statistics are based on the panel corrected standard errors (PCSEs), which adjust for autocorrelation, and heteroskedasticity.

*Indicates statistically significant at the 10% level.

**Indicates statistically significant at the 5% level.

***Indicates statistically significant at the 1% level.

in municipal bond funds then we would expect to see more tax-liquidation selling in years with higher capital gains tax rates.

The results in Table 3 show that the returns in March are negatively related to the capital gains tax rate (significant at the 1% level). This finding is robust to clustering by fund and controlling for prior year's return and year end volume and average year volume measures across funds. The coefficient estimate of −0.05 predicts, at the margin, a unit increase in the natural log of the capital gains tax rate will result in a 5% percent drop in the returns during the month of March. This is economically significant given the historical rate for capital gains tax is between 15 and 33% with changes of between 8% and 15%. The results, presented in Table 5, for abnormal March volume on the capital gains rate are equally revealing. The findings for March turnover (volume ratios) suggest that there is increased volume relative to shares outstanding (average monthly volume) when the capital gains tax rate is higher. The findings for abnormal volume measures are positive and significant at the 1% level.

5.6. March abnormal returns, volume, and unanticipated liability

The results, reported in Table 3, show that March abnormal returns are decreasing in unanticipated liability. This is paramount in proving that the Tax Liquidation Hypothesis is related to tax liability liquidation. Tax liability on unanticipated gains can be delayed until tax filing which is due April 15 or October 15 (if an extension is filed). Furthermore, the

Table 3 B: Panel regression of march returns on volume measures, net capital gains rate, and unanticipated gains

Model (1): Turnover coefficients		Model (2): Vol_ratio coefficients	

Coefficient estimates (t statistics in parentheses)

$$March\_Return_{it} - ret_{it-1}^{2;4-12} = \alpha_0 + \alpha_1 year\_end\_volume\_measure_{it-1} + \alpha_2 Average\_year\_end\_volume_{it-1} + \alpha_3 capital\_gains\_rate_{t-1} + \alpha_4 unanticipated\_liability_{t-1} + \mu_{it}$$

Panel A1: March monthly returns adjusted for previous Feb., Apr.–Dec. returns on previous year's volume measures, March volume measure, capital gains rate, and unanticipated liability

Year-end turnover	0.012	Year-end volume ratio	0.006
	(2.56)***		(4.87)***
Average year-end turnover	0.055	Average year-end volume ratio	0.012
	(8.85)***		(6.69)***
Capital gain rate	−0.001	Capital gain rate	−0.001
	(−5.57)***		(−5.58)***
Unanticipated liability	−0.012	Unanticipated liability	−0.014
	(−6.28)***		(−5.58)***
March muni yield Δ	−9.22	March muni yield Δ	−9.01
	(−22.69)		(−20.97)
Intercept	−0.016	Intercept	−0.017
R^2	0.41	R^2	0.40

Notes: This table shows the coefficients from regression of March returns, adjusted by the previous February through December (excluding March) average returns, on volume measures for year-end trading, contemporaneous March volume, the capital gains tax rate, and unanticipated liability. Model (1) measures volume by turnover and Model (2) measures volume by the volume ratio. In Panel A the return is calculated using all trading days in March. In Panel B the return is calculated using only the last 15 trading days of March and the first 15 of April. In Panel C the return is calculated for the week following the ex-dividend date for the fund. There are 168 groups and 22 years of data. All t statistics are based on the panel corrected standard errors (PCSEs), which adjust for autocorrelation, and heteroskedasticity.

coefficient of *Unanticipated_NCG* (−0.011) suggests that a 100% increase in the population wide NCG predicts negative March returns of more than four percentage points. The mean unanticipated liability for the time period in this study was 21%. The results found in Table 3 are, therefore, statistically and economically significant. Furthermore, the measure of net capital gains from the Statistics of Income is a crude measure for the most tax sensitive investors who are more likely to hold municipal bonds.

The existence of the Tax Liquidation Hypothesis is more likely when the capital gains tax rate is higher and when unanticipated liability are higher. This is because of the rules in the tax code that allow for an investor to pay the minimum of 100% of the prior year's tax liability or 90% of the current year's anticipated tax liability. The results, reported in Table 5, present the logistic regression of the existence of the Tax Liquidation Hypothesis on the natural log of the capital gains tax rate and the percentage of capital gains in excess of the prior year's capital gains. The limited dependent variable $March\_Effect_{it}$ takes a value of one if the return in March is negative and zero otherwise. The coefficients and z-statistics from Table 4 show that both the capital gains tax rate and unanticipated liability are positive and significant at all conventional levels. The marginal effects are calculated as the partial derivative of the dependent variable with respect to the independent variable. The results

Table 4 Panel regression of March volume measures on current year and previous year's returns, net capital gains rate, and unanticipated gains

Model (1): Turnover coefficients		Model (2): Vol_ratio coefficients	
Coefficient estimates (t statistics in parentheses) $volume\_measure_{it} = \alpha_{0t} + \alpha_{1t} return^{c}_{it} + \alpha_{2t} return^{p}_{it} + \alpha_{3} capital\_gains\_rate_{t} + \alpha_{4} unanticipated\_capital\_gains_{t} + \mu_{it}$			
Panel A: March monthly volume adjusted for share outstanding or average monthly volume on current and previous year's returns, capital gains rate, and unanticipated liability			
$Return^{P}$	−0.213	$Return^{P}$	−0.365
	(−9.29)***		(−7.51)***
$Return^{C}$	−0.288	$Return^{C}$	−0.785
	(−4.24)		(−5.45)
Capital gain rate	.001	Capital gain rate	0.008
	(2.34)**		(6.30)***
Unanticipated liability	0.047	Unanticipated liability	0.079
	(4.17)***		(3.30)***
Intercept	0.25	Intercept	0.668
R^2	0.06	R^2	0.04
Panel B: March 15 to April 15 average daily volume adjusted for share outstanding or average monthly volume on current and previous year's returns, capital gains rate, and unanticipated liability			
$Return^{c}$	0.207	$Return^{c}$	0.202
	(2.21)**		(4.18)***
$Return^{p}$	−0.288	$Return^{p}$	0.009
	(−3.23)***		(0.21)
Capital gain rate	0.038	Capital gain rate	−0.074
	(0.83))		(−3.13)***
Unanticipated liability	0.126	Unanticipated liability	0.05
	(3.35)***		(2.56)***
Intercept	1.04	Intercept	1.20
R^2	0.26	R^2	0.09

Notes: This table shows the coefficients from regression of March volume measure, against contemporaneous and previous year's returns, the capital gains tax rate, and unanticipated liability. $Return^{c}$ denotes the current year's return through February and $Return^{p}$ denotes the prior year's return of the fund. Model (1) measures volume by turnover and Model (2) measures volume by the volume ratio. In Panel A the volume is calculated using all trading days in March. In Panel B the volume is calculated as the average daily volume of the last 15 trading days of March and the first 15 of April. There are 168 groups and 22 years of data. All t statistics are based on the panel corrected standard errors (PCSEs), which adjust for autocorrelation, and heteroskedasticity.

*Indicates statistically significant at the 10% level.

**Indicates statistically significant at the 5% level.

***Indicates statistically significant at the 1% level.

from Table 4 show that tax-liquidation selling is more likely in years when the capital gains tax rate is high or when there are unanticipated liabilities, all else being equal. The results from the logistic regression are more significant when the average volume measures across funds are used instead of the volume measure of each fund. This indicates that the tax loss selling over all funds has a positive impact on which fund is more likely to be sold in March.

Table 5 Logistic regression of March returns on volume measures, net capital gains rate, and unanticipated gains

Model (1): Turnover coefficients		Model (2): Vol_ratio coefficients	
Coefficient estimates (*z*-statistics in parentheses) $TLH_{it} = \alpha_0 + \alpha_1 year\_end\_volume\_measure_{it-1} + \alpha_2 Average\_year\_end\_volume_{it-1} + \alpha_3 capital\_gains\_rate_t + \alpha_4 unanticipated\_capital\_gains_t + \mu_{it}$			
Tax liquidation hypothesis on previous year's volume measures			
Year-end turnover	−1.07	Year-end volume ratio	−0.56
	(4.60)***		(−7.54)***
March turnover	1.23	March volume ratio	0.25
	(2.66)***		(2.08)**
Capital gain rate	2.24	Capital gain rate	2.47
	(10.27)***		(11.05)***
Unanticipated liability	1.04	Unanticipated liability	1.08
	(6.18)***		(6.35)***
Marginal effects			
Year-end turnover	−0.25	Year-end volume ratio	−0.13
March turnover	0.29	March volume ratio	0.06
Capital gain rate	0.53	Capital gain rate	0.58
Unanticipated liability	0.25	Unanticipated liability	0.25

Notes: This table presents the logistic regression estimates and marginal effects of the existence of the *TLH* on capital gains tax rates and unexpected liability. The dependent variable *TLH* takes a value of one if March returns are negative, and zero otherwise. The independent variable *ln_NCG_Tax_Rate* is the natural log of the contemporaneous capital gains tax rate; *Unanticipated_NCG* is the current year's capital gain as a percentage of the previous year's capital gains. There are 168 funds and 22 years of data.

*Indicates statistically significant at the 10% level.

**Indicates statistically significant at the 5% level.

***Indicates statistically significant at the 1% level.

6. Conclusion

This article proposes the *tax liquidation hypothesis* based on investor behavioral biases and the current tax environment. Individual investors will hold cash accounts that are consistent with their preferences for risk and return. The cash account may be different across individuals but the pattern and hypotheses regarding formation and liquidation of these accounts for tax reasons should be consistent with the findings of this article.

We propose that having cash on hand and liquidating for tax purposes are not mutually exclusive events. These events can coexist harmoniously. A rational investor holds a portion of his wealth in cash that maximizes his utility over liquidity; given an out of pocket expenditure, that is, tax liability, he may unavoidably have to liquidate some portion of his invested wealth to rebalance his cash to investments ratio.

Notes

1 The Safe Harbor Rule was not listed by Brickley, Manaster, and Schallheim (1991) but was added here to explain unanticipated tax liability.

2 High net worth individuals will have to pay 110% of the prior year's tax.
3 The penalty for an underpayment of over $1,000 is 120 percent of the underpayment rate. The historical penalty rates are available from the IRS at http://www.irs.gov/pub/irs-pdf/n746.pdf
4 "Cash account" is a term used by Constantinides (1983) but does not mean that the account must be held in cash.
5 The period of 16.5 months comes from an investor selling an asset with a capital gain on January 1 and reinvesting the expected liability until the following April.
6 And subsequent years if there are carried forward losses.
7 We would like to thank Laura Starks, Lwe Yong, and Lu Zheng for providing me with the fund codes.
8 Shares of beneficial interest resemble common shares—the primary difference is that an SBI gets issued by a "trust entity" instead of a company.
9 All amounts are in actual dollars.
10 The rejection of the null hypothesis that both the consistent and efficient estimators are acceptable was significant at a 1% level. The primary reason for the rejection was the difference in the firm specific volume measure.
11 Fig. 5 graphs the March returns and the average returns for all other months by year to show the consistency of the Tax Liquidation Hypothesis through time.
12 The graph for returns including dividends is similar to the one presented in Fig. 2.
13 This article tests the hypothesis using controls for both the long term government bond capital appreciation as well as changes in the municipal bond yields.
14 The March volume ratio is the volume in March divided by the average monthly volume for the months February to October.
15 The months of January, November, and December were not included
16 Contemporaneous returns are the returns for January and February of the current year.
17 Paraphrased from the Ibbotson SBBI 2009 Yearbook.

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