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The tax-loss selling hypothesis, market liquidity, and price pressure around the turn-of-the-year ☆

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Abstract

In this paper, we use intra-day data for all stocks listed on the ISSM and provide new and direct evidence consistent with the tax-loss selling hypothesis. We find that (a) there is abnormal selling pressure prior to the year-end for stocks that have experienced large capital losses in the current and prior years (b) investors delay realizing capital gain by postponing the sale of capital gain stocks until after the new year (c) there is a significant decrease in the average trade size for stocks with large capital losses before the year-end and for stocks with capital gains in the new year, which suggests that individuals, rather than institutional investors, are the major sellers around the year-end (d) the tax-loss selling hypothesis, and not firm size or share price, is the fundamental explanation for abnormal January returns. Further, small or low share priced firms with capital gains do not experience abnormal returns in January. However, conditional on capital losses, small or low share priced firms magnify the turn-of-the-year effect (e) On average, the increase in selling activity adversely affects market liquidity by increasing bid-ask spreads and reducing depths. (f) The tax-loss selling pressure not only causes the price to be at the bid at the year-end, it also temporarily depresses the equilibrium price indicating the short run demand curve is not perfectly elastic (g) the year-end buying activity suggests that large investors buy capital loss stocks prior to the year-end to take advantage of the temporarily depressed price and capital gain stocks after the new year to reinvest the proceeds of the tax-loss selling.

JEL classification: G10; G14

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1. Introduction

Rozeff and Kinney (1976) are the first to document that mean equity returns in January are higher than in other months. Further, Keim (1983) and Roll (1983) document that the high January equity returns are concentrated within a narrow window that extends from the last trading day in December to the first few days in January of the following year. This seasonal pattern in stock returns, which Roll (1983) refers to as "turn-of-the-year effect", is found to be most pronounced in small firms (Keim, 1983; Reinganum, 1983; Blume and Stambaugh, 1983) or in low share price firms (Jaffe et al., 1989; Bhardwaj and Brooks, 1992) or in both.

Several hypotheses have been put forward to explain the abnormal January returns. Among them are the risk changes (Tinic and West, 1984; Ritter and Chopra, 1989), information changes (Seyhun, 1988) and institutional window dressing (Bildersee and Kahn, 1987; Lakonishok et al., 1991; Eakins and Sewell, 1994). However, the explanation that has received the most attention in the literature to date is the tax-loss selling hypothesis of Givoly and Ovadia (1983), Reinganum (1983) and Roll (1983). This hypothesis posits that investors who are motivated to reduce their year-end tax liability sell stocks that have experienced a decline in price over the year and use the realized losses to offset capital gains. These transactions produce a selling pressure that results in an increase in the number of trades at the bid price (i.e., sell trades), causing a decline in year-end stock prices. At the beginning of the new year, the selling pressure abates and stocks resume trading at their equilibrium price. The tax-loss motivated trading activity around the turn-of-the-year therefore results in positive abnormal stock returns in the new year.

Several studies have tested the tax-loss selling explanation by examining the return patterns around the year-end. However, the results presented in these papers do not provide conclusive support of this hypothesis. For example, Roll's (1983) finding of a negative relation between the prior year's returns and the turn-of-the year returns is consistent with both of the tax-loss selling and institutional window dressing hypotheses.[1] Further, Brown et al. (1983) and Kato and Schallheim (1985) examine the turn-of-the-year effect for Australia and Japan respectively and document a similar stock return pattern in January even though these countries having different tax laws and tax-year ends.[2]

[1] The window-dressing hypothesis posits that because institutional investors' stock picking ability depends on their ability to report portfolio gains, they have an incentive to sell stocks that have declined in value over the year and buy stocks that have increased in value. This trading strategy is normally undertaken at the year-end when institutional performance is evaluated.

[2] In the Brown et al. (1983) study, the tax year-end in Australia is June 30th. Kato and Schallheim (1985) state that Japanese firms can arbitrarily choose their fiscal year-end and individual investors do not pay taxes on capital gains.

Other studies examine year-end trading activity and provide evidence consistent with the tax-loss selling hypothesis. For example, Dyl (1977) finds that firms with the greatest decline in price experience the largest increase in year-end trading volume while Keim (1989) documents that there is an increase in selling pressure prior to the year-end, especially for firms in the smallest price deciles. Dyl (1977) however does not examine whether the increase in trading volume is caused by higher buying activity or by an increase in selling activity while Keim (1989) fails to relate the selling pressure to the tax-loss potential of equities. Therefore, the results of these studies do not provide direct testing of the fundamental implication of the tax-loss selling hypothesis of whether a relation exists between the tax-loss potential of stocks and selling activity immediately prior to the year-end and if this relation then disappears in the new year. Further, while these results indirectly support the tax-loss selling hypothesis, they are also consistent with the predictions of the institutional window-dressing hypothesis, which predicts higher year-end selling and trading activity driven by institutional managers rebalancing their portfolios.

The primary objective of this study is to present new and direct empirical testing of the tax-loss selling hypothesis by examining the trading pattern of all stocks listed on the *Institute for the Study of Securities Markets* (ISSM) database between 1986 and 1992. The intra-day transaction and quote information obtained from the dataset lets us explicitly classify each trade as either a buy or a sell. This allows us to conduct a more precise test of the tax-loss selling hypothesis than Keim (1989) who uses only the daily closing price to classify the entire day's trades as either buys or sells. Further, we divide firms into quartiles based on their tax-loss potential measured as the decline in share price from the highest point reached between January and the end of November to the last trading day in November. This classification scheme controls for the deficiencies in Dyl's (1977) and Keim's (1989) studies and allows us to directly test the fundamental implications of the tax-loss selling hypothesis that (a) there is an abnormal selling pressure prior to the year-end for stocks with capital losses and that this pressure is positively related to stocks' tax-loss potential, (b) the selling pressure for firms with the largest tax-loss potential cease in the new year when the motivation to realize losses disappears, and (c) there is selling pressure in the new year for stocks that have increased in value from investors motivated to reduce their current year's tax liability by delaying realizing capital gains. While the first two implications are consistent with both the tax-loss selling and the institutional window-dressing hypotheses, the last implication is predicted by the tax-loss selling hypothesis only.

The intra-day transactional data enables us to further distinguish between the tax-loss selling hypothesis and the institutional window-dressing hypothesis by determining the source of the year-end trading activity. Because individual investors, faced with capital constraints, are more likely to trade in smaller lots relative to institutional investors, we use the average trade size to identify the dominant trader at year-end. Thus, a decrease in trade size at the year-end is consistent with tax-loss selling as opposed to institutional trading. Sias and Starks (1997) also test this issue by analyzing institutional ownership data. However, the sample in their study is restricted to only 139 firms during the 1990–1991 year-end period. The authors

themselves note that the trading activity during their sample period could be influenced by the "increasing tensions between United States and Iraq just prior to the Gulf war". In our paper, we examine all stocks listed on the ISSM database over a 6-year period, which allows us to draw stronger conclusions about the source of year-end trading activity than prior studies. Finally, the methodology of our study allows us to provide new evidence supporting the tax-loss selling hypothesis by examining whether the trading activity of stocks classified on short-term and long-term capital losses is consistent with the prediction of the tax-loss selling hypothesis as suggested by Poterba and Weisbenner (2001).

The finding of seasonal trading pattern around the year-end also motivates us to reinvestigate the issue of whether tax-loss selling explains abnormal January returns and whether the size (share price) effect continues to be significant after controlling for tax-loss selling. Keim (1989) finds that relative to high share price firms, low share price firms experience higher returns at the turn-of-the-year after controlling for bid-ask fluctuation. Reinganum (1983) limits his attention to firms in the highest and lowest quartiles of capital losses and concludes that both tax-loss selling and firm size are significant. Because firms that experience capital losses over the year are more likely to be small firms or firms with low share prices any test of the tax-loss selling hypothesis must control for these firm size and share price effects. Previous studies by Keim (1989) and Reinganum (1983) do not explicitly account for the tax-loss potential of stocks and firm size. In this paper, we not only directly control for the firm size (share price), but we also include it as an interactive term with the firm's tax-loss potential to capture the possibility that firm size (share price) might magnify the tax-loss selling effect.

This study also presents a more comprehensive examination of the tax-loss selling hypothesis by extending the literature in two ways. First, we examine the impact of tax-loss selling motivated trading activity on market liquidity. An increase in year-end trading might make it more costly to match order flow causing an increase in bid ask spreads. Similarly, increased year-end trading might cause a share's market depth to be exceeded, lowering liquidity. Alternatively, year-end trading might have no significant impact on market liquidity if market makers view these transactions as being informationally neutral and are therefore willing to maintain spreads and increase depth. Therefore, the influence of year-end trading on market liquidity remains an unresolved issue, open to new insights from the analysis of transactional data. We also attempt to provide a preliminary microstructure explanation as to why small firms experience the highest year-end returns.

Our second set of contributions focus on the impact of tax-induced abnormal trading activity on equilibrium prices. The price pressure hypothesis posits that an increase in trading activity will affect a stock's equilibrium price. Evidence consistent with this hypothesis is significant because it offers investors a potential profitable trading opportunity and also violates a fundamental assumption of asset pricing theories that the demand curve for a firm's shares is perfect elastic (i.e., horizontal). While prior studies papers have tested this hypothesis, the transactions examined by these studies are either often contaminated by the release of economically relevant information or limited to a few additions, deletions or revisions in the composition

of a stock index.[3] In this study we examine the impact of predictable (and hence devoid of information) but abnormal trading activity induced by tax-loss selling on year-end prices. Further, we conduct cross-sectional tests on all firms over several year-ends using bid (ask) to bid (ask) returns that eliminates the possibility that a price change is due to bid-ask bounce. Our study therefore offers a sharper test of the price pressure hypothesis with higher statistical power and allows us to draw stronger conclusions than those reported by earlier researchers.

We find strong evidence consistent with the tax-loss selling hypothesis. We observe a significant increase in abnormal selling activity prior to the turn-of-the-year and this increase is highest for stocks that experience the largest capital losses during the year. After the turn-of-the-year, there is no evidence of abnormal selling pressure for these stocks. For firms that have experienced capital gains however, we find an increase in abnormal selling pressure in the new year. We also find that distinguishing between short-term (current year) and long-term (prior year) losses provides additional evidence that investors' trading strategies are consistent with the goal of reducing their tax liability. We observe a decrease in the average trade size for stocks with large capital losses before the year-end and for stocks with capital gains in the new year. These findings imply that capital constrained individuals, as opposed to institutions, are the primary cause of the trading pattern at year-end.

The results of our regression analyses suggest that the tax-loss selling hypothesis is the primary explanation for the abnormal January returns. The significant positive relation between tax-loss potential and turn-of-the-year returns holds even after controlling for firm size and share price effects. While firm size and share price are insignificant by themselves in explaining the abnormal January returns, they become significant only when interacted with a measure of capital loss. This implies that for firms with no capital losses, smaller size (lower share price) firms do not yield higher returns than larger size (higher share price) firms at the year-end. However, conditional on experiencing a decline in value, smaller firm size (or lower share price) significantly magnifies the impact of tax-loss selling on turn-of-the-year returns. This result, coupled with the dominance of individuals in year-end trading, provide strong evidence for the argument that tax-loss selling accounts for price and size effects around the turn-of-the- year.

We also find evidence that tax-loss trading significantly impacts the market microstructure of a firm's securities. On average, there is an increase in the bid-ask spread coupled with a decrease in market depth around the year-end, thus adversely influencing market liquidity. However, we observe a significant increase in bid depth for firms with the largest tax-loss potential, but this increase is insufficient to meet the increased selling volume for these firms induced by tax-loss trading. The shortfall in bid depth further magnifies the tax-loss selling effect for these firms. Moreover, the insufficiency is most severe for small firms who therefore experience a greater tax-loss selling effect than larger firms.

[3] Kraus and Stoll (1972), Scholes (1972) and Hess and Frost (1982) examine the valuation impact of large transactions. The samples of Harris and Gurel (1986), Shleifer (1986) and Kaul et al. (2000) contain 194, 246, and 31 observations, respectively.

We also find evidence that the tax-related increase in trading activity around the turn-of-the-year affects equilibrium prices. There is a significant reduction in average stock prices at the year-end with the decline most pronounced for stocks with large capital losses. These results hold even after controlling for price movement attributable to bid-ask bounce. These findings suggest that stocks are not perfect substitutes and that their demand curves are not perfectly elastic in the short-run. However, a trading strategy of buying large capital loss stocks prior to the year-end and selling them after the new year fails to yield abnormal profit net of transaction costs.

Finally, an examination of investors buying activity leads to the following interesting findings. First, there is an increase in buying activity prior to the year-end, especially for the shares of large capital-loss firms. This is consistent with Roll's (1983) hypothesis that some investors attempt to profit from the highly predictable seasonal price pattern induced by tax-loss selling. Second, there is also an increase in buying activity at the start of the new year that supports Ritter's (1988) hypothesis that investors who engage in tax-loss selling delay reinvesting (i.e., "park their proceeds") until after the new year. However, the abnormal buying activity is primarily concentrated on stocks experiencing a capital gain.

We organize this paper into four sections. In the following section we discuss our data and methodology. In Section 3 we present the results from an empirical examination of our hypotheses. We provide a brief summary and conclusion in Section 4.

2. Data and methodology

The sample in this study contains all firms listed on ISSM between 1987 and 1992 and offers several advantages. First, the database contains time-stamped bid and ask quotes, depth at the bid and the ask prices as well as volume and price for each trade. This feature, coupled with the Lee and Ready (1991) algorithm, allows us to sign each trade as either a buy or a sell and explicitly examine the buying and selling patterns of stocks round the turn-of-the-year. Second, while the Griffiths and White's (1993) sample is restricted to heavily traded Canadian-U.S. interlisted firms, our sample contains a greater number of firms.[4] This permits a test of the tax-loss selling hypothesis and its implications across a wider variety of firms than that examined in previous studies that use transaction data.

Finally, unlike prior studies such as Poterba and Weisbenner (2001) and Grinblatt and Moskowitz (1999), the data in our study resides within a stable tax regime. In the sample period covered in this study, we observe that (a) the maximum amount of adjusted gross income (AGI) that could be offset is $3,000, (b) the definition of

[4] A measure of the size of the firms used by Griffiths and White (1993) can be inferred from the following statistics they provide in their study. The NYSE stocks contained in their sample accounted for 12.5 percent of the companies listed on the exchange, 60.0 percent of the exchange's total market capitalization and 56.6 percent of the exchange's trading volume. All of these values are relative to December, 1988.

long- term asset is restricted to assets held for at least 12 months, and (c) there is no limit of the fraction of long-term loss that could be deducted against AGI.[5] The last point is of specific importance to this study because it eliminates the distinction between the long-term and short-term loss in terms of the fraction of loss that can be offset against AGI. Before 1986, the features of the tax code provided an incentive for investors to realize losses as short-term to avoid losing 50 percent of the tax loss deductibility associated with long-term losses. This resulted in tax-loss selling occurring throughout the year. However, the characteristics of the capital gains tax rules in the post-1986 period, coupled with the December tax year-end, imply that investors are more likely to engage in tax-loss selling at the year-end. Further, as noted by Odean (1998), individual investors exhibit a disposition effect in which they tend to sell winner stocks (stocks that have increased in value) early and hold loser stocks (stocks that have lost value) too long. At the year-end, however, the incentive to delay recognizing capital losses diminishes because of the significant benefits associated with tax-loss selling. Although tax-loss selling can occur at any anytime during the year, the impact of the revised tax law and the disposition effect encourages investors to sell stocks that have declined in value around year-end. We therefore test the implications of the tax-loss selling hypothesis by concentrating on the period at the turn-of-the-year.

Our proxy for the potential tax-loss candidacy of a specific stock is similar to that of Reinganum (1983). Annually, for each stock, we find the date of the highest price within the 11-month period beginning January 1 and continuing through November 29. The month of December is excluded since it is used to study the turn-of-the-year effect. From the date of the highest observed price through November 30, we calculate a total return that we use as an estimate of the firm's tax-loss potential. We then assign each firm to a portfolio based upon the quartile of its estimated tax-loss potential. Portfolio Q1 consists of those firms in the first quartile of estimated tax-loss potential; specifically, these firms have a tax-loss potential greater than 31.8 percent. Firms in portfolio Q2 are from the second quartile and represent those firms with a tax-loss potential less than 31.8 percent, but greater than 16.4 percent. We assign firms to portfolio Q3 if their tax-loss potential is between 6.3 percent and 16.4 percent. Finally, those firms in the fourth quartile of tax-loss are assigned to portfolio Q4 and have a tax-loss potential less than 6.3 percent and may, in fact, have a capital gain. Each portfolio contains 2,335 firms.

We use Lee and Ready's (1991) measure to classify a trade as either a sell or a buy. For each trade, we compare whether the trade price is closer to the bid or ask quote that is at least 5 seconds old. The 5-second interval corrects for the potential problem that quotes are often recorded prior to the trades that triggered them. We classify the trade as a sell (buy) if the current trade is closer to the bid (ask) quote. If the trade

[5] Prior to 1986, an asset could be held anywhere from 6 months (1943–1976) to 12 months (1978–1984) to qualify as a long-term asset. Secondly, the maximum amount of AGI that could be offset varied from $1,000 (1943–1976) to $2,000 in 1977 to $3,000 (1978–1995) and finally, the fraction of long-term loss that could be offset against AGI was restricted to 50 percent from 1970 to 1986.

price is exactly between the bid and ask we assign the trade equally between a buy and a sell.

Further, because the tax-loss selling hypothesis has implications for *abnormal* trading activity, we contrast the trading activity around the year-end with the trading activity in the month of July. We select July as the benchmark because of its centrality in the 11-month period over which the highest stock price used in calculating tax-loss potential is identified.[6] Finally, assuming that tax-loss selling reaches its peak near the last trading day of the year, the full extent of the price pressure effect due to tax-loss selling is measured as the return from this date. Additionally, given that the January anomaly is concentrated in the first week of January and because the focus of our paper is tax-loss selling whose effect is unlikely to last beyond 2 weeks, we estimate the magnitude of the January anomaly over the first 10 trading days (about 2 weeks) of the new year. Restricting our attention to this limited window also lowers the impact of risk factors on turn-of-the-year returns as documented by Banz (1981) and Fama and French (1992).

3. Empirical results

In this section we report the results from our empirical analysis. We first test for tax-loss selling hypothesis as a possible explanation for the year-end trading pattern and examine whether individual or institutional investors are the primary source of the abnormal trading activity. We then examine how tax-loss trading affects abnormal January returns after controlling for other relevant factors. We then analyze the impact of tax-loss trading on the stocks' market microstructure by examining changes in bid-ask spreads and market depths around the turn-of-the-year. Further, we present results of tests of the predictions of the price pressure hypothesis regarding the short-term elasticity of demand for equity and the profitability of trading strategies based on these inelasticities. Finally, we provide evidence about investors' buying activity around the turn-of-the-year and relate it to the hypotheses advanced by Roll (1983) and Ritter (1988). Because the implications of the tax-loss selling hypothesis involve computing percentage changes that are often skewed, we generally report median results for the different tests. For the turn-of-the-year return analysis however, we choose to report mean results to be consistent with the prior literature.

3.1. The tax-loss selling hypothesis

The tax-loss hypotheses posits that at year-end, investors sell stocks that have lost value and apply the losses to offset realized capital gains to reduce their tax liabilities. Because the tax advantage resulting from the sale of stocks with the highest tax losses are the largest, these firms are most likely to be candidates for

[6] As a robustness test, we also calculate abnormal trading activities using March as the benchmark month and obtain similar results.

tax-loss selling. Therefore, the tax-loss selling hypothesis predicts that a greater fraction of these firms trading activity in the period immediately preceding the year-end will occur at the bid (and hence be classified as a sell) relative to firms whose losses are correspondingly less. Similarly, to avoid realizing capital gains for the year, investors will delay selling stocks that have increased in value until the following year. For these stocks, the hypothesis predicts an abnormal number of transactions classified as sells in the new year. We test these implications by examining raw and abnormal trading activity for firms classified on tax-loss potential and therefore provide a more precise test than Dyl (1977) or Keim (1989).

3.1.1. Selling activity around the turn-of-the-year

Table 1 presents the pattern of selling activity around the turn-of-the-year. We examine the daily sell ratio, defined as the volume of sell trades to the total volume of trades for the day for each stock. A sell ratio of 0.75 indicates that three-fourths (one-fourth) of the shares traded for that day are classified as sells (buys). In panel A of Table 1, we report the year-end sell ratio for the ten trading days immediately preceding the year-end (pre-turn period). We observe that the sell ratio in the pre-turn period is highest for portfolio Q1 firms (portfolio of the largest tax-loss potential firms) and monotonically decreases as we approach the portfolio Q4 firms (portfolio of the smallest tax-loss potential firms). For portfolio Q1 firms we find that approximately 57 percent of the trading volume at the year-end is sells, while the corresponding ratio for portfolio Q4 firms is only 50 percent.

We find similar results when we examine the abnormal sell ratio defined as the percentage change in the daily sell ratio relative to that for the month of July. For portfolio Q1 firms we observe an increase in the sell ratio of 10.41 percent relative to the benchmark July sell ratio. This suggests that prior to year-end, firms with the highest tax-loss potential experience significantly greater selling activity than normal. The abnormal sell ratio monotonically decreases as the tax-loss potential of stocks falls and for firms in portfolio Q4, the abnormal sell ratio is only 2.15 percent. The difference in the abnormal sell ratios between portfolio Q1 and portfolio Q4 is statistically significant at the one percent level. These results suggest that there is a significant increase in raw and abnormal selling activity prior to the year-end especially for firms with high tax-loss potential and are consistent with the implications of the tax-loss selling hypothesis.

The abnormal sell ratio for capital loss stocks may be due to an abnormal increase in selling or an abnormal decrease in buying activity. It is also possible that both buying and selling increase over that period, but that the increase in selling activity is relatively larger than the buying activity. However, the tax-loss selling hypothesis specifically predicts an abnormal increase in selling activity for firms with large capital losses. Therefore, to determine the source of the abnormal sell ratio, we separately examine daily selling activities, defined as the lots of sell side trades, around the turn-of-the-year period.

In panel A we find that the raw selling activity does not vary systematically across the tax-loss potential quartiles in the pre-turn period. However, when we estimate abnormal selling activity defined as the percent change in selling activity relative to

Table 1
Measures of selling activity around the year-end for equity portfolios constructed on the basis of tax-loss potential
The daily sell ratio is measured as: (volume of sell trades)/(total volume of trades) for each day for the 10-day turn- of-the-year period. We use the Lee and Ready (1991) algorithm to classify trades as either buys or sells. The benchmark ratio is the average of daily sell ratios in July. The abnormal sell ratio is the percentage change in the daily sell ratios for the 10-day turn-of-the-year period relative to their corresponding July values. Selling activity refers to the daily sell-side lot size for the 10-day turn-of-the-year period. Abnormal selling activity is calculated as the percentage differences between the daily sell-side activity and the corresponding July values for the 10-day turn-of-the-year period. Tax-loss potential is calculated as the return between the peak stock price during the period January 1 through November 30, and November 30. Portfolio Q1 is the portfolio with the greatest tax-loss potential while portfolio Q4 has the least tax-loss potential. The pre-turn period refers to the ten days immediately preceding the year-end while the post-turn period represents the first ten trading days of the new year. All numbers reported are medians. Statistical significance for the Wilcoxon sign rank test at the one percent level is indicated by ***. A subscripted "a" indicates a significant difference in medians relative to portfolio Q4 at the one percent level.

Sell ratio				Selling activity		
Tax-loss quartile portfolio	Benchmark sell ratio	Pre-turn sell ratio	Pre-turn abnormal sell ratio (%)	Benchmark number of sells (lots)	Pre-turn number of sells (lots)	Pre-turn abnormal sells (%)
Panel A: Pre-turn period						
Q1	0.515	0.573	10.41^{***}_{a}	71.55	123.75	59.00^{***}_{a}
Q2	0.504	0.535	5.42^{***}_{a}	107.50	128.70	11.00^{***}_{a}
Q3	0.498	0.517	2.68^{***}	147.70	164.50	3.00
Q4	0.492	0.504	2.15^{***}	129.20	146.00	2.30
Panel B: Post-turn period						
Q1	0.515	0.500	-2.70^{***}_{a}	71.55	76.60	3.00
Q2	0.504	0.504	0.10	107.50	104.60	-2.70_{a}
Q3	0.498	0.506	1.27	147.70	161.25	2.40_{a}
Q4	0.492	0.501	2.25^{***}	129.20	145.10	8.00^{***}

the July benchmark level, we observe a monotonic decline in that measure as we move to firms with lower levels of tax-loss potential. For firms in portfolio Q1 we observe a 59 percent increase in sell trade lots relative to the July benchmark but an insignificant 2.30 percent abnormal increase for firms in portfolio Q4. Further, the difference in abnormal selling activity between portfolios Q1 and Q4 is significant at the one percent level. These results further support the implication of the tax-loss selling hypothesis that the increase in selling activity is greater for high tax-loss firms than low tax-loss (or even capital gains) firms.

In panel B we report the sell ratio and number of lots sold for the 10-day period subsequent to the turn-of-the-year. In contrast to the results of the pre-turn period, we find the opposite relation between tax-loss potential and the sell ratio in the new year. For firms with low tax-loss potential or capital gains (portfolio Q4 firms), we observe a significant abnormal sell ratio of 2.25 percent. This implies that these firms experience an abnormal selling pressure in the new year, which is consistent with

investors postponing the realization of profits until the following year to delay paying capital gains tax. For other firms, we observe a monotonic decline in abnormal sell ratio as we move from portfolio Q4 to portfolio Q1. Firms with the largest tax-loss potential experience a significant decline in the sell ratio of 2.70 percent, which is consistent with the disappearance of selling pressure after the turn-of-the-year. Similar results are also observed when we examine abnormal selling activity over the post-turn period. We find that firms with the least tax-loss potential (portfolio Q4) experience an increase in selling activity of approximately 8 percent, while the high abnormal pre-turn selling activity for portfolio Q1 firms disappears after the new year.

We test the robustness of our results by using an alternative measure for both the sell ratio and selling activity (not tabulated separately). We redefine the sell ratio as the fraction of sell trades relative to total trades and selling activity as number of daily trades classified as sell. In the pre-turn period, we find a 17.40 percent (90 percent) increase in abnormal sell ratio (selling activity) for portfolio Q1 firms while the corresponding increase in portfolio Q4 firms is only 2.03 percent (8.10 percent). In the post-turn period, portfolio Q4 firms experience an increase in abnormal sell ratio (selling activity) of 1.57 percent (23.70 percent) while portfolio Q1 firms have a decrease in abnormal sell ratio (selling activity) of 0.98 percent (3.90 percent).

The main tests of the tax loss-selling hypothesis presented above are cross-sectional in nature. But the hypothesis also has a time series implication. If there is a severe market downturn in a particular year, then the tax-loss selling in that year should likewise be greater. Indeed the year 1987 provides us with an opportunity to conduct such a test. During that year there was a severe market crash, with the market losing nearly 25 percent of its value during the last quarter. If the tax-loss selling hypothesis is correct, we should observe greater tax loss selling in 1987 relative to other years in our sample.[7]

To conduct this test, we form the tax-loss quartiles separately for 1987. Not surprisingly, the tax-loss potential of Q1 firms in 1987 is greater than that of Q1 firms calculated across the other sample years (i.e., 51.3 percent versus 29.3 percent).[8] Most importantly, the abnormal selling activity at year-end for the Q1 firms in 1987 is significantly greater (with a p value of 0.001) than that of the other Q1 firms for the remaining years in our sample.

In aggregate, the results presented in Table 1 reveal significant selling pressure prior to year-end for those stocks with the largest tax-loss potential, while the same selling pressure disappears after the new year. Further, investors delay selling stocks of firms with capital gains until the new year to avoid realizing profits. These results are consistent with the presence of tax-loss selling during the year-end period.

[7] We thank the referee for suggesting this test.

[8] For 1987, the cut-off points for the quartiles are 40 percent, and 29.3 percent for portfolios Q2 and Q3 respectively.

3.1.2. Long-term and short-term losses

Poterba and Weisbenner (2001) use changes in capital gains tax laws between 1942 and 1996 and the distinction between short- and long-term losses to study year-end returns and provide evidence consistent with the tax-loss selling hypothesis. In this study, we extend Poterba and Weisbenner's (2001) analysis by examining the relation between abnormal trading activity and short- and long-term tax-loss potential.

According to the 1986 Tax Reform Act, short- (long) term loss is initially offset against short- (long) term gain and any net short- (long-) term loss is first offset against long- (short-) term gains and then against AGI up to a maximum of $3,000. Therefore, the tax-loss selling hypothesis would predict abnormal selling activity prior to the year-end for stocks with short-term and long-term losses. Additionally, because short-term gains are taxed at the ordinary income tax rate, which is higher than the long-term capital gain rate, the tax savings from offsetting short-term gains is higher compared to offsetting long-term gains. Thus, investors have an incentive to accelerate the sale of stocks with short-term capital losses from after year-end to the period immediately preceding the turn-of-the-year. The existence of this incentive, coupled with the ability of investors to reduce their tax liability by postponing the sale of stocks with capital gains until after the new year, implies a negative relation between short-term tax-loss potential and abnormal selling activity in the new year. Finally, because there is no difference between short-term and long-term capital loss in the fraction of loss that can be used to offset AGI during our sample period, the distinction between short-term and long-term losses is greatly reduced. This implies that relative to the pre-1986 period, more investors are indifferent about short-term losses becoming long-term losses; this is particularly true for investors who lack large short-term gains. Further, given that investors postpone the recognition of capital gains until after the new year (Table 1, Panel B) and that long-term gains are taxed at a lower rate than short-term gains, most of the realized gains in the new year will be long-term gains.[9] Therefore, investors will have an incentive to offset these gains with realized long-term losses that they have accumulated from other stocks and thus reduce their overall tax liability. The tax-loss selling hypothesis thus predicts an increase in the sale of stocks with long-term losses after the turn-of-the-year.

We explore the relation between abnormal selling activity and long- and short-term tax-loss potential by estimating the following OLS regression equation:

$$\text{ABN SELL}_i = \alpha + \beta_1 * \text{ST-LOSS}_i + \beta_2 * \text{LT-LOSS}_i + \varepsilon_i, \tag{1}$$

where ABN SELL is the abnormal number of sell trades (models (1) and (3)) and abnormal sell volume (models (2) and (4)) relative to the July benchmark, ST-LOSS is the short-term loss proxied by the current year's tax-loss potential and LT-LOSS is the long-term loss proxied by the prior year's tax-loss potential.

We present the result in Table 2. In models (1) and (2) we examine abnormal tax-loss selling *prior* to year-end and find that the coefficients for both long-term and

[9] Strictly speaking, the panel indicates that selling activity increases in the new year for firms with short-term capital gains. However, other things constant, firms with short-term gain are also more likely to be the candidates for long-term gains.

Table 2
Regression results relating pre-turn and post-turn abnormal selling activity to tax-loss potential
Models (1) and (2) examine the relation between abnormal selling activity and short-term and long-term tax-loss potential in the pre-turn period. Models (3) and (4) examine the relation between abnormal selling activity and current and prior year tax-loss potential in the post-turn period. Abnormal selling activity is measured as percentage relative to the July benchmark measure. The dependent variable in models (1) and (3) is the abnormal number of sell trades and in models (2) and (4) it is the abnormal sell volume. Short-term tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 29, and November 30 of the current year. Long-term tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 29, and November 30 of the preceding year. The pre-turn period is the 10-day period prior to the year-end and the post-turn period is the 10-day period following the year-end. Statistical significance at the one percent level is indicated by***.

	Pre-turn period		Post-turn period	
Variable	Model 1	Model 2	Model 3	Model 4
Intercept	−0.10	−0.01	0.41***	0.42***
	(−0.34)	(−0.28)	(30.33)	(19.11)
Short-term tax-loss	1.50***	1.30***	−0.80***	−0.72***
potential	(33.13)	(18.06)	(−20.90)	(−11.69)
Long-term tax-loss	1.24***	1.11***	0.32***	0.36***
potential	(26.04)	(14.57)	(7.93)	(5.51)
Adjusted R^2	0.21	0.08	0.05	0.02
N	9,168	9,168	9,168	9,168

short-term losses are positive and significant. This indicates that both long-term and short-term losses generate abnormal tax-loss selling prior to year-end. These results are consistent with the findings reported by Grinblatt and Moskowitz (1999) that stocks classified as either short-term or long-term losers experience lower returns in December.

In models (3) and (4) we examine the abnormal tax-loss selling activity *after* the new year. We find that abnormal selling activity decreases with short-term losses and this result is consistent with investors accelerating the sale of stocks with short-term capital losses prior to the year-end and delaying the realization of capital gains until after the turn-of-the-year. In sharp contrast, the coefficients for the long-term tax-loss variable are significantly positive. This result, which to our knowledge has not been documented by prior studies, suggests that investors sell stocks with long-term capital losses after the new year to offset realized long-term gains from other stocks that investors had delayed selling until after the turn-of-the-year. Overall, the results presented in the table support the conclusion of Poterba and Weisbenner (2001) that tax-loss hypothesis can explain the trading activities of firms with short-term and long-term losses.

3.1.3. Individual tax-loss selling or institutional window-dressing?

An alternative explanation for the dramatic increase in selling activity at the turn-of-the-year observed in Tables 1 and 2 is portfolio rebalancing undertaken by

institutional investors. The performance of institutional investors is generally evaluated at year-end and depends on their ability to invest in a portfolio of stocks that have increased in value. Therefore, institutional investors adopt a trading strategy of eliminating stocks from their portfolios that have lost value and maintaining or purchasing stocks that have appreciated in worth. Therefore, the trading pattern produced by the portfolio rebalancing of institutional investors is similar to that of tax-loss selling. Hence, any test of the tax-loss selling hypothesis must be able to distinguish between these two alternative explanations.

Sias and Starks (1997) examine this issue by analyzing the year-end trading activity of institutional and individual investors of 139 firms obtained from the TORQ database over one year-end. In this study, we use an alternative measure that takes advantage of the transactional nature of our data set to distinguish between individual and institutional investors. Because individual investors have access to less capital than institutions, they trade in smaller size than institutional investors who have greater resources under their control. Therefore, a decrease in trade size suggests that individuals, as opposed to institutions, are the major investors. While this proxy for investor type is not as precise as Sias and Starks (1997), it enables us to examine the source of abnormal year-end trading on a larger sample of firms and for a longer time period than Sias and Starks.

In Table 3, we present data for both unadjusted and abnormal sell trade sizes, measured in lots of 100 shares. Abnormal sell trade size is defined as the percentage change in the size of a sell trade relative to the sell trade size in July. We find that in the pre-turn period the median sell trade size is 10.2 (10.3) lots per sell transaction for firms in portfolio Q1 (Q4). After controlling for the normal sell trade size in July, we find a significant decrease in the trade size of approximately 12 percent per trade for firms with the largest tax-loss potential (portfolios Q1 and Q2). This result suggests that the selling pressure of capital loss stocks in the pre-turn period is generated predominately by investors who trade in smaller lots of stocks. For the portfolio Q4 sub-sample of firms where tax-loss selling is at a minimum, we do not observe any significant change in trade size. These results confirm the findings of Griffiths and White (1993), Sias and Starks (1997), and Poterba and Weisbenner (2001) that individual investors trading, rather than institutional investor-driven window dressing, explain the pattern in year-end equity returns.

The abnormal sell trade size in the post-turn period generally decreases, but most of the decreases are not significant except for the portfolio of low tax-loss potential (Q4 firms). For these firms, the median sell trade size in January falls by 6.6 percent relative to the July average suggesting that individual investors are the primary sellers of these stocks. These results, coupled with the higher selling activity for Q4 firms in the post-turn period, provide additional support for the tax-loss selling hypothesis that individual investors delay selling stocks and realizing capital gains until after the new year. In contrast, Sias and Starks (1997) do not find evidence supporting this important implication of the tax-loss selling hypothesis. An explanation for the difference in results might be the smaller sample size, both in terms of observations and years, used in their study.

Table 3
The trade size (in lots) of selling activity at the turn-of-the-year
Size is the median sell trade size measured in round lots of 100 shares. The benchmark size is the average sell trade size in the month of July. The abnormal sell trade size is the percentage change in trade size relative to the median July trade size. Portfolio Q1 is the portfolio with the greatest tax-loss potential while portfolio Q4 has the least tax-loss potential. Tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 29, and November 30. The pre-turn period refers to the 10 days immediately preceding year-end while the post-turn period represents the first 10 trading days of the new year. All numbers reported are cross-sectional medians. Statistical significance for the Wilcoxon sign rank test at the one percent level is indicated by ***. The number of observations in each portfolio is similar to those reported in Table 1 and hence is not reported separately. A subscripted "a" indicates a significant difference in medians relative to portfolio Q4 at the one percent level.

Tax-loss quartile portfolio	Benchmark sells (lots)	Pre-turn sells (lots)	Pre-turn abnormal sells (%)	Post-turn sells (lots)	Post-turn abnormal sells (%)
Q1	11.47	10.19	-11.50^{***}_{a}	11.35	-2.60_{a}
Q2	11.71	10.39	-12.20^{***}_{a}	11.17	−5.10
Q3	11.38	10.81	-6.90^{***}_{a}	10.67	−5.40
Q4	10.37	10.23	−0.70	9.70	-6.60^{***}

3.1.4. Tax-loss selling hypothesis, firm size and share price effects and the January anomaly

A major objective of this paper is to examine whether the tax-loss selling hypothesis can explain the January anomaly. However, any test of this relation must control for factors like firm size and share price because prior studies find these factors to be significant in explaining abnormal January returns. There is a strong relation between tax-loss selling and firm size and share price. First, firms that experience capital losses over the year are more likely to be small firms or firms with low share prices at the year-end. Second, firms that are small or have low share price tend to be more volatile than larger companies and hence are more likely to be tax-loss candidates. Further, because smaller/low share priced firms are more likely to have less market depth, their stock prices are more sensitive to changes in trading volume than larger/high share priced firms.[10]

While Reinganum (1983) also tests the relation between abnormal January returns and tax-loss potential, this study differs from his in several dimensions. Unlike Reinganum who only examines firms in the two extreme quartiles of tax-loss potential, this paper tests the relation across all firms. Second, to test that the impact of tax-loss potential on January returns is not a manifestation of the size or share price effect, we control for firm size and share price in the regression analyses. Finally, we also use an interaction term between the firms' tax-loss potential and firm size to test whether firm size magnifies the impact of tax-loss selling on turn-of-the-year returns.

[10] We present a test of this in Section 3.2.

Table 4
Regression estimates of the influence of firm size, short and long-term tax-loss potential on turn-on-the-year returns
The dependent variable is the transaction price return from 2 trading days before the year-end through 5 trading days following the new year. Short-term tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 29, and November 30 of the current year. Long-term tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 29, and November 30 of the preceding year. Size is logarithm of the firm equity value on the last trading day of November. t-statistics are provided in the parentheses and significance at the one percent level is indicated by ***.

	Full sample	1987	1988	1989	1990	1991
Panel A: Relation between returns and firm size						
Intercept	0.260***	0.382***	0.141***	0.181***	0.181***	0.299***
	(13.258)	(4.117)	(12.177)	(12.177)	(12.025)	(13.357)
Size	−0.018***	−0.023***	−0.009***	−0.012***	−0.015***	−0.020***
	(−11.450)	(−2.996)	(−10.472)	(−10.472)	(−12.762)	(−11.578)
F statistic	131.109	8.978	97.29	109.669	162.873	134.04
Adjusted R^2	0.015	0.005	0.053	0.057	0.086	0.065
N	8,345	1,737	1,706	1,786	1,740	1,940
Panel B: Relation between returns and short and long-term tax-loss potential and firm size						
Intercept	−0.165***	−0.676***	0.018	−0.030	−0.061***	−0.138***
	(−4.879)	(−3.485)	(0.796)	(−1.349)	(−2.255)	(−3.568)
Short-term	0.739***	1.032	0.490***	0.735***	0.418***	1.157***
tax-loss potential	(7.990)	(2.248)	(6.670)	(8.424)	(5.364)	(8.893)
Long-term	0.510***	2.676***	0.018	−0.011	0.462***	0.141
tax-loss potential	(5.143)	(4.376)	(0.299)	(−0.103)	(4.442)	(1.182)
Size	0.012***	0.054***	−0.001	0.002	0.003	0.010***
	(4.734)	(3.596)	(−0.529)	(1.444)	(1.405)	(3.431)
Size* short-term	−0.053***	−0.079	−0.356***	−0.052***	−0.032***	−0.084***
tax-loss potential	(−6.799)	(−2.115)	(−5.573)	(−6.999)	(−4.894)	(−7.542)
Size* long-term	−0.035***	−0.193***	0.004	0.004	−0.038***	−0.005
tax-loss potential	(−4.222)	(−3.643)	(0.731)	(0.474)	(−4.260)	(−0.554)
F statistic	78.200	15.449	44.104	64.097	64.079	84.217
Adjusted R^2	0.044	0.044	0.120	0.159	0.162	0.184
N	8,341	1,576	1,575	1,700	1,629	1,842

We initially test the influence of firm size on January returns by estimating an OLS regression of year-end returns calculated from the share price two trading days prior to the year-end to five trading days (approximately 1 week) into the new year (Day −2, Day +5) against firm size. The result is reported in Panel A of Table 4. Consistent with the results of prior studies, we find a significant negative coefficient for firm size. This finding indicates that smaller firms experience higher returns relative to large firms around the turn-of-the-year. We find similar results when share price, rather than firm size, is used as the independent variable or when we use different return intervals (results not tabulated).[11]

[11] We calculate returns from 2 trading days prior to the year-end to 10 trading day (approximately half a month) into the new year (Day −2, Day +10).

We introduce the tax-loss trading effect into our analysis by including both the current and prior years' tax-loss potential as independent variables in the regression models and by adding an interactive variable between tax-loss potential and firm size. We test whether firm size by itself affects turn-of-the-year returns by assigning firms in portfolio Q4 a tax-loss potential of zero. Thus, the coefficient of the firm size variable captures the effect of firm size on the turn-of-the-year returns for firms that did not experience a tax-loss over the year.[12] We estimate the following OLS regression:

$$\begin{aligned} \text{RET}_i = \alpha &+ \beta_1 * \text{ST-LOSS}_i + \beta_2 * \text{LT-LOSS}_i + \beta_3 * \text{SIZE} \\ &+ \beta_4 * \text{SIZE} * \text{ST-LOSS}_i + \beta_5 * \text{SIZE} * \text{LT-LOSS}_i + \varepsilon_i, \end{aligned} \tag{2}$$

where RET is calculated from 2 trading days prior to 5 trading days subsequent to the year-end, ST-LOSS and LT-LOSS is the current year's and prior year's tax-loss potential respectively and SIZE is the log of the firm's equity value on the last trading day in November. The January size effect predicts a negative coefficient for firm size while the tax-loss hypothesis predicts positive coefficients for the tax-loss potential variables and negative coefficients for the interaction terms. We also replicate the analysis substituting share price for firm size. We obtain similar results and hence do not report them separately.

We present our empirical findings in Table 4, Panel B. For the full sample, we find the coefficients of tax-loss potential variables (both current and prior years) are positive and highly significant. This suggests that the tax-loss potential is important in explaining the turn-of-the-year returns. In contrast, the coefficient of firm size (share price) is significantly positive. This implies that small (low share price) firms with no tax-loss potential significantly *underperform* large (high share price) firms at the year-end, a finding that is contrary to the prediction of the firm size (share price) effect. The firm size (share price) effect becomes significant only when it interacts with the tax-loss potential variable. The negative coefficient for the variable suggests that for firms with a relatively large tax-loss potential, small firm size (low share price) magnifies the tax-loss related abnormal returns at the turn-of-the-year. An important implication of these results is that the observed size/share price effect documented by prior studies at the turn-of-the-year is, in fact, a tax-loss selling effect. Therefore, these results provide a significant contribution to the firm size/share price discussion of the January anomaly by precisely documenting the source of the abnormal turn-of-the-year returns.

We test the robustness of these results by providing annual estimates of our regression model. The R squares of the annual regressions are substantially larger than that of the full sample, partly because the annual variation in turn-of-the-year returns unrelated to tax-loss selling are absent in the yearly regressions. The R squares vary from 4.4 percent in 1987 to 18.4 percent in 1991. We continue to find that the current year's tax-loss potential to be significant and positive for all years. Similarly, the coefficient for the interactive term between the current year's tax-loss potential and firm size (share price) is significantly negative and is consistent with the tax-loss selling hypothesis. The coefficient of firm size (share price) variable is either

[12] We obtain similar results when we do not force the tax-loss potential of portfolio Q4 firms to be zero.

insignificant or positive indicating the well-documented firm size effect in January does not apply to stocks that do not experience capital losses.

3.2. Tax-loss selling and market liquidity

In this section we examine the impact of tax-loss motivated abnormal year-end trading activity on market liquidity by examining raw and abnormal spreads and depth at the bid and ask. Spreads are calculated as a percentage average of the bid and ask prices. Ask (bid) depth is estimated as the number of round lots quoted at the ask (bid) price. Abnormal spreads (depth) are estimated as the percentage change in spread (depth) between the pre-turn (post-turn) period relative to the corresponding July value. We present the results in Table 5.

Panel A contains median results for both year-end spreads and abnormal spreads. The cross-sectional median spread in the pre-turn period ranges from 4 percent for firms in portfolio Q1 to 1.3 percent for firms in portfolio Q4. We find a significant increase in abnormal spreads for stocks in portfolio Q1 to portfolio Q3 and the change in spread are positively related to the tax-loss potential. For portfolio Q1 firms, the median increase in spread is approximately 48 percent relative to their July spread and is significantly greater than the 0.2 percent decline in spreads observed for portfolio Q4 firms. The finding of an increase in the bid-ask spread at the year-end coupled with the increase in trading activity especially for the portfolio Q1 firms is consistent with the conclusion of Brock and Kleidon (1992) that profit-maximizing market makers respond to high trading activity in the pre-turn period by increasing bid-ask spreads. We obtain similar results when we examine abnormal increase in spreads over the post-turn period. The median increase in spreads is 51 percent for stocks in portfolio Q1 and this percentage decreases as we move to stocks with lower tax-loss potential.

In panels B and C we report our findings regarding the level and change in market depth at both the bid and the ask price. Firms with the highest capital losses (portfolio Q1) experience a significant increase in market depth at the bid-price of approximately 34 percent while those in portfolio Q4 experience a 11.7 percent decline prior to the year-end. These results are consistent with our earlier finding that there is abnormal selling pressure during the pre-turn period for those stocks with the largest capital losses as investors seek to realize capital losses prior to year-end. Specialists accommodate the abnormal year-end trades by increasing the bid depth for capital loss stocks because the selling is most likely to be tax-loss rather than informationally motivated.

Despite the significance increase in depth at the bid price, the relative liquidity of portfolio Q1 firms actually declines prior to the year-end. This is because the increase in bid depth is insufficient to accommodate the significant 59 percent increase in selling volume we report in Panel A of Table 1. We measure the shortfall in bid depth relative to the sell volume by computing the depth insufficiency, which is defined as

$$1 - \frac{bid\ depth/sell\ volume}{bid\ depth\ in\ July/sell\ volume\ in\ July}. \tag{3}$$

Table 5
Share liquidity around the turn-of-the-year period
Bid-ask spread is calculated as: $2*(\text{ask} - \text{bid})/(\text{ask} + \text{bid})$. Market depth is estimated as the number of round lots quoted at the ask price as well as the number of round lots quoted at the bid price. The abnormal spread is calculated as: (average spread in the pre-turn period—the average spread in July)/(average spread in July). Estimates of abnormal market depth are similarly defined. Portfolio Q1 is the portfolio with the greatest tax-loss potential while portfolio Q4 has the least tax-loss potential. Tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 30, and November 30. The pre-turn period refers to the 10 days immediately preceding year-end while the post-turn period represents the first 10 trading days of the new year. All numbers reported are medians. Statistical significance for the Wilcoxon sign rank test at the one percent level is indicated by ***. A subscripted "a" indicates a significant difference in medians relative to portfolio Q4 at the one percent level.

Panel A: Bid-ask spread

Tax-loss quartile portfolio	Benchmark Spreads	Pre-turn Spreads	Pre-turn abnormal spreads (%)	Post-turn spreads	Post-turn abnormal spreads (%)
Q1	0.026	0.040	48.10_{a}^{***}	0.040	50.90_{a}^{***}
Q2	0.016	0.019	20.70_{a}^{***}	0.019	19.10_{a}^{***}
Q3	0.013	0.014	8.60_{a}^{***}	0.014	6.60_{a}^{***}
Q4	0.012	0.013	−0.20	0.012	1.60

Panel B: Market depth: bid quote

Tax-loss quartile portfolio	Benchmark depth (lots)	Pre-turn depth (lots)	Pre-turn abnormal depth (%)	Post-turn depth (lots)	Post-turn abnormal depth (%)
Q1	20.100	27.709	33.70_{a}^{***}	21.196	1.30_{a}
Q2	19.400	19.703	0.10a	17.856	-8.90^{***}
Q3	19.100	17.769	−7.70	17.664	-9.70^{***}
Q4	20.000	18.365	-11.70^{***}	18.058	-10.80^{***}

Panel C: Market depth: ask quote

Tax-loss quartile portfolio	Benchmark depth (lots)	Pre-turn depth (lots)	Pre-turn abnormal depth (%)	Post-turn depth (lots)	Post-turn abnormal depth (%)
Q1	21.800	20.305	-7.60_{a}	19.952	−8.60
Q2	19.600	16.491	-14.70_{a}^{***}	17.517	-12.70_{a}^{***}
Q3	19.800	17.324	-14.20^{***}	18.166	-10.00_{a}^{***}
Q4	20.500	18.049	−12.80	19.225	−9.80

A positive (negative) depth insufficiency means that compared to July levels, there is a decline (increase) in depth at the bid-price relative to the number of shares sold at year-end. A depth insufficiency of 0 suggests that there is no change in the ratio of shares at the bid depth as a fraction of shares sold relative to that in July. In the

pre-turn period, the median depth insufficiency for portfolio Q1 firms is 0.15 (significant at 1 percent level) indicating an insufficient level of bid depth to meet the tax-loss motivated increased sell volume at the end of the year. Further, the pre-turn depth insufficiency is more severe for smaller firms. The Spearman correlation between depth insufficiency measure in the pre-turn period and the firm size for portfolio Q1 firms is −0.15 (significant at 1 percent level). This indicates that for high tax-loss potential firms, the depth insufficiency problem is more severe for smaller firms and hence magnifies the tax-loss selling effect.[13] This finding provides an insight regarding why small firms have a larger tax-loss selling effect than larger firms (Schultz, 1985) and also helps explain the significant coefficients in the regression between abnormal returns and the pre-turn interactive variable of tax-loss potential and firm size contained in Table 4.

Other than the increase in bid depth for the large capital loss stocks in the pre-turn period, we observe a general decrease in the depth for bid and ask depth over both the pre-turn and post-turn periods. Overall, the results presented in Table 5 suggest a decrease in liquidity at the turn-of-the-year.

3.3. Price pressure hypothesis

The price pressure hypothesis assumes that the demand curve for stock is not perfectly elastic and hence a change in trading activity affects the stock's equilibrium price resulting in abnormal returns. Any test of the hypothesis must include a change in trading activity without a change in the information set. The turn-of-the-year period is useful to test the short-run elasticity for stocks for two reasons. First, year-end trading is motivated by tax-loss selling and hence is informationally neutral. Second, the impact of a change in trading activity on stock prices would vary across quartiles of firms classified on tax-loss potential. That is, stocks with the largest tax-loss potential that experience the greatest increase in selling activity prior to the year-end (portfolio Q1 firms) will experience the largest decline in prices and hence the highest returns in the new year. For portfolio Q4 firms who have the smallest tax-loss potential, the January returns will be low because the abnormal selling activity prior to the year-end is not very high. Alternatively, if markets are efficient and the demand curve for equity is perfectly elastic, then year-end tax-loss motivated trading should have no impact on the share's equilibrium price and should be no significant return pattern across portfolios classified on tax-loss potential.

3.3.1. Is the demand curve for stocks perfectly elastic?

In Table 6, we report the results of our test of the effect of tax-loss trading on stock prices. Specifically, we present a series of transaction price and quote-to-quote returns calculated from two days prior to 5 days after the close of the year for a set of

[13] In estimating the insufficiency and its correlation between firm size we eliminate observations where the volume is smaller than 10 lots as the depth/volume ratio is not meaningful when the volume is very small.

Table 6
Turn-of-the-year returns for portfolios stratified on the basis of tax-loss potential
Tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 30, and November 30. Portfolio Q1 is the portfolio with the greatest tax-loss potential while Q4 has the least tax-loss potential. The trade-to-trade returns are calculated as (closing transaction price on day 5—closing transaction price on day −2)/(closing transaction price on day −2). The bid-to-bid returns are calculated as (closing bid price on day 5—closing bid price on day −2)/(closing bid price day −2). The ask-to-ask returns are calculated as: (closing ask price on day 5—closing ask price on day −2)/(closing ask price day −2). The ask-to-bid returns are calculated as: (closing bid price on day 5—closing ask price on day −2)/(closing ask price day −2). All numbers represent mean returns. Statistical significance for the Wilcoxon sign rank test at the one percent level is indicated by ***. A subscripted "a" indicates a significant difference in medians relative to portfolio Q4 at the one percent level. The number of observations in each portfolio is similar to those reported in Table 1 and hence is not reported separately.

Tax-loss quartile portfolio	Trade-to-trade returns	Bid-to-bid returns	Ask-to-ask returns	Ask-to-bid returns
Q1	0.087^{***}_{a}	0.071^{***}_{a}	0.067^{***}_{a}	-0.010^{***}
Q2	0.033^{***}_{a}	0.033^{***}_{a}	0.033^{***}_{a}	0.005^{***}_{a}
Q3	0.022^{***}	0.022^{***}	0.022^{***}	0.002^{***}_{a}
Q4	0.017^{***}	0.016^{***}	0.017^{***}	-0.008^{***}

portfolios stratified by their potential tax-loss.[14] In addition to finding significantly large positive returns for all portfolios over the turn-of-the-year, we document a monotonic relation between year-end returns and tax-loss potential. The average returns for firms in portfolio Q1 (8.7 percent) is about five times as great as those contained in portfolio Q4 (1.7 percent).

Because we show in Table 1 that the stocks in portfolio Q1 are more likely to trade at bid prices prior to year-end, a large return for portfolio Q1 may simply reflect the migration of prices away from the bid as the year-end selling pressure evaporates as opposed to a decline in prices as predicted by the price pressure hypothesis. Therefore, any examination of the price pressure hypothesis will have to control for the bias attributable to bid-ask bounce. This will ensure that the observed returns pattern is caused by temporary changes in supply/demand for shares and is not simply a result of share prices moving from bid to ask or vice versa. Unlike most prior studies that ignore the impact of bid-ask bounce on stock prices while testing the price pressure hypothesis, we are able to explicitly control for intra-spread price movements because of the transactional nature of our data. We construct returns from bid (ask) to bid (ask) and this measure is similar to that of Keim (1989). Therefore, a positive relation between tax-loss potential and spread-adjusted returns is consistent with the existence of price pressure induced by tax-loss motivated selling.

[14] We perform a similar analysis from two days prior to ten days after the turn-of-the-year and obtain similar results.

We find that the return results continue to exhibit statistical significance across all quartiles. While firms with high tax-loss potential experience a bid (ask) to bid (ask) return of 7.10 percent (6.70 percent), the corresponding values for firms in portfolio Q4 are 1.60 percent (1.70 percent). These results suggest that firms with the highest abnormal selling pressure have the greatest turn-of-the-year spread-adjusted returns. These findings provide direct evidence that tax-loss induced selling pressure not only makes year-end trading more likely to occur at bid prices but also temporarily reduces the equilibrium price of equity. Therefore, we conclude, similar to Harris and Gurel (1986), Shleifer (1986), and Kaul et al. (2000) that the demand curve for equity is not perfectly elastic.

3.3.2. Market efficiency and investor behavior around the year-end

The evidence of an inelastic demand curve would imply the possibility of an exploitable market inefficiency, which is the source of Roll's (1983) reservation of tax-loss selling as an explanation for the turn-of-the-year effect. In this section, we examine whether it is a profitable for investors to buy stocks prior to year-end at temporarily depressed prices and sell them at the start of the new year when prices return to normal levels. The profit from such a trading strategy can be measured as ask-to-bid returns calculated over the turn-of-the-year period.

In the last column of Table 6 we present our results concerning the ability of investors to profit from patterns in year-end equity prices. We find that the ask-bid returns are significantly negative for stocks with the greatest (portfolio Q1) and least (portfolio Q4) tax-loss potential. For firms in portfolio Q2 and Q3, we observe statistically significant, but economically insignificant returns at the turn-of-the-year. This suggests that after controlling for transaction costs, investors cannot earn abnormal prices by buying stocks at depressed year-end prices and then selling them at the start of the new year when prices rebound. We conclude from these findings that the market is efficient with respect to turn-of-the-year effect and there is no obvious trading strategy by which to profit from this trading pattern. This might explain the persistence of the January effect despite its widespread documentation.

3.4. Individual trading behavior at the turn-of-the-year

The preceding evidence provides strong support for the tax-loss selling hypothesis. Individual investors, motivated to lower their tax liability, sell stocks that have experienced a decline in prices over the year immediately prior to the year-end. The resulting increase in selling pressure causes a decline in stock prices, which is reversed in the following year when the selling pressure dissipates. Roll (1983) argues that investors anticipating tax-loss selling will seek to profit from it by buying shares at temporarily depressed share prices prior to year-end. Given the transactional nature of the data, we are able to examine investors buying activity and explicitly test Roll's conjecture.

Similar to the measure of selling activity, we define buying activity as the volume of buying trades expressed in the number of lots. In Table 7 we observe an increase in buying pressure for most portfolios of firms prior to year-end. However, this

Table 7
Buying activity at the turn-of-the-year
Buying activity refers to the number of daily lots transacted for buy-side trades. We use the Lee and Ready (1991) algorithm to classify trades as buys or sells. Abnormal buying activity is calculated as the percentage change in the buy activity relative to the July daily buy activity for the 10-day period. Buy size is the median buy trade size measured in round lots of 100 shares. The benchmark size is the average buy trade size in the month of July. The pre-turn/post-return abnormal buy trade size is the percentage change in trade size in the 10-day pre-turn/post-turn period relative to the median July trade size. Tax-loss potential is calculated as the return between where the stock price reaches its peak over the period January 1 through November 30, and November 30. Portfolio Q1 is the portfolio with the greatest tax-loss potential while portfolio Q4 has the least tax-loss potential. The pre-turn period refers to the 10 days immediately preceding year-end while the post-turn period represents the first 10 trading days of the new year. All numbers reported are medians. Statistical significance for the Wilcoxon sign rank test at the one percent level is indicated by ***. A subscripted "a" indicates a significant difference in medians relative to Q4 at the one percent level.

Tax-loss quartile portfolio	Benchmark buys (lots)	Pre-turn buys (lots)	Pre-turn abnormal buys (%)	Post-turn buys (lots)	Post-turn abnormal buys (%)
Panel A: Buying activity around the turn-of-the-year					
Q1	67.70	86.30	23.63_{a}^{***}	61.90	-8.00_{a}^{***}
Q2	111.60	113.20	3.29	106.90	-3.62_{a}
Q3	131.80	141.40	2.13	151.50	6.78^{***}
Q4	117.50	117.15	0.00	129.75	10.81^{***}
Panel B: Trade size for buying activity					
Q1	11.18	11.75	4.60_{a}^{***}	10.99	-0.70_{a}
Q2	11.51	11.00	−4.40	10.96	−5.60
Q3	11.36	11.41	−0.70	10.92	−5.80
Q4	10.15	10.17	−1.10	9.57	-6.00^{***}

abnormal increase is most pronounced for firms with the highest tax-loss potential (23.63 percent) and it decreases as we move to firms with capital gains in portfolio Q4 (0 percent). Similar results are obtained when we define abnormal buying activity as the number of buys trades relative to the daily average of the number of buy trades in July (not reported). These results are consistent with investors attempting to take advantage of the temporary depressed share price of large capital loss in the pre-turn period. We also observe a significant increase in abnormal trade size of 4.6 percent for stocks in portfolio Q1 in the pre-turn period, implying that it is primarily large institutional investors who are attempting to take advantage of the temporarily depressed prices (Panel B).

We document a decrease in buying activity after the new year for portfolio Q1 firms. Because these firms experience significant positive abnormal buying activity during the pre-turn period, this finding suggests that investors accelerate their planned purchase from after the new year to before the new year. We also observe a 6.78 percent increase and 10.81 percent increase in buying for portfolio Q3 and portfolio Q4 firms respectively after the new year. Additionally, the median abnormal trade size for portfolio Q4 firms decreases by 6 percent, which implies that

the primary buyers of these stocks are individual investors. These results are consistent with Ritter's (1988) "parking the proceeds" hypothesis that investors repurchase stocks after the new year with the proceeds from the pre-turn sale of their capital loss stocks. However, investors appear to concentrate their repurchase on firms that did not experience significant capital losses in the previous year. A possible explanation for this is the increased supply of these stocks by investors delay selling stocks whose share price have risen until the new year to reduce their tax liability.

4. Conclusion

This study presents a comprehensive test of the implications of the tax-loss selling hypothesis by analyzing transaction data over a 6-year sample period and provides new and direct results consistent with that hypothesis. We find an abnormal increase in selling activity prior to the year-end for firms that have experienced a decline in share price over the year. The abnormal selling pressure for these stocks disappears in January. For firms with capital gains however, we observe abnormal selling activity in the new year. This is consistent with the fundamental implication of the tax-loss selling hypothesis that investors who are motivated to reduce their tax liabilities, sell capital loss stocks prior to the year-end to realize losses and then delay the sale of capital gains stocks until the new year to postpone the recognition of capital gains. An examination of trading activity of stocks with short-term and long-term losses is also consistent with the implications of the tax-loss selling hypothesis.

We also test to see if the trading pattern observed in January might be explained by institutional window-dressing rather than individual tax-loss trading. We find a reduction in the average size of sell side transactions during the turn-of-the-year period. Since individual investors are more capital constrained than institutions and hence are more likely to trade in smaller lots, we conclude similar to Griffiths and White (1993), Sias and Starks (1997), and Poterba and Weisbenner (1998), that individual investors dominate year-end trading.

This study also makes a significant contribution in explaining the well-documented January anomaly. We find that the tax-loss selling hypothesis, as opposed to firm size or share price effects, is the primary explanation for the January anomaly. Firm size/share price become significant *only* when they are interacted with measures of tax-loss potential, implying that for stocks with capital losses, smaller firm size (lower share price) will magnify the turn-of-the-year effect. We find no evidence that small/low price firms with capital gains earn significantly higher returns than large/high price firms.

Further, this study examines the impact of year-end trading on market liquidity. Overall, we find an increase in bid-ask spreads and a decrease in market depth at year-end, suggesting that tax-loss trading has an adverse effect on market liquidity. For firms with the largest tax-loss potential, however, we observe an increase in bid-depth but this increase is insufficient to satisfy the increased trading volume motivated by tax-loss selling. This causes a decline in relative liquidity for these firms that amplifies the tax-loss selling effect. Further, because this insufficiency is most

severe for small firms, these firms experience the largest turn-of-the-year effect. These findings provide a microstructure explanation to Schultz's (1985) question as to why small firms have a greater tax-loss effect than large firms.

This paper also examines the presence of price pressure effects produced by tax-loss trading. We find that the non-information based selling at year-end temporarily depresses equilibrium equity prices even after controlling for bid-ask bounce. This finding suggests that stocks are not perfect substitutes for one another and consequently that the short-run demand curve for equity is not perfectly elastic. Similar to Harris and Gurel (1986) and Shleifer (1986), we conclude that price pressure is present in the capital market. However, an investor cannot systematically earn meaningful economic returns after controlling for transaction costs from a strategy of buying tax-loss candidate at year-end and selling them at the beginning of the new year.

Finally, this paper provides insights into the nature of trading behavior over the year-end period. Consistent with Roll's (1983) conjecture, we find abnormal buying activity of capital-loss stocks by institutional investors reflecting an attempt to exploit temporary price depressions. Further, we find an increase in buying activity subsequent to the new year, which supports Ritter's "parking the proceeds" hypothesis but the abnormal buying seems to be concentrated in stocks with capital gains.

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