Stock prices under pressure: How tax and interest rates drive seasonal variation in expected returns

Johnny Kang, Tapio Pekkala, Christopher Polk, and Ruy M. Ribeiro[1]

First draft: March 2006
This version: February 2015

Abstract

We show that interest rates drive mispricing at the turn of a tax period as investors face the trade-off between selling a temporarily-depressed stock this period and selling next period at fundamental value, but with tax implications delayed accordingly. We confirm these patterns in US returns, volume, and individual selling behavior as well as in UK data where tax and calendar years differ. At quarter-end, the trade-off is only present following recessions, consistent with the tax code. We then link a significant portion of the variation in the risks and abnormal returns of size, value, and momentum to tax-motivated trading.

JEL classification: G11, G12

Key words: price pressure, tax-loss harvesting, January effect, downward-sloping demand curves

---

[1]Kang: AQR Capital Management, LLC, Two Greenwich Plaza, Greenwich, Connecticut 06830, USA. Email johnny.kang@aqr.com. Pekkala: Pacific Investment Management Company (PIMCO), London, UK. Email pekkalatapio@gmail.com. Polk: London School of Economics, Houghton St., London WC2A 2AE, UK. Email c.polk@lse.ac.edu. Ribeiro: Pontifical Catholic University of Rio de Janeiro (PUC-Rio) - Department of Economics, Rio, Brazil. Email rmribeir@gmail.com. We are grateful for comments from Malcolm Baker, Jennifer Blouin, John Campbell, Randy Cohen, Josh Coval, Andrea Frazzini, Mark Grinblatt, Cam Harvey, Li Jin, Jim Poterba, Toby Moskowitz, Andrei Shleifer, Chester Spatt, Dick Thaler, Pietro Veronesi, Tuomo Vuolteenaho, an anonymous Associate Editor and two anonymous referees, participants in the 2005 HBS brownbag lunch, the 2006 University of Toronto Rotman business school seminar series, the 2007 Wharton Household Portfolio Choice and Financial Decision-Making conference, the 2007 Chicago Quantitative Alliance spring meeting, the 2008 Western Finance Association conference, and especially George Constantinides, Craig French, Paul Tetlock, and Clemens Sialm.

Previous research has argued that a tax-motivated seller should sell losers early and hold on to winners under the assumption that tax-selling behavior does not create distortions in market prices (Constantinides (1983, 1984)). However, recent research has argued that such tax-selling behavior at the turn of the year does generate seasonality in the cross-section of average stock returns, whose magnitude depends on the level of the capital gains tax rate (in particular, Poterba and Weisbenner (2001) and Grinblatt and Moskowitz (2004)). We build on these results and show that (because interest rates determine the present value of the tax gain/loss) the impact of tax-motivated selling also depends on the level of interest rates. In the presence of downward sloping demand curves for stocks and limits to arbitrage, both interest rates and capital gains tax rates drive the extent to which past losers trade at a temporary low price at the end of the tax year in the US and the UK. Furthermore, certain taxpayers in the US are required to pay taxes on a quarterly basis which can generate stock return seasonality even at the turn of non-year-end tax quarters.[2]

Our framework suggests that the expected magnitude of a stock return rebound following a period of tax-motivated selling should vary both in the cross-section and in the time-series. The cross-section of average rebound returns should vary with a stock's capital gains overhang, defined as the ratio of the cumulative gain since the stock's purchase to its current price.[3] For a given level of capital gains overhang, time-series variation in the rebound return should depend on both the capital gains tax rate (which determines the magnitude of the tax payment or credit) and the interest rate (which drives the personal benefit/cost of delaying that tax payment/credit).

While the previous literature has focused on the January rebound, showing that variation in capital gains tax rates appears to forecast variation in the degree of

[2]In general, tax-selling effects in the United States may be generated by two types of individuals who differ by how often they pay taxes. Individuals whose income primarily comes from wages that are subject to withholding generally pay taxes only once a year, while individuals whose income primarily comes from non-wage sources (including but not limited to the sale of investments) may be required to pay taxes every quarter based on their estimated annual income. For the former, only the turn of the year is relevant for tax-motivated trading, while the latter may engage in tax-motivated trading at any tax quarter, including the turn of the year. We thank an anonymous referee for highlighting the importance of estimated tax payments to our analysis.

[3]The terminology capital gains overhang is standard in this literature (see, for example, Grinblatt and Han (2005)).

selling pressure for loser stocks, we argue that variation in interest rates is at least as important.[4] We first provide an exact formulation for the way these two rates drive the stock return seasonality caused by tax-motivated selling. We then show that this formulation does a good job describing cross-sectional and time-series variation in expected returns both at the turn of the year and at the turn of the tax quarter, though in the latter case, only after recessions, when important aspects of estimated tax rules are likely to be binding.

The following example clarifies the intuition behind our analysis of the turn-of-the-tax-period effect and, more specifically, the turn-of-the-tax-year effect. Consider a US investor who is not required to pay estimated taxes, implying a tax period corresponding to the calendar year and a tax rate of 15%. Suppose this investor bought a stock at \$100 several years ago. The stock has declined in value since this purchase and is currently trading at \$4. Selling the stock at \$4 on the last trading day of December would generate a capital loss of \$96 and offer a tax deduction of \$14.40 (15%*\$96). Thus, proceeds total \$18.40, which is the sum of \$14.40 from the tax deduction and \$4 from the stock sale.

Alternatively, the investor could wait to sell the stock on the first trading day in January. The decision to wait provides January sales proceeds of \$4 (ignoring the small discounting across the turn of the year), but now the tax benefit will not occur until one year later and thus must be discounted by the appropriate one-year rate, here assumed to be 5%. The total present value of the proceeds from waiting until January now equals \$17.71: \$4 due to the sale and \$13.71 due to the present value of the tax benefit (15%*\$96/1.05). Waiting to sell the stock on the first trading day in January results in a present value loss of \$0.69 due to the deferral of the tax savings by one year. This analysis makes it clear that the investor would be willing to sell the stock below the \$4 fair value in December, but only to a certain limit.

Assuming that the beginning-of-January price is the fair value of \$4, what De-

[4]In our formulation, the tax-selling premium is the amount of expected rebound return for a unit spread in capital gains overhang and is a function of interest rates and tax rates. Variation in this premium is largely due to interest rates. If one were to fix interest rates at their average level over the sample, only allowing tax rates to vary, the resulting variation in the tax-selling premium is roughly one-third of the variation in the premium we document.

cember price, P, would make the investor indifferent between selling in December versus January? To be indifferent, the proceeds of the sale at the end of the year, P-15%*(P-$100), must equal the present value of the proceeds from selling the stock at the beginning of next year, $4-15%*($4-$100)/1.05. By equating these two values, one finds that the stock can sell as low as $3.19 implying a $0.81 discount relative to its fair value. This lower bound limits the extent to which price pressure can drive the stock price down in December and thus limits the magnitude of the January rebound. This lower bound depends on both the interest rate and the capital gains tax rate in addition to the level of the capital loss. Below $3.19, the investor delays selling the stock, at $3.19 the investor is indifferent, and anywhere above $3.19 the investor is better off selling now rather than waiting. In Section 1, we derive an explicit formula which captures a more general case than the above example. The formula shows a stock's rebound return following the end of a tax period depends not only on the marginal seller's capital gains overhang and tax rate but also on the appropriate interest rate corresponding to the seller's tax horizon.[5]

The example above highlights the importance of interest rates in the decision process. Suppose that the interest rate in the previous example were zero. Since there would be no benefit for accelerating the tax benefit to occur in this tax period rather than the next, the solution for P is clearly $4. More generally, at very low interest rates or if an investor's tax horizon is very short, a rational tax-motivated seller tolerates very little mispricing.

We take these predictions to the data, while generalizing to the cases of investors with different horizons and tax profiles. Our measure of a stock's capital gains overhang follows Grinblatt and Han (2005). Specifically, we use past volume to weight past prices in order to create a proxy for a stock's tax basis and therefore the capital gains overhang of the marginal seller of the stock. Just as the example above suggests, we show that the ability of this variable to describe cross-sectional variation in average returns at the turn of a tax period is a function of interest rates and tax rates, which we dub the tax-selling premium. This predictability is robust to including con-

[5]Under the US tax code, an investor's tax horizon can range from being negative to being longer than one year, depending on the implications of estimated tax rules for a particular taxpayer. We discuss this complexity in Section 1, with additional analysis in the Internet Appendix.

trols for various firm characteristics (size, book-to-market, trading volume, and past return patterns) in our regression analysis.

We carefully explore the nature of this documented cross-sectional and time-series variation in expected returns to show that it is consistent with our economic explanation. We find that the majority of the tax-selling effect occurs within the days surrounding the turn of the tax period, but this effect, in the case of the turn of the tax year, is also present on a smaller scale during the entire month of December. One might expect to find a stronger turn-of-the-year effect as both investors who pay annual taxes and investors who pay quarterly estimated taxes are relevant. In contrast, we would expect the quarterly tax-selling effect to be smaller (as it is generated by a subset of investors with potentially shorter discounting horizons) and less frequent (as this effect is only likely to be present when investors take advantage of the specific aspects of the tax code). In particular, we exploit the fact that, to avoid penalty, the minimum estimated quarterly tax payment must be the smaller of 22.5% of whatever the year in question tax turns out to be (the current-year safe harbor) *or* 25% of the tax paid in the previous year (the prior-year safe harbor). Thus, one would expect that after recessions, the prior-year safe harbor is binding. Tax horizons will lengthen as tax-motivated loss realizations are particularly important in this instance since they lower taxes in the recession year and, as a consequence, lower estimated taxes in the following year.

Though we primarily analyze US data, we also find similar time-series and cross-sectional variation in expected returns in UK data during the turn of that country's tax year.[6] As the UK tax year ends in April, we argue that these international results provide strong evidence that our US findings are consistent with a tax-selling explanation.[7] Note that there is no reason to find quarterly effects in the UK data, as there is no equivalent to the US estimated-taxes framework in the UK, and we do not find any.

---

[6]Reinganum and Shapiro (1987) show that after the introduction of capital gains taxes in the UK, the difference in April returns between winners and losers becomes significantly greater than zero, consistent with a tax-loss selling story. Our empirical contribution is to show that this premium varies with the interest rate as predicted by our formulation.

[7]We thank Cam Harvey for this suggestion.

Moreover, we document that this phenomenon shows up in the trading volume of individual investors. We examine trading behavior using two different methods. First, using the TAQ database, we find that stocks with low capital gains overhang have more selling pressure at the turn of the year than stocks with high capital gains overhang and that this imbalance varies as a function of our tax-selling premium. Our second method directly measures investors' propensity to sell using the actual trades from the large discount brokerage studied in Odean (1998). We show that not only are investors more likely to harvest capital losses before the turn of the year but also this tendency to accelerate the realization of capital losses is much stronger in the years where interest rates and tax rates are high.

Since these firm-level findings make us confident that the tax-based pricing model is a useful description of average returns at the turn of the year, we then examine the way that tax-based cross-sectional and time-series variation in expected returns affects standard monthly performance attribution regressions. We first show that tax-loss selling effects are also present at the aggregate level. Specifically, we document that the return on the market portfolio in January has a similar predictable component that is a function of interest rates, tax rates, and the market's capital gains overhang. Since this is the case, one might expect that measures of risk can be driven by cross-sectional variation in the covariance of firm-level and market capital gains overhang. We confirm that our tax-selling variables drive the alpha and market beta of a long-short overhang portfolio. Moreover, similar predictable patterns can be found in the Fama-French (1993) and Carhart (1997) factors. Indeed, controlling for our tax-selling variable results in a CAPM alpha for SMB that is statistically insignificant from zero. These findings have important implications for researchers examining economic stories describing time-variation in the risks and returns of these factors.[8]

In short, our empirical results are consistent with the view that tax-motivated selling in the presence of downward-sloping demand curves results in stock return

[8]For example, Chordia and Shivakumar (2002) and Cooper, Gutierrez, and Hameed (2004) forecast returns on momentum strategies with variables that are clearly related to the variables our tax-based approach suggests. Cochrane (2001) argues that the average return on SMB has disappeared due to a significant increase in the trading of small-cap stocks by mutual funds. Our results provide an alternative explanation for the time-variation in SMB's expected return.

seasonality (a strong turn-of-the-tax-year effect and a smaller, less-frequent, turn-of-the-tax-quarter effect) where the extent of the resulting price pressure depends on the level of interest rates and capital gains tax rates. Consequently, our results have a practical implication for those trying to exploit the January effect, as we show that the magnitude of the anomaly should and does vary over time. In years when capital gains overhang is limited, capital gains tax rates are low, and interest rates are also low, one should not expect a large January effect.

This time variation has a related implication. Note that some market commentators have argued that savvy investors must have eliminated the January effect since recent returns to strategies exploiting that phenomenon have been low. However, as interest rates have also been quite low in recent data, we provide an alternative explanation for this recent poor performance. In fact, we show that the time-series variation in the tax-selling premium that we document is not subsumed by the inclusion of a time trend.

Nevertheless, as is the case with other financial anomalies, it is always difficult to explain the reason this inefficiency has not been arbitraged away. We suggest a few explanations for the limits to arbitrage in this case. First, unlike the value and momentum anomalies, the return pattern discussed here cannot be exploited on a regular basis but at most only once a year during the turn of the tax year (ignoring the weaker and less frequent turn-of-the-non-tax-end-quarter effect we also document). Hence, arbitrageurs may be reluctant to allocate a significant fraction of their risk capital to exploit this return pattern. Second, most arbitrageurs may not be aware of the time variation in the profitability of the January effect that our analysis documents. Finally, these effects should be stronger in stocks where there are many taxable investors. Presumably, the market for these stocks may be less efficient.

One can also question why investors do not trade earlier in the year to try to avoid the clumping that appears to occur. We argue that investors may naturally display inattention to this decision because it is costly to observe and process information.[9] This argument is consistent with a growing recent literature that has used investor

[9]Stokey (2009) presents an extensive analysis of the issues related to inaction and infrequent adjustment that occur in stochastic control models with fixed costs.

inattention to understand patterns in financial markets. Reis (2006) develops a model of optimal inattention for a consumer who faces a cost of observing additive income, such as labor income. Gabaix and Laibson (2002) model the cost of observing the stock market as a utility cost. Huang and Liu (2007) apply the concept of rational inattention to study the optimal portfolio decision of an investor who can obtain costly noisy signals about a state variable governing the expected growth rate of stock prices. Abel, Eberly, and Panageas (2007) study optimal inattention to the stock market in the context of Merton's (1971) model and the presence of information and transaction costs. Though modeling the dynamic nature of the problem we study is beyond the scope of this paper, these papers suggest that inattention might play an important role in such an analysis.[10] Anecdotally, many investors do seem to make portfolio decisions infrequently.[11] Moreover, our empirical results are consistent with the clumping of tax-motivated trades occurring and generating price impact.

Finally, our work also relates to a growing empirical literature documenting price pressure in asset markets, a phenomenon initially suggested by Scholes (1972). Mitchell, Pulvino, and Stafford (2004) document price pressure subsequent to merger announcements and show that the trades of hedge funds appear to move prices away from fundamentals. Coval and Stafford (2007) document that extreme mutual fund flows result in forced trading that temporarily moves prices away from fundamental values.[12] These price pressure findings are not restricted to equity markets; Ellul, Jotikasthira, and Lundblad (2011), Mitchell, Pedersen, and Pulvino (2007), and Singleton (2014) document price pressure in the bond, convertible bond, and crude-oil futures markets,

[10]Intuitively, one is adding additional costs (the cost of observing and processing information, i.e. paying attention) and benefits (avoiding the clumping of trades near the turn of the tax period) to the dynamic problem studied in Constantinides (1984). It seems plausible that reasonable calibrations of the more complicated version of Constantinides exist where investors are reluctant to incur both transaction and attention costs until the end of the tax period draws near.

[11]Both Ameriks and Zeldes (2004) and Mitchell, Mottola, Utkus and Yamaguchi (2006) provide striking evidence that investors' portfolio adjustments are far from frequent.

[12]Recent papers have explored some implications of the results of Coval and Stafford (2007). Lou (2012) shows that flow-driven demand shocks more generally affect prices than just in the extreme fire-sale situations of Coval and Stafford. Anton and Polk (2014) show that stocks that are relatively more connected by common institutional ownership covary more together, generating a cross-reversal effect. Vayanos and Woolley (2013) model the price effects of fund flows developing a rational theory of institutionally-driven momentum, reversal, comovement, and cross-reversal.

respectively. In fact, the 2010 American Finance Association presidential address of Darrell Duffie (Duffie (2010)) uses the aforementioned assumption of investor inattention to model exactly these types of price pressure effects.

This paper is organized as follows. Section 1 briefly summarizes the most relevant recent literature and shows why both tax and interest rates should explain seasonal variation in expected returns. Section 2 describes the data and the construction of our main variables. Section 3 analyzes the empirical implications for the cross-section and time-series of US and UK expected stock returns, US trading volume, and actual individual investor trading behavior, as well as the implications for performance attribution. Section 4 provides the conclusions.

1 The setting

While our results apply to the end of any tax period, a large previous literature has examined the turn-of-the-year effect in stock returns resulting from tax-motivated selling.[13] Recent empirical work by Klein (2001a, 2001b), Grinblatt and Han (2005), Frazzini (2006), and Jin (2006) has more carefully examined this effect by studying the direct empirical links between a proxy for a stock's tax basis and patterns in returns. All of these papers relate measures of capital gains or losses to subsequent stock returns. Like these papers, our work exploits cross-sectional variation in a proxy for capital gains overhang; however, we also model and test a specific prediction about the magnitude of the effect for a given level of overhang.

A few researchers have also exploited time-series variation when testing the general

[13]The tax-selling hypothesis has been directly considered as an explanation for stock return seasonality by Wachtel (1942), Rozeff and Kinney (1976), Branch (1977), Dyl (1977), Roll (1983), Reinganum (1983), Chan (1986), Schultz (1985), Jones, Pearce and Wilson (1987), Reinganum and Shapiro (1987), Sims (1995), Reese (1998), Poterba and Weisbenner (2001), Grinblatt and Moskowitz (2004), and Ivković, Poterba and Weisbenner (2004). Dammon, Dunn and Spatt (1989) study the valuation of tax options when short and long term capital gains tax rates differ. Bossaerts and Dammon (1994) study the option value to time the realization of capital gains and losses and Dammon and Spatt (1996) consider transaction costs and long and short term capital gains tax rates. Dammon, Spatt and Zhang (2001) build a dynamic consumption and portfolio decision model in the presence of capital gains taxes and short-sale restrictions. Dammon, Spatt and Zhang (2004) examine optimal asset allocation and location between taxable and tax-deferred accounts.

predictions of a tax-based explanation for the turn-of-the-year effect. Most prominently, Poterba and Weisbenner (2001) study the way variation in the turn-of-the-year effect can be linked to changes in capital gains tax rates/regimes. Grinblatt and Moskowitz (2004) investigate the extent to which tax-loss selling drives the profits on technical trading strategies based on past return patterns. They find that trading profits are only statistically significant during high tax regimes.[14] The key contributions of our paper are to argue that interesting variation should also come from the interest rate channel and to provide empirical evidence that this channel is important.

Thus, the objective of this section is to build a measure that relates the maximum price distortion at the end of a tax period to all the relevant factors in a simple setting. In particular, we take the point of view of a marginal tax-motivated seller holding an unrealized capital gain/loss at the end of a tax period t facing a tax rate and interest rate.[15] The seller is rational with unbiased expectations of the price at the beginning of the next tax period, $t+1$. This investor evaluates the benefit of selling his holdings at the end of the tax period t at a distorted price in order to receive the tax benefit associated with realizing capital losses now instead of later (at the end of the next tax period).

For the sake of simplicity, assume the investor can sell stock i in the beginning of the next tax period $t+1$ at the true value of P_i with no uncertainty. Under the assumption of downward-sloping demand curves, tax-motivated selling will result in price pressure at the end of the tax period t. Consequently, the investor must determine the lowest price at which he would be willing to sell the stock at time t. To be clear, the investor solves for the end-of-tax-period price $P_{i,t}$ that makes him indifferent between selling either at t or at the beginning of $t+1$ and takes all other inputs as given. The reference price, RP_i, the price originally paid for the stock, determines the investor's cost basis for the purpose of taxation. The two other important parameters of this tax-loss harvesting decision are the capital gains tax rate, τ_t, and the discount factor, $B_t = \frac{1}{1+r_t}$, that accounts for the time-value of

[14] A recent paper by Sialm (2009) studies dividend taxes and stock returns more generally to show that before-tax returns are higher for those stocks that have higher effective tax rates.

[15] The arguments in this section are made for a loser stock; however, a similar rationale applies to winner stocks as well.

money as well as the creditworthiness of the investor through an interest rate, r_t.[16] Note that for simplicity, we do not have a subscript i on τ or r, since we are assuming the same tax and interest rate for all stocks at time t.

This discount factor reflects the present value cost of the tax consequences of selling at the beginning of next period $t+1$ rather than at the end of period t. We emphasize that such a discount factor is appropriate despite the fact that there is only a one-day difference between trading days in our framework, because delaying the sale by one day has the impact of delaying the tax benefit until the end of the following tax period.[17] Indeed, for some investors, the relevant time horizon for the interest rate is not necessarily the length of their next tax period as estimated tax rules may require the individual to pay only a portion of the tax at the end of the next tax period. Thus, analogous to measuring the duration of a coupon bond, the effective discounting horizon takes into account all future tax savings, weighted by the horizon at which these savings occur, and can be significantly longer than the length of the next tax period.[18]

We equate the after tax proceeds of the sale in t and $t+1$:

$$\begin{aligned} \text{[Proceeds at end of tax period } t] &= \text{[Proceeds at beginning of tax period} t+1] \\ P_{i,t} - \tau_t(P_{i,t} - RP_i) &= P_i - \tau_t(P_i - RP_i)B_t. \end{aligned} \tag{1}$$

This equation can be rearranged into

$$-\tau_t(P_{i,t} - RP_i)(1 - B_t) = (P_i - P_{i,t})(1 - B_t\tau_t). \tag{2}$$

[16]There are several complications of the tax code that are not considered in our analysis. For example, there is a cap on the size of the capital loss deduction one can make against personal income in any one year. Also, typically short-term capital gains are taxed at a higher rate than long-term capital gains. In fact, in some years, short-term capital gains have been taxed at the personal tax rate. Moreover, the ability to implement a short-the-box strategy has changed over the time period we study. Additionally, there are, of course, portfolio aspects of the decision. We ignore these complications for the sake of simplicity.

[17]Note that we ignore the one-trading-day discount effect on the sale proceeds for the sake of simplicity.

[18]We discuss some of the relevant aspects of the tax code in the Internet Appendix.

The equation above highlights the condition that makes the marginal seller indifferent. The equation says that the present-value loss of delaying the tax credit must be compensated by the after-tax $t+1$ rebound. For the sake of concreteness, we return to the example given in the introduction of a US investor whose relevant tax period is the calendar year. At the temporarily low price of $3.19, the investor can generate tax savings this year equal to -15%*($3.19-100) = $14.52 by harvesting the capital loss now. At an interest rate of 5%, delaying the harvest of this tax loss by one day results in a present value loss of $14.52*(1 - 1/1.05)= $0.69, as the investor must wait one year to receive the tax credit. This dollar amount is the value of the left-hand side of equation (2). However, this delay allows the investor to capture the $t+1$ price rebound of ($4-$3.19) = $0.81 which results in an after-tax gain of $0.81*(1-15%/$1.05) = $0.69, as the tax on the realized capital gain is paid at $t+1$.

Dividing by P_t and rearranging gives the stock's $t+1$ rebound as a return,

$$\frac{P_i - P_{i,t}}{P_{i,t}} = -\tau_t \frac{(1-B_t)}{(1-B_t\tau_t)} \frac{P_{i,t} - RP_i}{P_{i,t}}.$$

This equation shows that the stock's $t+1$ rebound return is a function of the capital gains tax rate, the level of the interest rate, and the capital gains overhang of the stock, $g_{i,t} = \frac{P_{i,t}-RP_i}{P_{i,t}}$. We further define $\gamma_t \equiv \tau_t \left(\frac{1-B_t}{1-B_t\tau_t}\right)$ in order to write the stock's tax-selling rebound return as

$$\text{time } t+1 \text{ rebound} = -\gamma_t g_{i,t} \tag{3}$$

We dub γ_t the *tax-selling premium*. Under our assumptions, this equation applies for all stocks. The capital gains overhang, $g_{i,t}$, is different for every stock, driving cross-sectional variation in the effect, but the tax-selling premium, γ_t, is the same for all stocks, driving time-series variation in the effect. Our description has focused on the case where the marginal investor in the stock has a negative capital gains overhang, and thus a positive rebound return. Nevertheless, a similar rationale applies to stocks where the marginal investor has a positive capital gains overhang. A tax-motivated investor sells a winner stock this tax period rather than next only if $P_{i,t}$ is (temporarily) so high that it compensates the investor for the present value loss of paying taxes this tax period rather than the next tax period.

Our subsequent analysis exploits cross-sectional variation in $g_{i,t}$ and time-series variation in γ_t to explain return patterns across the turn of a tax period. In particular, we measure the extent to which temporary price pressure occurs at the end of tax period t and dissipates in the beginning of tax period $t+1$.[19] We emphasize that the interest rate channel that our novel formulation identifies generates significantly more variation in the predicted magnitude of the effect than the tax rate channel (in fact, more than twice as much for an investor whose tax period is one year). The predicted value of γ, based on realized values of the two rates in question, varies from close to 0 to 478 basis points over the sample. This variation is primarily due to interest rates. If one were to fix interest rates at their average level over the sample, only allowing tax rates to vary, the resulting variation in γ is much smaller (77 to 321 basis points), roughly one-third of the variation in γ seen in the sample we study.

In the above analysis, we made the simplifying assumption that the relevant characteristics (tax rate and discount factor) of the marginal investor/seller in question were constant across stocks and through time. In more realistic scenarios, these characteristics may vary. In particular, the tax horizon implicit in the discount factor may be different across individuals who differ by how often they pay taxes. Individuals whose income primarily comes wages that are subject to withholding generally pay taxes only once a year, while individuals whose income primarily comes from non-wage sources (including but not limited to the sale of investments) may be required to pay taxes every tax quarter based on their estimated annual income. For the former, only the turn of the year is relevant for tax-motivated trading, while the latter may engage in tax-motivated trading at any tax quarter, including the turn of the year.

Though the tax horizon of the turn-of-the-year investor is 12 months, the tax horizon of the turn-of-the-quarter investor can vary from zero months (and even negative, implying that it is optimal to defer loss realizations) to over a year based

[19]The mispricing we investigate at the end of a tax period is equal to the mispricing at the beginning of the next tax period. However, when measured in returns, the alpha at the end of a tax period is not exactly equal to the alpha at the beginning of a tax period because the base price on which the return occurs is different. Our empirical work takes this difference into account. However, our description of the intuition ignores this difference for simplicity.

on a variety of aspects of the tax code, which we discuss in the Internet Appendix. Though we grant the inherent difficulty in identifying the marginal seller, we exploit an important aspect of the tax-selling decision to help with identification.

In particular, we exploit flexibility in the tax code that allows an investor's minimum year $t+1$ quarterly estimated tax payment to be the smaller of either 22.5% of whatever the year in question tax turns out to be (the current-year safe harbor) *or* 25% of the tax paid in the previous year (the prior-year safe harbor) (see page 48 of IRS Publication 505 and AIIM rules).[20] Thus, one would expect that after recessions, the prior-year safe harbor is binding. Tax horizons will lengthen as tax-motivated loss realizations are particularly important in this instance since they lower taxes in the recession year and, as a consequence, lower estimated taxes in the following year. Alternatively, after expansions, where investors may forecast a decline in income in year $t+1$, one would expect the current-year safe harbor to be binding. In this scenario, there is less benefit in realizing a capital loss in December of year t and the influence of turn-of-the-tax-quarter investors should be relatively minor.[21]

As a consequence, the discounting horizon of the marginal seller may have both seasonal and cyclical patterns that interact. When economic conditions are improving, since the typical estimated tax payer can take advantage of the prior-year safe harbor, we expect a longer horizon. Hence, after recessions, investors who pay estimated tax become more important at the turn of the year, as they are more likely to trade for tax reasons and, as a consequence, accept a larger price discount when doing so. Thus, we can quantify their importance by measuring how the turn-of-the-year effect changes after recessions. Finally, during the turn of the tax quarter, there are a range of possible tax horizons. Since it is likely that the discounting horizon is shorter, the magnitude of the impact on stock prices will be smaller as well.

[20]Taxpayers with adjusted gross income more than \$150,000 (\$75,000 if married filing a separate return) compare 22.5% of this year's tax to 27.5% of last year's tax in order to calculate the minimum estimated tax payment. The annualized income installment method (AIIM) calculates the installment payment that would be due if the income minus deductions earned before the due date were annualized. This exception to the underpayment penalty provides some relief to taxpayers who earn unexpected or uneven income during the year.

[21]See the Internet Appendix for a more detailed discussion and numerical examples. In general, one might expect that the typical sophisticated investor will smooth his/her income leading to a discounting horizon close to three months.

Despite these arguments, we acknowledge that ultimately the relevant discounting horizon is an empirical question. Therefore, in our tests, we consider a range of discounting horizons (limited only by the need for conciseness) and allow for the possibility of differential effects during expansions and recessions.

2 Data

In this section, we provide a description of the key variables used for these empirical tests. We first explain the way we compute our two key explanatory variables, the capital gains overhang, g, and the tax-selling premium, γ, and then describe the various control variables we employ. As the sources for these variables are standard datasets (CRSP, Compustat, TAQ, and the data from a large discount brokerage studied in Odean (1998)), we leave a detailed description of the raw data to Section 1 of the Internet Appendix.

2.1 Tax-selling premium

In theory, γ should be a function of the marginal investor's capital gains tax rate and interest rate. Our implementation computes the US version of γ using the one-year Fama-Bliss interest rate and the maximum long-term capital gains tax rate (for the highest ordinary income bracket) each year, available from Internal Revenue Service publications.[22] The UK version of γ is computed using the Bank of England base rate and the capital gains tax rate each year, available from the HM Revenue & Customs website.

Although the appropriate interest rate depends on the creditworthiness of the marginal investor, we find that different interest rates imply similar variation in the US version of γ. In the analysis that follows, we use Fama-Bliss interest rates of

[22]By using the rates that were appropriate for each year t in question, we ignore the possibility that investors may anticipate that capital gains tax rates may change from year t to $t+1$. In Tables IA.V and IA.VI of the Internet Appendix to this paper, we estimate versions of our benchmark regression in Table II that allow investors to partially or even fully anticipate tax rate changes. Our results are qualitatively similar to those presented in the paper where we assume the tax rate does not change at the turn of the tax year.

the appropriate maturity primarily because these data are available over a long time period. Section 2 of the Internet Appendix documents that using other interest-rate proxies that include an explicit credit component, such as the rates on auto and personal loans, generates very similar variation in γ over most of the common sample period.[23]

2.2 Capital gains overhang

In theory, the relevant capital gains overhang, $g_{i,t}$, is that of the marginal seller, but this value obviously cannot be identified. Therefore, we use the capital gains overhang variable proposed by Grinblatt and Han (2005). They define capital gains overhang as the percentage deviation of a proxy for the stock's current reference price, $RP_{i,t}$, from the current price, $P_{i,t}$, where the proxy for a stock's current reference price is estimated using a turnover-weighted sum of end-of-week prices over the past 260 weeks, where $TO_{i,t}$ is the turnover of stock i in week t. Specifically, we measure $TO_{i,t}$ as the sum of daily trading volume relative to shares outstanding. Suppressing the subscript i for readability, the relevant equations are

$$\begin{aligned} g_t &= \frac{P_t - RP_t}{P_t} \\ \text{with } RP_t &= \phi^{-1} \sum_{n=0}^{260} \widehat{V}_{t,t-n} P_{t-n} \\ \text{where } \widehat{V}_{t,t-n} &= TO_{t-n} \left[\prod_{\tau=1}^{n-1} (1 - TO_{t-n+\tau}) \right] \\ \text{and } \phi &= \sum_{n=0}^{260} \widehat{V}_{t,t-n} \end{aligned}$$

Therefore, the weights, $\widehat{V}_{t,t-n} / \phi$, given to each past price, P_{t-n}, can be interpreted as the probability that the marginal seller bought the stock at that price, where $\widehat{V}_{t,t-n}$ is

[23] Indeed, a rate with a credit component may better capture the relatively strong performance of our Section 3.3 TAX factor since the onset of the financial crisis. During that period, rates containing a credit component diverged from traditional risk-free rate proxies.

a function of the past turnover from $t-n$ to $t-1$. Hence this probability is also equal to the probability that the reference price is equal to the price at $t-n$. Averaging over all possible reference prices yields the estimated cost basis.

The capital gains overhang measure has the following intuitive interpretation. If a stock had relatively high turnover exactly one year ago, but volume has been very low ever since, then the current shareholders are more likely to have bought the stock a year ago. Consequently, the price one year ago is a good proxy for the marginal investor's purchase price. Conversely, if that stock instead had relatively high turnover in the most recent month, then last month's price is a good proxy for the marginal investor's purchase price. Note that we compute g for each firm using price and volume data from the CRSP database for US firms and the Compustat Global database for UK firms.

2.3 Control Variables

We conduct cross-sectional regressions using both returns and selling pressure as dependent variables. The returns-based regressions forecast daily firm-level returns, which are obtained from the CRSP database for US firms and from Compustat Global for UK firms. The selling pressure regressions, used for analyzing investor behavior, are also conducted at the daily frequency. We compute selling pressure, $Sell$, defined as the ratio of sell trades to all trades, following Lee and Ready (1991) and Hvidkjaer (2008) using the TAQ database. We further compute versions of selling pressure for small ($Sell_S$) and large ($Sell_L$) trades. Following Lee and Ready (1991), we set the cutoff point separating a large trade from a small trade at $10,000. We stop our selling pressure analysis in January 2005 as small trades are much less likely to represent retail trading after then as many institutions began using computerized trading algorithms to break up their trades.[24]

The key variables in our regressions are a firm's capital gains overhang and the tax-selling premium. However, in most of the specifications, we also include other standard control variables. We include the book-to-market equity ratio (BM) in

[24]Our main selling pressure results are robust to only analyzing the pre-decimalization data. Decimalization was completed in April 2001.

the regressions in order to capture the well-known value effect in the cross-section of average stock returns (Fama and French (1992)). We control for size (ME) given the evidence in Fama and French (1992) that size plays some role in describing the cross-section of average returns. We control for past returns over the last three years and trading volume as in Grinblatt and Han (2005), since our capital gains variable uses both as inputs. In particular, we decompose returns over the last three years into the one-month return, $r_{-1:0}$; the one-year return (excluding the past one-month return), $r_{-12:-1}$; and the three-year return (excluding the past one-year return), $r_{-36:-12}$. We calculate two measures of volume. The first is the average monthly turnover, $\overline{V}$, from the past 12 months. The second is monthly turnover, $TURN$, which is simply the sum of daily turnover for the month in question. For both volume measures, note that we divide Nasdaq volume by two in an attempt to minimize the double counting of trades on that exchange.

2.4 Descriptive statistics of overhang portfolios

Though our analysis uses firm-level regressions, we first look at the characteristics of portfolios sorted on g to summarize how g varies in the cross-section and is related to other variables used in the finance literature to forecast cross-sectional variation in stock returns.

Table I reports equal-weight average characteristics for portfolios formed monthly on capital gains overhang. We choose equal-weight to correspond to our firm-level regressions which weight stocks equally. By definition, past returns are correlated with stocks' capital gains overhang.[25] Nevertheless, it is interesting to see the extent to which there is spread in past returns over different horizons because of the capital

[25] One possible concern is that variation in overhang is simply variation in momentum. In their Table I Panel B, Grinblatt and Han (2005) study the cross-sectional determinants of the capital gains overhang and show that about 59% of the cross-sectional variation in the capital gains variable can be explained by differences in past returns (over the past month, past year, and past three years), past turnover (over the past month, past year, and past three years), and firm size. Given that more than 40% of the variation remains unexplained and that all seven variables are each very significant, it is not just returns over the past year that are driving cross-sectional variation in overhang. Indeed, the thesis of Grinblatt and Han (2005) is that overhang clearly and reliably drives out $r_{-12:-1}$ in cross-sectional regressions forecasting returns.

gains overhang sort and the way that translates into characteristics that are indirectly driven by past returns, $SIZE$ and BM. We find that high overhang stocks are typically large growth stocks with positive momentum while low overhang stocks are typically small value stocks with negative momentum. This tendency does not have to be true for every single stock (in fact, our stock-level regressions hope to disentangle these sources of independent variation), but it is the case at the level of quintile portfolios. Note that seasonal effects have been documented in the average returns associated with many of these variables, especially in the case of the $SIZE$ characteristic. By suggesting that previous analyses merely identified a tax-selling seasonal that varies through time, our framework provides an alternative explanation.

Also of particular interest is the fact that though there is no pattern in average monthly turnover over the past year, there is a pattern in the most recent monthly volume. Stocks with a low g experience higher turnover in December, while stocks with a high g experience higher turnover in January. Even stronger patterns can be seen in our selling pressure variable $Sell$. Stocks with a low g are being sold by both small ($Sell_S$) and large ($Sell_L$) investors in December. These patterns are consistent with optimal tax-selling behavior in the context we consider here.

3 Empirical Results

Our empirical analysis consists of three parts. First, we consider the ability of the product of g and γ to forecast cross-sectional and time-series variation in stock returns. Second, we examine the implications for trading volume and the trading behavior of individual investors. Finally, we analyze the consequences for aggregate returns and performance attribution.

3.1 Cross-sectional and time-series variation in firm-level returns

In this subsection, we analyze cross-sectional and time-series variation in firm-level returns linked to tax-motivated trading. In particular, we show that the product of the tax-selling premium (γ, a function of capital gains rates and interest rates) and a stock's capital gains overhang (g) forecasts firm-level returns around the turn of the tax year. We first examine US data and then turn to the UK, where the tax and calendar year end do not coincide. In these regressions, we first cross-sectionally demean all firm-level data. In the US case, we also test the robustness of the results to tax law changes.

3.1.1 US return regressions

Since our hypothesis has both cross-sectional and time-series implications, in Table II we estimate pooled regressions examining whether the interaction between γ and g forecasts daily returns. We estimate a regression forecasting daily returns using the product of γ and g, as well as interacting that variable with dummies corresponding to two weeks before and after the turn of the year ($Yr(-2)$ and $Yr(+2)$), two weeks before and after the turn of a non-year-end quarter ($Qtr(-2)$ and $Qtr(+2)$), the business day before December 25th and New Year's Day (XE and NYE), and a dummy equal to 1 if the current year (up to and including the tax quarter in question) had any month classified as a NBER recession and the previous year did not ($NBER$). Regressions in Table II generally take the form of equation (4), which also controls for a number of firm-specific variables defined in Table I.

$$
\begin{aligned}
r_{i,t} \quad = \quad & a_1\gamma_{t-1}g_{i,t-1}RoY \qquad (4) \\
& + a_2\gamma_{t-1}g_{i,t-1}Qtr(-2) + a_3\gamma_{t-1}g_{i,t-1}Qtr(+2) \\
& + a_4\gamma_{t-1}g_{i,t-1}Yr(-2) + a_5\gamma_{t-1}g_{i,t-1}Yr(+2) \\
& + a_6\gamma_{t-1}g_{i,t-1}RoYNBER \\
& + a_7\gamma_{t-1}g_{i,t-1}Qtr(-2)NBER + a_8\gamma_{t-1}g_{i,t-1}Qtr(+2)NBER \\
& + a_9\gamma_{t-1}g_{i,t-1}Yr(-2)NBER + a_{10}\gamma_{t-1}g_{i,t-1}Yr(+2)NBER \\
& + a_{11}\gamma_{t-1}g_{i,t-1}XE + a_{12}\gamma_{t-1}g_{i,t-1}NYE \\
& + a_{13}\gamma_{t-1} + a_{14}g_{i,t-1} \\
& + a_{15}\ln BM_{i,t-1} + a_{16}\ln ME_{i,t-1} + a_{17}\ln ME_{i,t-1}Jan \\
& + a_{18}r_{i,-1:0} + a_{19}r_{i,-12:-1} + a_{20}r_{i,-36:-12} + a_{21}\overline{V}_{i,t-1} + \varepsilon_{i,t}
\end{aligned}
$$

We first calculate γ under the assumption that the marginal seller has a quarterly tax horizon. Standard errors are robust to cross-sectional correlation using the method of Rogers (1983, 1993).[26] The first regression in Panel A shows that the effect of $\gamma * g$ is statistically significant in December and January but not around the turn of the non-year-end tax quarter. We find negative slopes on the XE and NYE dummies, consistent with tax-loss harvesting by taxable investors throughout the last two weeks of the year, but with savvy investors purchasing temporarily depressed stocks on the last working days of the year. We find a small positive effect throughout the rest of the year.

Note that our model predicts that the coefficient on the tax premium is 1.0 and -1.0 for the periods before and after the turn of the tax period. Since we examine 10 days surrounding the turn of each tax period, we should therefore find a coefficient of 0.1 and -0.1 on the corresponding interactions. With our assumption of a quarterly horizon, we instead find that the absolute magnitude of the corresponding coefficients is much greater than 0.1. One possible interpretation is that the data are inconsistent with quarterly discounting. Of course, another possible conclusion is simply that our model is misspecified. We will test possible misspecifications that may arise because of changes in tax code over our sample later in the analysis. For now, we explore other possible tax horizons.

We next calculate γ under the assumption that the marginal seller has an annual tax horizon. Given the correlation in interest rate movements, it is not surprising that we generally find similar statistical significance when using an annual γ in Regression (2). More importantly, we find that the coefficient linked to the rebound return is very close to its predicted value of -0.1. Regression (3) in Panel A offers a compromise between the approach of regression (1) and (2) by using a quarterly γ for the turn of the tax quarter and an annual γ otherwise. This specification for γ is used throughout the rest of the table as well as the rest of the paper, unless otherwise noted. Next, we add standard controls. Regression (4) of Panel A adds $\ln ME$, $\ln BM$, as well as

[26]See Petersen (2009) for a careful study of the appropriateness of Rogers' (1983, 1993) estimator in various contexts.

interacts $\ln ME$ with a dummy variable for January (Jan). These variables control for the well-known size and value effects. Regression (5) of Panel A further controls for patterns in average returns related to the one-month return, $r_{-1:0}$, the one-year return $r_{-12:-1}$, the three-year return $r_{-36:-12}$, and the average monthly turnover $\overline{V}$ over the past 12 months. Our results are robust to both sets of controls.

Regardless of the horizon we assume, these initial turn-of-the-tax-quarter tests suggest that estimated tax payments do not generate seasonality in returns. However, as discussed in Section 2 and the Internet Appendix, the discounting horizon of the estimated-tax investor may vary over time with economic conditions, becoming longer just after recessions (more precisely, when the investor is making a trading decision near the end of a recession) and even negative in extreme cases just before a recession. Regression (6) of Table II reports results where we interact the relevant coefficients with our NBER recession dummy. We now find evidence of a turn-of-the-tax-quarter effect for those years. Specifically, the NBER recession dummy interaction is statistically significant in the last two weeks of the tax quarter. This finding is consistent not only with price pressure bounds at the turn of the tax quarter that are linked to our tax-selling premium but also with our argument that the prior-year safe harbor plays an important role in the sensitivity of estimated taxes to the timing of harvesting capital losses. Though we do not find a sharp rebound after the turn of the tax quarter, it is not unreasonable to imagine that prices slowly return to fundamental value.

We also find a significant NBER interaction effect at the turn of the year. In particular, there is a strong positive interaction in the last two weeks of the year as well as a negative, though not statistically significant interaction in the first two weeks of the year. This result is consistent with the horizon of investors who pay estimated tax lengthening when their income is rising coming out of a recession. Indeed, this result is consistent with the tax horizon of estimated-tax investors after recessions being longer than the twelve-month horizon of turn-of-the-year investors.

We will use regression (6) in Table II Panel A as our baseline specification for conciseness. The remaining regressions in Table II use this specification to study additional empirical predictions, test alternative hypotheses, as well as document the robustness of our findings to different subsamples and tax law environments.[27] In particular, in Panel B of Table II, we re-estimate our benchmark regression over different sub-periods. In column (1), we examine the Compustat period that begins in 1963. In columns (2) and (3), we split the sample in 1986 as that is when estimated tax rules changed (as will be discussed) and also when institutional ownership began to grow significantly. Finally, in column (4), we study a more recent sample. Consistent with our hypothesis, $\gamma * g$ has the expected effect around the turn of the year in all sub-periods. In fact, the January rebound return is stronger in the 1993-2014 subsample. Despite the fact that NBER recessions are not evenly distributed across our sample, the point estimates on this interaction are generally consistent with our full-period findings.[28]

A closer look at the subperiod analysis reveals that the the NBER interaction at the turn of the tax quarter is getting stronger over time. To understand this finding, we collected the full history of the changes to the tax code. In particular, we considered changes to personal income tax rules, estimated tax rules, as well as changes to capital gains tax rules as these are the changes more likely to affect decisions to trade for tax reasons.[29] In particular, we found that the percentage of tax in the current-year safe harbor has increased over time from 70% to the current level of 90%.[30] All else equal, this change results in the prior-year safe harbor becoming

[27] We have re-estimated these equations using different tax rates, including both the average maximum tax rate and the average federal marginal tax rate from the NBER's TAXSIM dataset [see Feenberg and Coutts (1993)]. Our conclusions remain qualitatively the same. We report results using the maximum capital gains tax rate as that tax rate is available over the longest time period.

[28] Of the eight relevant interactions, five are statistically significant, seven have positive point estimates, and all eight have 95% confidence intervals that contain a positive value.

[29] The main source we used is the Internal Revenue Code which is available, for example, on the Cornell Law School website (http://www.law.cornell.edu/uscode/text/26) and in printed versions (for example, Internal Revenue Code: Income, Estate, Gift, Employment and Excise Taxes, (Summer 2013 Edition)). Both of these versions contain not only the current version of the tax code, but also a list of the changes with respect to the first code. In order to make sure the timing of the tax changes was precise and to obtain more detailed information on the changes, we have also consulted older versions of the tax code available online (for example, the 1954 internal revenue code is available on http://www.constitution.org/uslaw/sal/068A_itax.pdf)).

[30] Our main results are robust to controlling for other changes in estimated tax rules. These changes include the introduction of rules modifying the current-year safe harbor percentage for high-income investors (currently defined as investors with AGI above $150,000). The applicable percentages were

relatively more attractive following recessions, consistent with the trend we find in the NBER interaction at the turn of the tax quarter.[31]

Our analysis of the decision to realize capital gains/losses at the end of the tax year ignores trading costs. If trading costs are high, then there will be less trading, and thus less price pressure from tax-loss sellers. To measure how this effect varies in the cross section we interact the $\gamma * g$ variable with a stock's relative (to price) bid-ask spread, $\frac{bid-ask}{P}$. Since the coefficient on $\gamma * g$ is positive in December and negative in January, and since the relative bid-ask spread should be positively correlated with relative transaction costs, we expect a negative interaction in December and a positive interaction in January indicating an attenuation of the effect for high-transaction-cost stocks. We test this idea in Table II Panel C regression (1) and find that the $Yr(-2)$ interaction is negative but insignificant. The $Yr(+2)$ interaction is positive and statistically significant. A one-sided joint hypothesis test on the vector of two interaction coefficients rejects the null that the relative bid-ask spread interaction with $Yr(-2)$ is > 0 and with $Yr(+2)$ is < 0 with a p-value less than 0.1%.

One alternative hypothesis is that γ is simply capturing a downward trend in the capital gains overhang effect, instead of the joint effect of interest rates and capital gains tax rates as specified in the formulation we derived. As a consequence, regression (2) in Table II Panel C interacts a linear time trend (*trend*) with g. We find a negative and statistically significant coefficient on $trend * g$, which is consistent with a decreasing effect of g. However, this interaction does not subsume the $\gamma * g$ effect in December and January as coefficients remain roughly the same in magnitude and statistical significance. Regression (3) in Table II Panel C considers the possibility that the interaction between g and the linear time trend differs as a function of the relevant turn-of-the-tax-period interactions. This more flexible trend specification still

105 in 1998, 108.6 in 1999, 110 in 2000, 112 in 2001 and 110 since 2002, while before then there was no differentiation. Since these changes affect only a subset of tax-motivated investors, we did not necessaily expect to find our main findings to vary with these changes and they did not, at least in specifications we considered. The level for minimum tax liability below which penalties are waived was $1000 since 1998 and was $500 between 1985 and 1997, after having increased $100 a year between 1980 and 1985 with no rule before 1980.

[31]This ratio was 70% in the early years of our sample, increasing to 80% in 1966, and subsequently to 90% in 1986. Though we show simple subperiod breakdowns, we have also formally tested these changes using the exact timing of the changes.

does not subsume the $\gamma * g$ effect as coefficients and t-statistics associated with $\gamma * g$ remain strong in the weeks around the turn of the year.

Another alternative hypothesis is that it is really only one component of γ (either the interest rate or the capital gains tax rate) that is providing the forecasting power. Hence, we test whether interest rates (r) or tax rates (τ) are individually important in explaining the time-series variation in the capital gains overhang effect. Regression (4) in Table II Panel C shows that neither τ nor r in isolation interacts with g in a consistent fashion, providing additional support for our claim that γ is the correct conditioning variable.

We have also tested the robustness of our results to more general changes in the tax code than just the changes in estimated tax rules discussed above. Since the list of changes we discovered is very large, we focused on those changes that are particularly important, ignoring, for example, changes that affected only subgroups such as fishermen. In particular, we follow Poterba and Weisbenner (2001) who also considered revisions in three key provisions of the Federal capital gains tax laws (their Table I). First, we consider changes in the definition of the long-term holding period, $LTHold$, which has varied between 6 and 12 months. Second, we consider the percentage of long-term losses deductible from "Adjusted Gross Income" (or AGI), $LTDeduct$, which has varied between 50 and 100 percentage points. Third, we consider the loss limit, $LossLimit$, on capital losses deductible from AGI, which has varied between \$1,000 and \$3,000. We transform each variable, each of which take on three different values over our sample into -1, 0, and +1 variables where higher values indicate periods that are more conducive to tax-motivated selling. In general, the results in Table II Panel D confirm that our findings are robust to controlling for these changes. Furthermore, these results show that the interaction of our turn-of-the-tax-period effect with two of these three variables is consistent with economic intuition. Specifically, the coefficient on $LTDeduct$ is 0.017, with a t-statistic of 2.20 at the turn of the year. The coefficient on $LossLimit$ is 0.054, with a t-statistic of 1.78 at the turn of the quarter.[32] Finally, we also note that our results continue to hold

[32] We also considered normalizing loss limit by GDP or the value of the stock market with similar results. The interactions with $LTHold$ at both the turn of the year and quarter are statistically significant but with signs inconsistent with tax-motivated selling. We leave this puzzling finding to

in subperiods where these aspects of the tax code have not changed, i.e. 1993-2014.

3.1.2 UK return regressions

The fact that the turn of the tax year coincides with the turn of the calendar year in the US has resulted in a long debate as to whether tax-motivated trading or window dressing is causing the turn-of-the-year effect. Researchers have argued that window dressing could explain similar return patterns as fund managers sell losers and buy winners at the end of the reporting period to make their year-end portfolios look strong. Our approach helps distinguish between these two hypotheses as there does not seem to be any obvious reason that the magnitude of the window dressing effect would be related to time-series variation in γ.[33] Nevertheless, we take this concern seriously and turn to international data for further insight.

We test the same hypothesis with international data, choosing the UK because its tax year does not coincide with the calendar year. Specifically, the tax year in the UK begins on the 6th of April and ends on the 5th of April of the next calendar year. As a result, the UK provides a clean setup to test these two plausible hypotheses. Any seasonality in the UK stock market around the turn of the tax year would be strong evidence for tax-motivated trading causing seasonality in stock returns. There is no equivalent to estimated taxes in the UK tax code.

We are not the first to use UK data to test the tax-selling hypothesis. In particular, Reinganum and Shapiro (1987) show that after the introduction of capital gains taxes in the UK, the difference in April returns between winners and losers becomes significantly greater than zero, consistent with a tax-loss selling story. Our primary empirical contribution is to show that this premium varies with the interest rate as

future research but conjecture that splitting our capital gains overhang into short- and long-term components might help explain this result.

[33]Other researchers have examined tax-motivated price pressure stories that occur at times other than the turn of the year to rule out alternative explanations such as window dressing. See, for example, Guenther and Willenborg (1999), Blouin, Raedy and Shackelford (2003), and Dai, Maydew, Shackelford and Zhang (2008). Additionally, the fact that there is a strong turn-of-the-year tax effect in the early part of the sample when institutions played a much smaller role in intermediated investment is inconsistent with a window dressing story.

predicted by our formulation.[34]

The results using UK data provide further evidence of tax-motivated trading, as Table III shows results similar to Table II. Seasonality in UK returns indeed occurs at the turn of the tax year and varies as a function of our tax-selling premium. All coefficients are positive in March and negative in April, regardless of the controls. Coefficients are jointly statistically significant at the 1% level in both March and April.

3.2 Cross-sectional and time-series variation in trading behavior

The time-series and cross-sectional patterns we have found in firm-level returns are consistent with tax-motivated selling pressure. In this section, we examine further implications of that explanation, particularly the way our suggested variables explain seller-initiated volume and the behavior of individual investors. First, we examine all trading volume at the turn of the year. Unlike previous research, we exploit a long panel of trading data, namely the TAQ database, and categorize all trades over the 1993-2005 period as small or large, buy or sell.[35] Second, we also examine trading patterns by studying the actual trades of individual investors, obtained from Odean's dataset, to confirm that these investors harvest (defer) capital losses (gains) based on the level of our tax-selling premium.

3.2.1 Seller-initiated trading volume

We build on the results of the previous subsection to test our framework's ability to explain time-series and cross-sectional variation in seller-initiated trades as a whole as well as in small and large trade subsets. We examine these subsets as previous research has argued that small trades are primarily from individuals while large trades

[34]Other differences include the fact that Reinganum and Shapiro (1987) examine only monthly stock returns and use an arguably cruder proxy for a stock's capital gains overhang. In contrast, we use daily returns and measure capital gains overhang as in Grinblatt and Han (2005).

[35]In contrast, Sias and Starks (1997) use TAQ data from only December 1990 and January 1991 to examine a similar question.

are primarily from institutions. We would expect negative overhang stocks to have high selling pressure in December followed by low selling pressure in January and a similar effect at the turn of the tax quarter, at least after recessions. Similarly, we expect the opposite effect in the case of positive overhang stocks.

In Table IV, we forecast the level of selling pressure.[36] Throughout the table, we use the same independent variables as Table II Panel A regression (6). Specifically, we estimate equation (4) using daily selling pressure on the left-hand side instead of daily returns. Note that we expect $Sell_{i,t}$ to move in the opposite direction of the predicted return; and, therefore, we now expect a positive (negative) slope in January (December) on our tax-selling variable. As in the return regressions, all firm-level variables are cross-sectionally demeaned. Standard errors are robust to simultaneous correlation both across firms and across years based on the method developed by Thompson (2011).

We do find that both returns and selling pressure exhibit similar seasonality, as selling pressure results are consistent with the return regressions shown in Table II. Regression (1) in Table IV reports the results from a regression forecasting the level of selling pressure without the inclusion of the NBER interaction. We find that December slopes on $\gamma * g$ are all negative and highly statistically significant, indicating taxable investors are selling negative overhang stocks and holding on to positive overhang stocks in December. As expected, January exhibits the opposite pattern.

For example, in the last two weeks of December, the coefficient on $\gamma * g$ is approximately -1.6 with a t-statistic in excess of 12 when we use all trades. Then, in the case of a negative overhang stock, selling pressure reverses into buying pressure after the turn of the year as slopes on $\gamma * g$ turn positive in January. Specifically, we find a reversal in selling pressure in the first two weeks of January with a statistically-significant coefficient of roughly 1.3. These results are economically quite large, at least when compared to the coefficient on $\gamma * g$ of approximately -0.05 for the rest of the year excluding turn of the tax periods. We also find that the coefficients as-

[36]Versions of these regressions using the first difference of those variables are available in the Internet Appendix.

sociated with the business days before Christmas and New Year's Day are consistent with the corresponding coefficient estimates of the return regressions.

We also split the data into small and large trades in regressions (1) and (2). We do this as past research (Lee and Ready (1991) and others) has associated small trades with buying by individual investors and large trades with buying by institutional investors. We find the reversal in selling pressure to be strong and more statistically significant in the case of small trades, but present for both subsets. Though the results for small and large trades are very similar, the January slopes seem to be slightly higher for small trades. Interestingly, the savvy buying pressure in the last weeks of the year seems to come from institutional investors on Christmas Eve and from individual investors on New Year's Eve.

We do not find any clear pattern in the trades around non-year-end quarters in regressions (1) to (3). Regressions (4) to (6) introduce NBER interactions following the same specification as in regression (6) of Table II Panel A. We find additional selling pressure in the last weeks of December following recessions. These regressions also indicate selling pressure after recessions just before the turn of non-year-end quarters as we find very negative point estimates.[37]

3.2.2 Actual individual trades

We examine trading patterns by studying the actual trades of individual investors to confirm that these investors harvest (defer) capital losses (gains) based on the level of our tax-selling variables. In particular, Figure 1 reports the results of what is essentially a difference-in-difference test of the trading implications of equation (1). That figure shows the *difference* in the propensity to realize capital gains/losses in

[37]Past research has looked for similar links between returns and selling pressure. Ritter (1988) finds that individual investors who are customers at Merrill Lynch place more sell orders in December than in January. While this finding is consistent with tax selling, a limitation is that it focuses only on a small subgroup of investors. Sias and Starks (1997) show that individuals sell stocks at the end of the year. This evidence is consistent with tax-motivated selling, but they find that individuals also sell past one-year winners in December. They view this result as inconsistent with tax selling, but to the extent that return momentum is a poor proxy for capital gains overhang, it may be difficult to draw conclusions about tax-motivated selling from their results. Another limitation of Sias and Starks (1997) is that they use TAQ data from only December 1990 and January 1991.

December compared to January (as well as at the turn of the quarter) for *different* levels of γ. In particular, we split the sample into above-median and below-median γ.

We process all of the trades in the Odean dataset in the following way. We follow each stock in the database from the time it was purchased until the time it was eventually sold. We keep track of the close for that stock at the end of each day in between the purchase date and the eventual sell date, using every closing price to calculate an unrealized capital gain/loss. For each of eleven evenly-spaced bins ranging from -100% to >100%, these unrealized gains and losses are then compared to observed realized gains and losses to measure a tendency for investors to sell as a function of capital gain/loss. Then for each bin, we subtract the January propensity to sell from the December propensity to sell (and similarly for the turn of the quarter, but averaged across three quarters). These turn of the year and quarter differences to sell are plotted separately for high γ years and low γ years. The average value of γ for the high γ years subset is 0.040, while the average value of γ for the low γ years subset is 0.022.[38]

There are two strong conclusions to draw from the figure. First, investors tend to accelerate the realization of capital losses in December (compared to January), this effect is also true around non-year-end quarters though much weaker. Second, both tendencies are higher in those years when γ is higher, and dramatically so for the turn of the year. Together these two facts confirm the central prediction of our conjecture: investors' propensity to sell at the turn of the year depends on the product of the capital gains overhang, g, and the tax-selling premium, γ, which is a function of the interest and tax rate environment. Our framework also suggests that investors may delay realizing capital gains in high γ years. However, because of the non-linear relation between capital gains and capital gain overhang, a relatively large capital gain results in a relatively small amount of overhang. Consequently, one would not expect variation in γ to generate much variation in selling probabilities for stocks with unrealized capital gains, and it does not.

[38]Given the short time dimension of this panel, we unfortunately do not have enough variation to allow for NBER interactions as we did with our returns and selling pressure tests.

3.3 Implications for performance attribution

Our analysis has tried to measure the firm-specific and aggregate variables that drive cross-sectional and time-series patterns in average returns at the turn of the year. To do so, we have used a particular measure of firm-specific capital gains overhang and have controlled for other well-known patterns in the cross-section such as a stock's size, its book-to-market equity ratio, and its return momentum that are known to be correlated with our particular measure of a firm's capital gains overhang.

However, given this correlation, a natural complementary question to ask is the following: To what extent can the tax-selling effect drive market beta and the abnormal return associated with bets on the size, book-to-market, and momentum characteristics? To answer these questions, we first document the extent to which the market return can be forecast by our tax-selling variables. We then estimate conditional CAPM time-series regressions pricing the three Fama-French/Carhart non-market factors.

First, we test whether tax-motivated selling can explain aggregate returns in January. To do so, we measure the market's capital gains overhang, g_M, as the value-weighted average of firm-level measures of g. Table V shows that $\gamma * g_M$ does predict market returns in January in all of the specifications we consider. This effect is both statistically and economically significant. Namely, based on the specification of Table V regression (1), a one-standard-deviation increase in the joint product of $\gamma * g_M$ results in a decrease in the equity premium of approximately one percent. We also report the results of specifications that control for the independent effect of γ or g_M. Note that we find a statistically significant relationship despite the inclusion of the aggregate book-to-market variable in these regressions.

As we find that market returns are indeed affected by tax-selling behavior, we estimate conditional CAPM time-series regressions that include $\gamma * g$ as a conditioning variable. In these regressions, we analyze the three Fama-French/Carhart non-market factors. We choose these three factors because of their widespread use in academic research. In particular, these factors represent more reasonable implementations of strategies based on size, book-to-market, or momentum characteristics than the strategies implicit in our earlier cross-sectional regression tests. For comparability, we create a zero-cost overhang factor that is formed in a similar way to the momentum factor of Carhart. Specifically, each month we sort all NYSE stocks on our overhang measure and calculate 20th and 80th percentile breakpoints. We then buy all NYSE-AMEX-NASDAQ stocks that are below the NYSE 20th percentile and sell all NYSE-AMEX-NASDAQ stocks that are above the NYSE 80th percentile. The positions in the long and short sides are value-weight. Thus, we will be able to show both the extent to which a tax-selling premium is a component of the premiums on these well-known factors as well as the nature of the tax-selling premium on value-weight positions based on a traditional sorting approach. Figure 2 plots g for the bottom, middle, and top quintiles to provide an idea of the time-series and cross-sectional variation in overhang throughout the sample.

Figure 3 plots the January return on the TAX factor for each of the years of the sample against an OLS forecast of the expected January return on the TAX factor using the product of the tax-selling premium and the factor's capital gains overhang, $\gamma * g_{TAX}$. As detailed in the Figure legend, the regression coefficient in that regression is -2.11 with an associated t-statistic of -3.80. That regression's adjusted R^2 is 18.5%. These statistics and this figure confirm that there is a time-series relation between the January return on TAX and our predicted January rebound return as well as document that the average January return on TAX is positive.[39] Moreover, these results confirm that the general conclusion from the firm-level regression analysis is robust to weighting firms by market capitalization.

The specification of our conditional CAPM regression follows from two of our results. Specifically, we have shown that 1) there is time-series and seasonal variation around the turn of the year in the cross-sectional premium for the capital gains overhang variable and 2) this variation can be observed at the market level as well.

[39] One could arguably attribute the large positive realized return (35%) on the TAX factor in January 2001 to to the large negative return to a momentum strategy (-24%) in January as the tech boom subsided. Regardless, the 2001 observation is not influential. In fact, the t-statistic and R^2 increase to -4.74 and 27.0% respectively when that observation is dropped from the sample. Note that the relation in Figure 2 continues to be statistically significant if one instead predicts CAPM-adjusted returns instead of raw returns as in the Figure. Finally, if one imposes a theoretically-correct coefficient of -1 in the regression, the resulting intercept is statistically insignificant from zero under either benchmarking approach.

The first finding indicates that our conditional CAPM regression should have the intercept be a function of the trading strategy's forecasted December dislocation and January rebound. That premium, of course, will depend on the trading strategy's beginning-of-period capital gains overhang, the tax-selling premium which depends on the beginning-of-period tax and interest rates, and the particular month in question, as we derived in Section 1. Not only do we allow the alpha in our CAPM regression to vary through time but we also consider time variation in the regression's market beta. Cochrane (2001) points out that a time-varying CAPM beta only affects pricing to the extent that the beta is correlated with time-variation in the market premium. Therefore, the second finding (the market's tax-selling premium forecasts the subsequent excess return on the market) indicates that our conditional CAPM regressions should have a time-varying beta that is a function of the market's forecasted December dislocation and January rebound. As at the firm level, that predictable return will depend on the market's beginning-of-period capital gains overhang, the tax-selling premium (which depends on the beginning-of-period tax and interest rates), and the particular month in question.

Table VI summarizes the extent to which cross-sectional and time-series variation in tax-selling premiums drive conditional alphas and betas for the three well-known factor portfolios HML, SMB, UMD and our low-minus-high overhang portfolio, which we denote as TAX. Note that we attribute performance of the returns on the actual factors generated by Ken French (obtained from his web site). However, we can only proxy for the capital gains overhang of French's factors as not all of the stocks in the factor portfolios have the necessary data our measure requires. In particular, while our firm-level overhang measure requires five years of price and volume data, these strategies do not. Presumably, our findings would be stronger if instead, we had priced the return on factors whose construction imposed a five-year data requirement as well.

The first regression of each panel in Table VI first documents the extent of seasonality in the CAPM alpha of the factors being considered. The TAX factor has a strong negative alpha from February to December and a strong positive alpha in January. For HML, a significant portion of its average abnormal return occurs in

January. Indeed, for SMB, all of the significant return comes in January. For UMD, the strong average returns outside of the turn of the year are partially offset by a very large negative premium in January.

The second regression of each panel in Table VI then demonstrates that variation in the market's tax-selling effect drives beta at the turn of the year. For the three factor portfolios TAX, HML, and SMB, when the market's forecasted tax-selling January rebound, $-\gamma * g_M$, is relatively high, January betas are predictably relatively high as well.[40] In each of these cases, December betas are correspondingly relatively low, with both the TAX and SMB estimates statistically significant. As one might expect from the evidence in Table I, we find the opposite effect for the momentum portfolio. The January beta for the momentum portfolio is predictably higher when the market's tax-selling premium is relatively low. Since Table V shows that the market's tax-selling premium forecasts the excess return on the market, it is not surprising that controlling for this conditional beta effect reduces the absolute magnitude of the alpha of these four trading strategies in January.

Figure 4 uses higher-frequency estimates of the beta of the components of the TAX factor to confirm that the link between the market risk of the TAX factor and the market's forecasted tax-selling January rebound return is particularly present in the days surrounding the turn of the year. Specifically, Figure 4 graphs five-day rolling betas throughout December and January for low, middle, and high overhang quintile portfolios.[41] When the market has a relatively high forecasted January rebound be-

[40] For the sake of interpretability, we normalize the time-series $\gamma * g_M$ so that the coefficients on $RMRF$ represent the average beta during the months in question and the coefficient on $\gamma * g_M * RMRF$ represent the change in beta for a one standard deviation move in $\gamma * g_M$.

[41] We compute betas for the capital gains overhang quintile portfolios as follows. Trading days are numbered (between -20 and +20) around the turn of each year such that 0 is the last trading day in December and +1 is the first trading day in January. Betas are then computed versus the CRSP value-weighted market portfolio for each trading day. Thus, the day(0) beta accounts for the covariance between quintile portfolio returns and market returns on the last trading day of each year. This procedure yields a series of 41 trading day betas for each quintile portfolio. We then use these series to compute trailing five-day moving averages for each quintile portfolio.

Note that Figure 3 plots the daily moving average betas conditional on the market's tax-selling alpha. Thus, the procedure described above is slightly modified so that the trading day betas are computed separately for years with positive versus negative expected January market rebound return. Our split compares positive versus negative rather than simply high versus low values of the cause of both a large capital loss in December and high tax and interest rates, low overhang stocks covary much more with the market in the days subsequent to the turn of the year than do high overhang stocks.

Similarly, Figure 4 confirms that the predictability in daily returns and selling pressure depends on the market's expected January rebound return. Figure 4 shows that patterns in both daily returns and selling pressure are stronger when the tax-selling effect in the market return is stronger. Specifically, when the market's expected January rebound return, $-\gamma * g_M$, is large, low overhang stocks display much higher selling pressure in December and more strongly outperform high overhang stocks in January.[42] Again these results are more concentrated on the days very close to the turn of the year.

The third regression of each panel in Table VI not only controls for time-varying beta but also attributes a portion of the remaining conditional alpha to our strategy-specific tax selling premium variable. We find that January alphas are no longer statistically significant for TAX, SMB, and UMD. The January alpha for SMB is reduced by 75% from regression (1) to regression (3), while the January alpha for UMD is reduced by 38%. Thus, for SMB, the alpha throughout the year is never statistically significant. Interestingly, HML's alpha is only statistically significant in January.

In summary, Table VI shows that a portion of the risk and abnormal return of the Fama-French/Carhart non-market factors can be linked to our tax-selling premium, as the tax-selling effect is strong in both market and factor portfolios. Most noticeably, our tax-selling variables explain all of the abnormal average returns on the size factor, SMB, and explains all of the non-January abnormal return on the value factor, HML. These findings have important implications for those researchers examining economic stories describing time-variation in the properties of these factors.[43]

January rebound return to be consistent with the corresponding regression (3) of Table 6 Panel A.

[42]The difference between the cumulative January return for the low overhang portfolio and the high overhang portfolio is 4.00% during years of a low expected January rebound return for the market and 8.72% during years of a high expected January rebound return for the market. Each of these differences is statistically significant at the 1% level. Moreover, the difference between these cumulative returns of 4.72% is significant at the 5% level (t-statistic of 2.09).

[43]For example, Chordia and Shivakumar (2004) argue that returns on momentum strategies can

4 Conclusions

Our framework implies that temporary distortion in stock prices may arise because of the taxation of capital gains. In particular, we exploit the trade-off a rational investor faces when realizing tax losses (gains) this tax year instead of next tax year in the presence of temporary downward (upward) price pressure. Optimal tax selling can generate stock return overreaction at the end of the tax year and a corresponding reversal at the beginning of the subsequent tax year. The magnitude of these predictable returns is not only a function of a stock's tax basis but also a function of interest rates and capital gains tax rates, which together bound the temporary distortion. The vast amount of literature on tax-selling at the turn of the year ignores time-series variation in the effect. The two previous papers (Poterba and Weisbenner (2001) and Grinblatt and Moskowitz (2004)) that do examine time-series variation in the effect only look at variation resulting from the tax rate. The interest rate channel that we identify generates significantly more variation in the predicted magnitude of the effect than the tax rate channel (in fact, roughly twice as much).

A variety of empirical evidence confirms this prediction. We document patterns in the cross-section of average returns at the turn of the tax year that are consistent with our story. We also document the evidence of a quarterly effect even though it is smaller (as it is generated by a subset of investors with potentially shorter discounting horizons) and less frequent (as the link between estimated tax payments and the timing of realized capital gains/losses will likely be stronger when recovering from a recession). Our main tests use US data, but additional tests using UK data provide an important out-of-sample confirmation, as the UK tax and calendar year end differ. We also identify trading patterns that are consistent with tax-motivated

be explained once they are adjusted for the predictability of stock returns based on macroeconomic variables. These variables include the interest rate which is an important component of our tax-selling premium. Cooper, Gutierrez, and Hameed (2004) forecast returns on momentum strategies with the state of the market, which they define as whether the past three-year return on the market is positive or negative. That definition is clearly related to our measure of market overhang, g_M, that drives seasonal patterns in risk for the momentum factor. Cochrane (2001) argues that the average return on SMB has disappeared due to a significant increase in the trading of small-cap stocks by mutual funds. Our results provide an alternative explanation for the time-variation in SMB's expected return.

selling driving these temporary movements in stock prices. Stocks with low capital gains overhang have more selling pressure in individuals' trades at the turn of the tax year than stocks with high capital gains overhang, and this imbalance also varies with the same function of interest rates and capital gains tax rates. Moreover, in the actual trades of investors using a large discount brokerage, the tendency to harvest losses in December rather than in January also varies with this bound. Finally, we find that these effects are also present in aggregate returns. As a consequence, performance attribution at the turn of the year is not only affected by the firm-level trade-off, but also by distortion in measuring risk arising from this tax-selling-based predictability.

Interestingly, our emphasis on the importance of the interest rate also explains why recent returns to strategies exploiting that phenomenon have been low. These low returns are not due to savvy investors eliminating the effect, but instead are explained by the rather low interest rates in the recent data. As interest rates rise, our formulation predicts that the January effect should reappear.

References

[1] Abel, Andrew B., Jan C. Eberly, and Stavros Panageas, 2007, Optimal Inattention to the Stock Market, *American Economic Review, Papers and Proceedings*, 97(2), 244–249.

[2] Ameriks, John and Stephen Zeldes, 2004, How do household portfolio shares vary with age?, Working paper, Columbia University.

[3] Anton, Miguel and Christopher Polk, 2014, Connected Stocks, *Journal of Finance* 69, 1099-1127.

[4] Blouin, Jennifer, Jana Raedy, and Douglas Shackelford, 2003, Capital gains taxes and equity trading: Empirical Evidence, *Journal of Accounting Research* 41, 611-651.

[5] Bossaerts, Peter and Robert M. Dammon, 1994, Tax-Induced Intertemporal Restrictions on Security Returns, *Journal of Finance* 49, 1347-1372.

[6] Branch, Ben, 1977, A Tax Loss Trading Rule, *Journal of Business* 50, 198-207.

[7] Chan, K. C., 1986, Can Tax-Loss Selling Explain the January Seasonal in Stock Returns?, *Journal of Finance* 41, 1115-1128.

[8] Carhart, Mark, 1997, On Persistence in Mutual Fund Performance, *Journal of Finance* 52, 57-82.

[9] Chordia, Tarun and Lakshmanan Shivakumar, 2002, Momentum, Business Cycle, and Time-varying Expected Returns, *Journal of Finance* 57, 985-1019.

[10] Cochrane, John H., 2001, *Asset Pricing*, Princeton University Press.

[11] Constantinides, George, 1983, Capital Market Equilibrium with Personal Tax, *Econometrica* 51, 611-636.

[12] Constantinides, George, 1984, Optimal Stock Trading with Personal Taxes: Implications for Prices and the Abnormal January Returns, *Journal of Financial Economics* 13, 65-89.

[13] Cooper, Michael J., Roberto C. Gutierrez Jr., and Allaudeen Hameed, 2004, Market States and Momentum, *Journal of Finance* 59, 1345-1365.

[14] Coval, Joshua and Erik Stafford, 2007, Asset Fire Sales (and Purchases) in Equity Markets, *Journal of Financial Economics* 86, 479-512.

[15] Dai, Zhonglan, Edward Maydew, Douglas A. Shackelford, and Harold H. Zhang, 2008, Capital Gains Taxes and Asset Prices: Capitalization or Lock-In?, *Journal of Finance* 63, 709-742.

[16] Dammon, Robert M., Kenneth B. Dunn, and Chester S. Spatt, 1989, A Reexamination of the Value of Tax Options, *Review of Financial Studies* 2, 341-372.

[17] Dammon, Robert M. and Chester S. Spatt, 1996, The Optimal Trading and Pricing of Securities with Asymmetric Capital Gains Taxes and Transactions Costs, *Review of Financial Studies* 9, 921-952.

[18] Dammon, Robert M., Chester S. Spatt, and Harold H. Zhang, 2001, Optimal Consumption and Investment with Capital Gains Taxes, *Review of Financial Studies* 14, 483-616.

[19] Dammon, Robert M., Chester S. Spatt, and Harold H. Zhang, 2004, Optimal Asset Location and Allocation with Taxable and Tax-Deferred Investing, *Journal of Finance* 59, 999-1037.

[20] Duffie, Darrell, Presidential Address: Asset Price Dynamics with Slow-Moving Capital, *Journal of Finance* 45, 1237-1267.

[21] Dyl, Edward E., 1977, Capital Gains Taxation and Year-End Stock Market Behavior, *Journal of Finance* 32, 165-175.

[22] Ellul, Andrew, Pab Jotikasthira, and Christian T. Lundblad, 2011, Regulatory Pressure and Fire Sales in the Corporate Bond Market, *Journal of Financial Economics* 101, 596-620.

[23] Fama, Eugene F. and Kenneth R. French, 1992, The Cross Section of Expected Stock Returns, *Journal of Finance* 47, 427-465.

[24] Fama, Eugene F. and Kenneth R. French, 1993, Common Risk Factors in the Returns on Stocks and Bonds, *Journal of Financial Economics* 33, 3-56.

[25] Feenberg, Daniel R., and Elizabeth Coutts, 1993, An Introduction to the TAXSIM model, *Journal of Policy Analysis and Management* 12, 189–194.

[26] Frazzini, Andrea, 2006, The Disposition Effect and Under-reaction to News, *Journal of Finance* 61, 2017-2046.

[27] Gabaix, Xavier and David Laibson, 2002, The 6D Bias and the Equity-Premium Puzzle, NBER Macroeconomics Annual 2001, Bernanke, Ben S. and Kenneth Rogoff, eds. MIT Press, Volume 16. Cambridge and London.

[28] Gompers, Paul, and Andrew Metrick, 2001, Institutional Ownership and Equity Prices, *Quarterly Journal of Economics* 116, 229-259.

[29] Graham Benjamin, and David L. Dodd, 1934, *Security Analysis*, First Edition, Mc-Graw Hill, New York.

[30] Grinblatt, Mark, and Bing Han, 2005, Prospect Theory, Mental Accounting, and Momentum, *Journal of Financial Economics* 78, 311-333.

[31] Grinblatt, Mark, and Tobias J. Moskowitz, 2004, Predicting stock price movements from past returns: the role of consistency and tax-loss selling, *Journal of Financial Economics* 71, 541-579.

[32] Guenther, David, and Michele Willenborg, 1999, Capital gains tax rates and the cost of capital for small business: Evidence from the IPO market, *Journal of Financial Economics* 53, 385-408.

[33] Huang, Lixin, and Hong Liu, 2007, Rational Inattention and Portfolio Selection, *Journal of Finance*, 62(4), 1999-2040.

[34] Hvidkjaer, Soren, 2006, A Trade-Based Analysis of Momentum, *Review of Financial Studies*, 19(2), 457-491.

[35] Hvidkjaer, Soren, 2008, Small trades and the cross-section of stock returns, *Review of Financial Studies*, 21(3), 1123-1151.

[36] Ivković, Zoran, James Poterba, and Scott Weisbenner, 2004, Tax-Motivated Trading by Individual Investors, NBER Working Paper No. 10275.

[37] Jegadeesh, Narasimhan, and Sheridan Titman, 1993, Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance* 48, 65-91.

[38] Jin, Li, 2006, Capital Gain Tax Overhang and Price Pressure, *Journal of Finance* 61, 1399-1431.

[39] Jones, Charles P., Douglas K. Pearce, and Jack W. Wilson, 1987, Can Tax Loss Selling Explain the January Effect? A Note, *Journal of Finance* 42, 453-61.

[40] Keim, Donald, 1983, Size related anomalies and stock return seasonality: further empirical evidence, *Journal of Financial Economics* 12, 13-32.

[41] Klein, Peter, 2001a, The capital gain lock-in effect and equilibrium returns, *Journal of Public Economics* 71, 355-378.

[42] Klein, Peter, 2001b, The capital gain lock-in effect and long-horizon return reversal, *Journal of Financial Economics* 59, 33-62.

[43] Lakonishok, Josef, and Seymour Smidt, 1986, Volume for Winners and Losers: Taxation and Other Motives for Stock Trading, *Journal of Finance* 41, 951-974.

[44] Lee, Charles M.C. and Mark J. Ready, 1991, Inferring Trade Direction from Intraday Data, *Journal of Finance* 46, 733-746.

[45] Lou, Dong, 2012, A Flow-Based Explanation for Return Predictability, *Review of Financial Studies*, 25(12), 3457-3489.

[46] Merton, Robert C., 1971, Optimum consumption and portfolio rules in a continuous-time model, *Journal of Economic Theory*, 3(4), 373-413.

[47] Mitchell, Mark, Lasse Pedersen, and Todd Pulvino, 2007, Slow moving capital, *American Economic Review* 97, 215-220.

[48] Mitchell, Mark, Todd Pulvino, and Erik Stafford, 2004, Price pressure around mergers, *Journal of Finance* 59, 31-63.

[49] Mitchell, Olivia S., Gary R. Mottola, Stephen P. Utkus, and Takeshi Yamaguchi, 2006, The inattentive participant: Portfolio trading behavior in 401(k) plans, Working paper, University of Pennsylvania.

[50] Odean, Terrance, 1998, Are investors reluctant to realize their losses?, *Journal of Finance* 53, 1775-1798.

[51] Petersen, Mitchell, 2009, Estimating standard errors in finance panel data sets: Comparing approaches, *Review of Financial Studies* 22, 435-480.

[52] Poterba, James M., and Scott J. Weisbenner, 2001, Capital Gains Tax Rules, Tax-Loss Trading, and Turn-of-the-Year Returns, *Journal of Finance* 56, 353-368.

[53] Reese, William A., Jr., 1998, Capital gains taxation and stock market activity: Evidence from IPO's, *Journal of Finance* 53, 1799-1820.

[54] Reinganum, Marc, 1983, The Anomalous Stock Market Behavior of Small Firms in January: Empirical Tests of Tax-Loss Selling Effects, *Journal of Financial Economics* 12, 89-104.

[55] Reinganum, Marc, and Alan C. Shapiro, 1987, Taxes and stock return seasonality: Evidence from the London Stock Exchange, *Journal of Business* 60, 281-295.

[56] Reis, Ricardo, 2006, Inattentive Consumers, *Journal of Monetary Economics*, 53(8), 1761-1800.

[57] Ritter, Jay R., 1988, The buying and selling behavior of individual investors at the turn of the year, *Journal of Finance* 43, 701-717.

[58] Rogers, W. H., 1983, Analyzing complex survey data. Rand Corporation memorandum. Santa Monica, CA.

[59] Rogers, W. H., 1993, Regression standard errors in clustered samples. Stata Technical Bulletin Reprints STB-13 – STB-18, 88-94.

[60] Roll, Richard, 1983, The turn-of-the-year effect and the return premia of small firms, *Journal of Portfolio Management* 9, 18-28.

[61] Rozeff, Michael F. and William R. Kinney, 1976, Capital Market Seasonality: The Case of Stock Returns, *Journal of Financial Economics* 3, 379-402.

[62] Scholes, Myron, 1972, The market for corporate securities: Substitution versus price pressure and the effects of information on stock prices, *Journal of Business* 45, 179–211.

[63] Schultz, P., 1985, Personal income taxes and the January effect: small firm stock returns before the War Revenue Act of 1917: A note, *Journal of Finance* 40, 333-343.

[64] Shackelford, D., 2000, Stock Market Reaction to Capital Gains Tax Changes: Empirical Evidence from the 1997 and 1998 Tax Acts, In *Tax Policy and the Economy*. Vol. 14, edited by J. Poterba, pp. 67-92. Cambridge, MA: National Bureau of Economic Research and MIT Press.

[65] Shackelford, D., 2004, Capital Gains Taxes and Equity Prices, NBER Reporter: Research Summary Fall 2004.

[66] Shleifer, Andrei, 1986, Do Demand Curves for Stocks Slope Down?, *Journal of Finance* 41, 579-590.

[67] Shleifer, Andrei, and Robert W. Vishny, 1997, The Limits of Arbitrage, *Journal of Finance* 52, 35-55.

[68] Sialm, Clemens, 2009, Tax Changes and Asset Pricing, *American Economic Review* 99(4), 1356-1383.

[69] Sias W. Richard, and Laura T. Starks, 1997, Individuals and Institutions at the Turn-of-the-year, *Journal of Finance* 52, 1543-1562.

[70] Sims, Theodore, 1995, Taxation, optimization, and the January seasonal effect (and other essays in taxation and finance), Ph.D. dissertation, Massachusetts Institute of Technology, Department of Economics.

[71] Singleton, Kenneth J., 2014, Investor Flows and the 2008 Boom/Bust in Oil Prices, *Management Science* 60(2), 300-318.

[72] Stokey, Nancy L., 2009, *The Economics of Inaction: Stochastic Control Models with Fixed Costs.* Princeton University Press, Princeton NJ.

[73] Thompson, Samuel B., 2011, Simple formulas for standard errors that cluster by both firm and time, *Journal of Financial Economics* 99, 1-10.

[74] Vayanos, Dimitri and Paul Woolley, 2013, An Institutional Theory of Momentum and Reversal, *Review of Financial Studies* 26(5), 1087-1145.

[75] Wachtel, Sidney B., 1942, Certain observations on seasonal movements in stock prices, *Journal of Business* 15, 184-193.

Table I: Descriptive Statistics (1954-2014)

This table reports various characteristics of capital-gains-overhang-sorted quintile portfolios formed each month. These portfolios are equal-weight portfolios. We compute capital gains overhang, g, as in Grinblatt and Han (2005). The characteristics include a decomposition of returns over the last three years into the one-month return, $r_{-1:-0}$; the one-year return (excluding the past one-month return), $r_{-12:-1}$; and the three-year return (excluding the past one-year return), $r_{-12:-36}$. Market capitalization, ME, and the book-to-market equity ratio, BM, are computed as in Fama and French (1992). BM is the previous fiscal year's ending book value divided by the corresponding year's December market value. ME is the latest end-of-June market value in thousands. We also report the average monthly turnover, $\overline{V}$, from the past 12 months as well as the monthly turnover, $TURN$, the sum of daily turnover within the past month. For both volume measures, we divide Nasdaq volume by two in an attempt to make volume numbers comparable across exchanges. We compute $Sell$ as the fraction of seller-initiated trades relative to all trades for both small (S) and large (L) trades. The cut-off delimiting a small versus a large trade is $10,000, as in Lee and Ready (1991). The sample starts in February of 1954 and ends in January 2014.

Panel A: December

	g	$r_{-1:0}$	$r_{-12:-1}$	$r_{-36:-12}$	ME	BM	$\overline{V}$	$TURN$	$Sell_S$	$Sell_L$
H	0.283	0.042	0.550	0.662	2190	0.658	0.039	0.043	0.508	0.519
4	0.091	0.023	0.269	0.461	2520	0.768	0.049	0.048	0.515	0.509
3	-0.060	0.011	0.135	0.372	2008	0.855	0.052	0.050	0.533	0.520
2	-0.305	0.001	0.007	0.290	1229	0.970	0.050	0.050	0.559	0.537
L	-1.741	-0.020	-0.197	0.084	269	1.501	0.040	0.049	0.607	0.572

Panel B: January

	g	$r_{-1:0}$	$r_{-12:-1}$	$r_{-36:-12}$	ME	BM	$\overline{V}$	$TURN$	$Sell_S$	$Sell_L$
H	0.294	0.053	0.572	0.673	2110	0.67	0.036	0.047	0.510	0.521
4	0.107	0.041	0.267	0.469	2547	0.78	0.045	0.052	0.515	0.508
3	-0.035	0.040	0.131	0.382	2011	0.87	0.047	0.052	0.519	0.508
2	-0.256	0.047	0.011	0.312	1253	1.02	0.048	0.051	0.522	0.514
L	-1.544	0.077	-0.183	0.118	295	1.86	0.039	0.039	0.537	0.538

Panel C: February-November

	g	$r_{-1:0}$	$r_{-12:-1}$	$r_{-36:-12}$	ME	BM	$\overline{V}$	$TURN$	$Sell_S$	$Sell_L$
H	0.296	0.038	0.544	0.627	1911	0.697	0.037	0.046	0.509	0.518
4	0.115	0.019	0.266	0.435	2437	0.789	0.046	0.050	0.511	0.507
3	-0.020	0.010	0.130	0.351	2205	0.863	0.049	0.051	0.519	0.510
2	-0.228	0.002	0.005	0.280	1295	0.993	0.050	0.048	0.530	0.523
L	-1.358	-0.004	-0.198	0.077	300	1.547	0.041	0.037	0.554	0.550

Table II: Pooled Return Regression Estimates (1954-2014)

We report the results from pooled regressions of day t stock returns on $t-1$ characteristics. Characteristics are measured on a weekly basis for conciseness. All firm-specific variables, defined in Table I, are cross-sectionally demeaned, and when appropriate, interacted with our proposed tax-selling premium variable, $\gamma_t = \tau_t \left(\frac{1-B_t}{1-B_t\tau_t}\right)$, a function of capital gains tax rates (τ_t) and interest rates ($r_t = \frac{1}{B_t} - 1$) as derived in Section 1 of the paper, and with dummy variables for different periods of the year. The dummy variables are RoY for the rest of the year, $Qtr(X)$ for the X weeks relative to the quarter-end, $Yr(X)$ for the X weeks relative to the year-end, XE for the business day before Christmas and NYE for the business day before New Year's Day. t-statistics (in parentheses) are robust to cross-correlation in the residuals using the clustered standard errors of Rogers (1983, 1993). The sample starts in February of 1954 and ends in January of 2014. Panel A presents regressions of daily returns onto interactions of the calendar dummies, g and γ, along with several firm-specific variables as controls. In regressions (1) and (2) of Panel A, γ is calculated under the assumption that the marginal seller has quarterly and annual tax horizons, respectively. That is, γ is calculated using 3-month and 12-month interest rates, respectively. In regression (3) of Panel A (along with the rest of the table), γ is calculated using 3-month interest rates for the turn of the tax quarter and 12-month interest rates otherwise. Panel B shows sub-sample analysis of regression (6) in Panel A. Regressions (1) through (4) in Panel B correspond to sub-periods 1963-2014, 1954-1985, 1986-2014, and 1993-2014, respectively. Regression (1) in Panel C includes interactions between the calendar dummy variables and a stock's average relative (to price) bid-ask spread ($\frac{bid-ask}{P}$) during month $t-1$. Regressions (2) and (3) in Panel C account for a possible trend in the effect of g on returns. Regression (4) in Panel C analyzes whether the interactive effect of γ can be explained simply through interactions with its components, interest rates (r) or capital gains tax rates (τ) individually. Panel D controls for interactions with variables reflecting changes in tax laws as described in Section 3.1.1 of the text. For Panel A, these regressions generally take the form

$$\begin{aligned} r_{i,t} \; = \; & a_1\gamma_{t-1}g_{i,t-1}RoY \\ & + a_2\gamma_{t-1}g_{i,t-1}Qtr(-2) + a_3\gamma_{t-1}g_{i,t-1}Qtr(+2) \\ & + a_4\gamma_{t-1}g_{i,t-1}Yr(-2) + a_5\gamma_{t-1}g_{i,t-1}Yr(+2) \\ & + a_6\gamma_{t-1}g_{i,t-1}RoYNBER \\ & + a_7\gamma_{t-1}g_{i,t-1}Qtr(-2)NBER + a_8\gamma_{t-1}g_{i,t-1}Qtr(+2)NBER \\ & + a_9\gamma_{t-1}g_{i,t-1}Yr(-2)NBER + a_{10}\gamma_{t-1}g_{i,t-1}Yr(+2)NBER \\ & + a_{11}\gamma_{t-1}g_{i,t-1}XE + a_{12}\gamma_{t-1}g_{i,t-1}NYE \\ & + a_{13}\gamma_{t-1} + a_{14}g_{i,t-1} \\ & + a_{15}\ln BM_{i,t-1} + a_{16}\ln ME_{i,t-1} + a_{17}\ln ME_{i,t-1}Jan \\ & + a_{18}r_{i,-1:0} + a_{19}r_{i,-12:-1} + a_{20}r_{i,-36:-12} + a_{21}\overline{V}_{i,t-1} + \varepsilon_{i,t} \end{aligned}$$

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)
$\gamma * g * RoY$	0.028 (2.06)	0.006 (1.50)	0.006 (1.47)	0.008 (1.87)	0.007 (1.76)	0.006 (1.26)
$\gamma * g * Qtr(-2)$	0.030 (1.53)	0.007 (1.30)	0.026 (1.31)	0.030 (1.51)	0.025 (1.22)	-0.002 (-0.09)
$\gamma * g * Qtr(+2)$	0.023 (1.39)	0.007 (1.31)	0.019 (1.15)	0.022 (1.21)	0.026 (1.41)	0.025 (1.23)
$\gamma * g * Yr(-2)$	0.205 (6.87)	0.052 (6.66)	0.052 (6.67)	0.051 (6.40)	0.052 (6.51)	0.040 (3.65)
$\gamma * g * Yr(+2)$	-0.410 (-5.12)	-0.110 (-5.19)	-0.110 (-5.20)	-0.107 (-5.19)	-0.105 (-5.16)	-0.101 (-5.00)
$\gamma * g * RoY * NBER$						0.004 (0.94)
$\gamma * g * Qtr(-2) * NBER$						0.081 (2.37)
$\gamma * g * Qtr(+2) * NBER$						-0.001 (-0.03)
$\gamma * g * Yr(-2) * NBER$						0.037 (2.12)
$\gamma * g * Yr(+2) * NBER$						-0.029 (-0.38)
$\gamma * g * XE$	-0.507 (-6.63)	-0.137 (-6.97)	-0.137 (-6.97)	-0.132 (-6.41)	-0.133 (-6.42)	-0.134 (-6.67)
$\gamma * g * NYE$	-1.064 (-4.69)	-0.281 (-4.72)	-0.281 (-4.72)	-0.269 (-4.01)	-0.270 (-4.02)	-0.271 (-4.21)
γ	0.000 (-3.36)	0.000 (-3.30)	0.000 (-3.03)	-0.001 (-1.66)	-0.001 (-2.29)	-0.001 (-2.28)
g	-0.001 (-10.00)	-0.001 (-8.81)	-0.001 (-9.09)	-0.001 (-7.76)	-0.001 (-8.00)	-0.001 (-7.93)
$\ln BM$				0.015 (3.72)	0.016 (4.03)	0.016 (4.06)
$\ln ME$				-0.006 (-5.33)	-0.005 (-4.39)	-0.005 (-4.31)
$\ln ME * Jan$				-0.009 (-9.51)	-0.010 (-9.70)	-0.010 (-9.73)
$r_{-1:0}$					-0.003 (-5.58)	-0.003 (-5.58)
$r_{-12:-1}$					0.000 (4.30)	0.000 (4.35)
$r_{-36:-12}$					0.000 (-1.47)	0.000 (-1.42)
$\overline{V}$					-0.001 (-2.56)	-0.001 (-2.59)

Panel B

	(1) 1963-2014	(2) 1963-1985	(3) 1986-2014	(4) 1993-2014
$\gamma * g * RoY$	0.007	0.001	-0.004	-0.047
	(1.49)	(0.10)	(-0.69)	(-4.15)
$\gamma * g * Qtr(-2)$	0.002	-0.017	-0.041	-0.325
	(0.08)	(-0.40)	(-1.34)	(-4.70)
$\gamma * g * Qtr(+2)$	0.027	0.032	-0.038	-0.269
	(1.35)	(1.10)	(-1.21)	(-3.36)
$\gamma * g * Yr(-2)$	0.041	0.021	0.043	0.125
	(3.71)	(1.74)	(2.22)	(2.42)
$\gamma * g * Yr(+2)$	-0.099	-0.126	-0.093	-0.277
	(-4.93)	(-5.09)	(-3.32)	(-4.55)
$\gamma * g * RoY * NBER$	0.003	0.009	0.006	0.032
	(0.78)	(1.21)	(1.05)	(1.19)
$\gamma * g * Qtr(-2) * NBER$	0.079	0.068	0.103	0.484
	(2.30)	(1.31)	(2.36)	(4.07)
$\gamma * g * Qtr(+2) * NBER$	-0.002	0.019	0.011	0.305
	(-0.07)	(0.60)	(0.24)	(1.23)
$\gamma * g * Yr(-2) * NBER$	0.035	0.055	0.023	-0.095
	(2.06)	(2.32)	(0.97)	(-0.44)
$\gamma * g * Yr(+2) * NBER$	-0.028	0.032	-0.048	-0.285
	(-0.36)	(0.47)	(-0.50)	(-4.78)
$\gamma * g * XE$	-0.132	-0.108	-0.150	-0.247
	(-6.67)	(-4.40)	(-5.55)	(-2.72)
$\gamma * g * NYE$	-0.270	-0.321	-0.230	-0.930
	(-4.19)	(-9.73)	(-2.39)	(-4.56)
γ	-0.002	0.002	-0.004	-0.003
	(-3.45)	(3.34)	(-3.83)	(-2.41)
g	-0.001	0.000	-0.001	0.000
	(-7.95)	(-1.18)	(-6.20)	(-2.50)
$\ln BM$	0.020	0.017	0.022	0.023
	(4.46)	(3.90)	(3.77)	(3.22)
$\ln ME$	-0.006	-0.006	-0.008	-0.010
	(-4.64)	(-3.02)	(-4.27)	(-4.77)
$\ln ME * Jan$	-0.010	-0.014	-0.009	-0.007
	(-9.50)	(-8.84)	(-6.22)	(-5.21)
$r_{-1:0}$	-0.003	-0.005	-0.002	-0.002
	(-5.43)	(-16.82)	(-4.54)	(-3.69)
$r_{-12:-1}$	0.000	0.001	0.000	0.000
	(3.99)	(6.60)	(2.51)	(2.04)
$r_{-36:-12}$	0.000	0.000	0.000	0.000
	(-1.36)	(0.51)	(-1.69)	(-1.83)
$\overline{V}$	-0.001	-0.003	-0.001	-0.001
	(-2.25)	(-3.19)	(-1.72)	(-1.75)

Panel C

	(1)		(2)	(3)		(4)	
		interact $\gamma * g$ with $\frac{bid-ask}{P}$			interact g with $trend$	replace γ with both	
						r	τ
$\gamma * g * RoY$	0.005	0.001	-0.005	0.001	-0.001	0.127	-0.004
	(1.05)	(0.68)	(-1.00)	(0.32)	(-4.41)	(3.67)	(-4.31)
$\gamma * g * Qtr(-2)$	0.007	-0.076	-0.041	-0.016	-0.005	0.100	-0.005
	(0.25)	(-1.12)	(-1.63)	(-0.64)	(-2.47)	(1.85)	(-3.59)
$\gamma * g * Qtr(+2)$	0.029	-0.047	-0.013	0.009	-0.007	0.027	-0.003
	(1.38)	(-0.79)	(-0.61)	(0.48)	(-3.53)	(0.42)	(-1.76)
$\gamma * g * Yr(-2)$	0.044	-0.023	0.029	0.029	0.001	0.203	-0.002
	(4.43)	(-1.34)	(2.48)	(3.08)	(0.66)	(1.17)	(-0.88)
$\gamma * g * Yr(+2)$	-0.131	0.147	-0.112	-0.105	-0.002	0.038	-0.012
	(-6.35)	(5.77)	(-5.28)	(-4.92)	(-0.66)	(0.17)	(-3.40)
$\gamma * g * RoY * NBER$	0.004		0.006	0.007		-0.094	0.002
	(0.98)		(1.29)	(1.73)		(-1.38)	(1.40)
$\gamma * g * Qtr(-2) * NBER$	0.086		0.090	0.092		-0.203	0.006
	(2.54)		(2.63)	(2.76)		(-1.67)	(2.48)
$\gamma * g * Qtr(+2) * NBER$	0.002		0.006	0.013		-0.336	0.006
	(0.07)		(0.18)	(0.44)		(-2.00)	(1.84)
$\gamma * g * Yr(-2) * NBER$	0.037		0.038	0.037		0.295	-0.002
	(2.19)		(2.21)	(1.93)		(0.54)	(-0.16)
$\gamma * g * Yr(+2) * NBER$	-0.034		-0.026	-0.021		1.430	-0.036
	(-0.47)		(-0.35)	(-0.28)		(1.17)	(-1.36)
$\gamma * g * XE$	-0.133		-0.134	-0.124		-0.133	
	(-5.35)		(-6.68)	(-6.79)		(-6.07)	
$\gamma * g * NYE$	-0.331		-0.271	-0.261		-0.270	
	(-7.55)		(-4.20)	(-4.64)		(-4.25)	
γ	-0.001		-0.001	-0.001		-0.001	
	(-1.22)		(-2.51)	(-2.63)		(-2.29)	
g	-0.001		0.000	-0.001		0.000	
	(-7.83)		(-2.96)	(-5.28)		(-0.03)	
$g * trend$			0.000				
			(-2.86)				
$\ln BM$	0.009		0.017	0.018		0.014	
	(3.13)		(4.39)	(4.61)		(3.74)	
$\ln ME$	-0.005		-0.006	-0.005		-0.006	
	(-3.85)		(-4.65)	(-4.55)		(-4.61)	
$\ln ME * Jan$	-0.009		-0.010	-0.010		-0.009	
	(-9.06)		(-9.70)	(-9.62)		(-9.37)	
$r_{-1:0}$	-0.003		-0.003	-0.003		-0.003	
	(-5.34)		(-5.58)	(-5.57)		(-5.55)	
$r_{-12:-1}$	0.000		0.000	0.000		0.000	
	(4.33)		(4.18)	(4.25)		(4.10)	
$r_{-36:-12}$	0.000		0.000	0.000		0.000	
	(-1.37)		(-1.60)	(-1.50)		(-1.51)	
$\overline{V}$	-0.001		-0.001	-0.001		-0.001	
	(-2.64)		(-2.37)	(-2.47)		(-2.61)	

Panel D

		Interact $\gamma * g$ with			
		$NBER$	$LTHold$	$LTDeduct$	$LossLimit$
$\gamma * g * RoY$	0.002	0.009	-0.018	-0.008	0.017
	(0.50)	(2.14)	(-3.57)	(-2.16)	(3.78)
$\gamma * g * Qtr(-2)$	-0.006	0.099	-0.116	0.019	0.054
	(-0.24)	(2.93)	(-3.45)	(0.82)	(1.78)
$\gamma * g * Qtr(+2)$	0.014	0.017	-0.036	-0.034	0.022
	(0.69)	(0.56)	(-0.95)	(-1.47)	(0.65)
$\gamma * g * Yr(-2)$	0.037	0.037	-0.018	0.017	0.002
	(3.27)	(2.01)	(-1.90)	(2.20)	(0.26)
$\gamma * g * Yr(+2)$	-0.107	-0.039	0.007	-0.017	0.020
	(-5.29)	(-0.48)	(0.22)	(-0.61)	(0.76)
$\gamma * g * XE$	-0.134				
	(-6.58)				
$\gamma * g * NYE$	-0.271				
	(-4.23)				
γ	-0.002				
	(-2.77)				
g	-0.001				
	(-6.57)				
$\ln BM$	0.015				
	(3.93)				
$\ln ME$	-0.006				
	(-5.07)				
$\ln ME * Jan$	-0.010				
	(-9.72)				
$r_{-1:0}$	-0.003				
	(-5.58)				
$r_{-12:-1}$	0.000				
	(4.17)				
$r_{-36:-12}$	0.000				
	(-1.66)				
$\overline{V}$	-0.001				
	(-2.72)				
$Column\ Variable$			0.000	0.000	0.000
			(4.20)	(0.21)	(1.96)

Table III: Pooled Return Regression Estimates in the UK (1996-2014)

We report the results from pooled regressions of day t stock returns on $t-1$ characteristics using UK data. Characteristics are measured on a weekly basis for conciseness. All firm-specific variables, defined in Table I but computed with UK data, are cross-sectionally demeaned, and when appropriate, interacted with our proposed tax-selling premium variable γ, defined in Table II but computed with UK data. The dummy variables are RoY for the rest of the year, $TaxYr(X)$ for the X weeks relative to the UK tax year-end (i.e., April 5th), and $Yr(X)$ for the X weeks relative to the calendar year-end (i.e., December 31st). t-statistics (in parentheses) are robust to cross-correlation in the residuals using the clustered standard errors of Rogers (1983, 1993). The sample starts in January 1996 and ends in January 2014. The full specification of the regression takes the form

$$\begin{aligned} r_{i,t} &= a_1\gamma_{t-1}g_{i,t-1}RoY \\ &+ a_2\gamma_{t-1}g_{i,t-1}TaxYr(-2) + a_3\gamma_{t-1}g_{i,t-1}TaxYr(+2) \\ &+ a_4\gamma_{t-1}g_{i,t-1}Yr(-2) + a_5\gamma_{t-1}g_{i,t-1}Yr(+2) \\ &+ a_6\ln BM_{i,t-1} + a_7\ln ME_{i,t-1} + a_8\ln ME_{i,t-1}Jan \\ &+ a_9 r_{i,-1:0} + a_{10}r_{i,-12:-1} + a_{11}r_{i,-36:-12} + \varepsilon_{i,t} \end{aligned}$$

	(1)	(2)
$\gamma * g * RoY$	0.053	0.054
	(2.43)	(2.36)
$\gamma * g * TaxYr(-2)$	0.132	0.134
	(2.08)	(2.10)
$\gamma * g * TaxYr(+2)$	-0.171	-0.170
	(-3.35)	(-3.31)
$\gamma * g * Yr(-2)$	0.050	0.052
	(0.83)	(0.86)
$\gamma * g * Yr(+2)$	-0.196	-0.193
	(-2.78)	(-2.74)
$\ln BM$	0.083	0.081
	(3.42)	(3.65)
$\ln ME$	0.005	0.005
	(0.36)	(0.37)
$\ln ME * Jan$	-0.096	-0.096
	(-2.76)	(-2.76)
$r_{-1:0}$		-0.001
		(-0.67)
$r_{-12:-1}$		0.001
		(1.17)
$r_{-36:-12}$		-0.001
		(-2.45)

Table IV: Pooled Selling Pressure Regression Estimates (1993-2005)

We report the results from pooled regressions of the day t level in selling pressure (for all, small, or large sized trades) on $t-1$ characteristics. Characteristics are measured on a weekly basis for conciseness. All firm-specific variables, defined in Table I, are cross-sectionally demeaned, and when appropriate, interacted with our proposed tax-selling premium variable, $\gamma_t = \tau_t \left(\frac{1-B_t}{1-B_t\tau_t}\right)$, a function of capital gains tax rates (τ_t) and interest rates ($r_t = \frac{1}{B_t} - 1$) as derived in Section 1 of the paper, and with dummy variables for different periods of the year. The dummy variables are RoY for the rest of the year, $Qtr(X)$ for the X weeks relative to the quarter-end, $Yr(X)$ for the X weeks relative to the year-end, XE for the business day before Christmas and NYE for the business day before New Year's Day. t-statistics (in parentheses) are robust to simultaneous correlation both across firms and across days based on the method developed by Thompson (2011). The sample starts in February of 1993 and ends in January 2005. The specifications of these regressions are consistent with regressions (5) and (6) of Table II Panel A and take the form

$$
\begin{aligned}
Sell_{i,t} \quad = \quad & a_1\gamma_{t-1}g_{i,t-1}RoY \\
& + a_2\gamma_{t-1}g_{i,t-1}Qtr(-2) + a_3\gamma_{t-1}g_{i,t-1}Qtr(+2) \\
& + a_4\gamma_{t-1}g_{i,t-1}Yr(-2) + a_5\gamma_{t-1}g_{i,t-1}Yr(+2) \\
& + a_6\gamma_{t-1}g_{i,t-1}RoYNBER \\
& + a_7\gamma_{t-1}g_{i,t-1}Qtr(-2)NBER + a_8\gamma_{t-1}g_{i,t-1}Qtr(+2)NBER \\
& + a_9\gamma_{t-1}g_{i,t-1}Yr(-2)NBER + a_{10}\gamma_{t-1}g_{i,t-1}Yr(+2)NBER \\
& + a_{11}\gamma_{t-1}g_{i,t-1}XE + a_{12}\gamma_{t-1}g_{i,t-1}NYE \\
& + a_{13}\gamma_{t-1} + a_{14}g_{i,t-1} \\
& + a_{15}\ln BM_{i,t-1} + a_{16}\ln ME_{i,t-1} + a_{17}\ln ME_{i,t-1}Jan \\
& + a_{18}r_{i,-1:0} + a_{19}r_{i,-12:-1} + a_{20}r_{i,-36:-12} + a_{21}\overline{V}_{i,t-1} + \varepsilon_{i,t}
\end{aligned}
$$

	(1) all	(2) small	(3) large	(4) all	(5) small	(6) large
$\gamma * g * RoY$	-0.055	-0.187	-0.095	-0.058	-0.190	-0.094
	(-0.92)	(-2.88)	(-1.23)	(-0.95)	(-2.87)	(-1.19)
$\gamma * g * Qtr(-2)$	0.674	0.414	-0.838	1.010	0.771	-0.713
	(2.17)	(1.20)	(-2.42)	(3.32)	(2.26)	(-2.01)
$\gamma * g * Qtr(+2)$	-0.148	-0.169	-1.717	-0.094	-0.089	-1.948
	(-0.55)	(-0.55)	(-5.55)	(-0.32)	(-0.27)	(-6.31)
$\gamma * g * Yr(-2)$	-1.607	-1.786	-1.289	-1.584	-1.761	-1.285
	(-12.57)	(-11.56)	(-9.94)	(-12.48)	(-11.44)	(-9.95)
$\gamma * g * Yr(+2)$	1.313	1.195	1.156	1.596	1.477	1.353
	(6.71)	(5.97)	(5.26)	(7.38)	(6.45)	(5.25)
$\gamma * g * RoY * NBER$				-0.037	-0.047	-0.266
				(-0.34)	(-0.36)	(-2.54)
$\gamma * g * Qtr(-2) * NBER$				-1.948	-2.072	-1.641
				(-3.22)	(-3.17)	(-2.23)
$\gamma * g * Qtr(+2) * NBER$				-0.595	-0.797	1.168
				(-1.04)	(-1.32)	(1.01)
$\gamma * g * Yr(-2) * NBER$				-0.628	-0.678	-0.948
				(-4.02)	(-4.35)	(-3.99)
$\gamma * g * Yr(+2) * NBER$				-0.811	-0.805	-0.697
				(-3.86)	(-3.61)	(-2.75)
$\gamma * g * XE$	0.220	0.128	0.800	0.220	0.129	0.795
	(1.18)	(0.62)	(2.22)	(1.26)	(0.67)	(2.18)
$\gamma * g * NYE$	0.011	0.449	0.126	0.013	0.451	0.127
	(0.05)	(2.03)	(0.59)	(0.06)	(2.08)	(0.62)
γ	-0.430	-0.316	-0.551	-0.430	-0.317	-0.552
	(-17.39)	(-16.39)	(-19.27)	(-17.37)	(-16.38)	(-19.26)
g	-0.001	-0.001	0.001	-0.001	0.000	0.002
	(-1.91)	(-1.44)	(1.63)	(-1.50)	(-1.05)	(2.32)
$\ln BM$	0.368	0.965	0.032	0.369	0.966	0.033
	(10.34)	(18.48)	(0.85)	(10.38)	(18.53)	(0.86)
$\ln ME$	-1.745	-1.471	-1.613	-1.747	-1.473	-1.614
	(-70.10)	(-53.96)	(-69.87)	(-70.20)	(-54.02)	(-69.93)
$\ln ME * Jan$	0.055	0.058	0.003	0.053	0.056	0.001
	(3.29)	(4.23)	(0.20)	(3.13)	(4.05)	(0.08)
$r_{-1:0}$	-0.009	0.001	-0.013	-0.009	0.001	-0.013
	(-9.33)	(0.75)	(-9.20)	(-9.37)	(0.73)	(-9.26)
$r_{-12:-1}$	-0.002	-0.005	-0.001	-0.002	-0.005	-0.001
	(-6.73)	(-10.19)	(-2.29)	(-6.83)	(-10.26)	(-2.36)
$r_{-36:-12}$	0.000	-0.002	0.001	0.000	-0.002	0.001
	(-0.68)	(-11.76)	(5.73)	(-1.00)	(-12.10)	(5.45)
$\overline{V}$	-0.074	-0.027	-0.092	-0.074	-0.027	-0.091
	(-24.78)	(-9.19)	(-36.00)	(-24.75)	(-9.11)	(-36.03)

Table V: Aggregate Time-Series Regression Estimates (1954-2014)

We report the results from monthly regressions forecasting the excess return on the market portfolio with our tax-selling premium variable, γ, defined in Table 2 and the value-weight average, g_M, of the firm-level capital gains overhang, g, defined in Table I. We also include in these regressions the value-weight average, BM_M, of the firm-level book-to-market ratio, BM, also defined in Table I. Dummy variables corresponding to periods of the year are also included in the interactions. These variables include RoY, Dec, and Jan for February-November (or rest of year), December, and January respectively and refer to the month of the return being predicted. The sample starts in February of 1954 and ends in January 2014. The regression specification that includes the union of all of the independent variables we consider would be

$$\begin{aligned} RMRF_t &= a_0 + a_1\gamma_{t-1}g_{M,t-1}RoY + a_2\gamma_{t-1}g_{M,t-1}Dec + a_3\gamma_{t-1}g_{M,t-1}Jan \\ &+a_4 g_{M,t-1}RoY + a_5 g_{M,t-1}Dec + a_6 g_{M,t-1}Jan \\ &+a_7\gamma_{t-1}RoY + a_8\gamma_{t-1}Dec + a_9\gamma_{t-1}Jan + a_{10}BM_{M,t-1} + \varepsilon_{i,t}. \end{aligned}$$

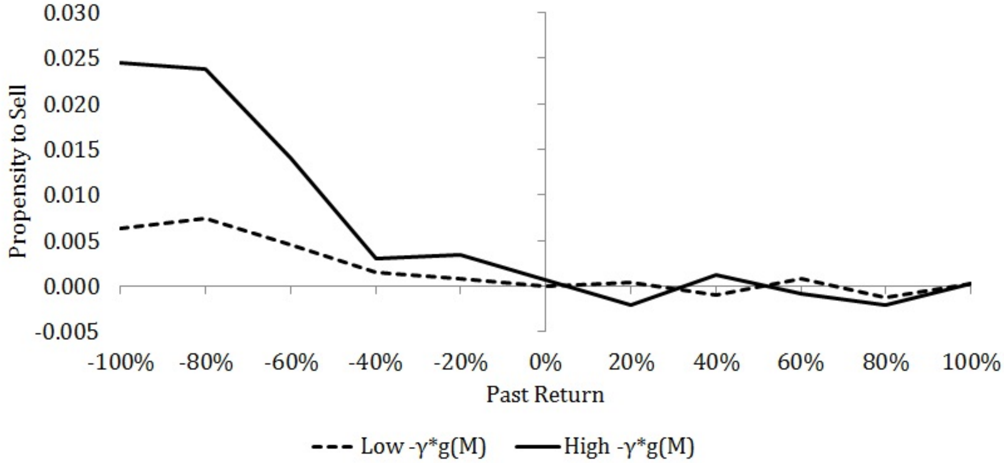
	(1)	(2)	(3)
Intercept	-0.388	-0.454	-1.140
	(-0.90)	(-1.05)	(-2.30)
$\gamma * g_M * RoY$	0.212	-0.778	0.448
	(0.31)	(-0.74)	(0.65)
$\gamma * g_M * Dec$	1.267	-2.653	0.911
	(0.76)	(-0.96)	(0.53)
$\gamma * g_M * Jan$	-3.914	-6.632	-5.643
	(-2.09)	(-2.16)	(-2.81)
$g_M * RoY$		0.031	
		(1.39)	
$g_M * Dec$		0.111	
		(1.85)	
$*Jan$		0.073	
		(1.22)	
$\gamma * RoY$			-0.514
			(-3.50)
$\gamma * Dec$			-0.247
			(-0.87)
$\gamma * Jan$			0.175
			(0.59)
BM_M	0.397	0.461	1.162
	(0.92)	(1.06)	(2.33)
R^2	0.008	0.017	0.030

Table VI: Portfolio Time-Series Regression Estimates (1954-2014)

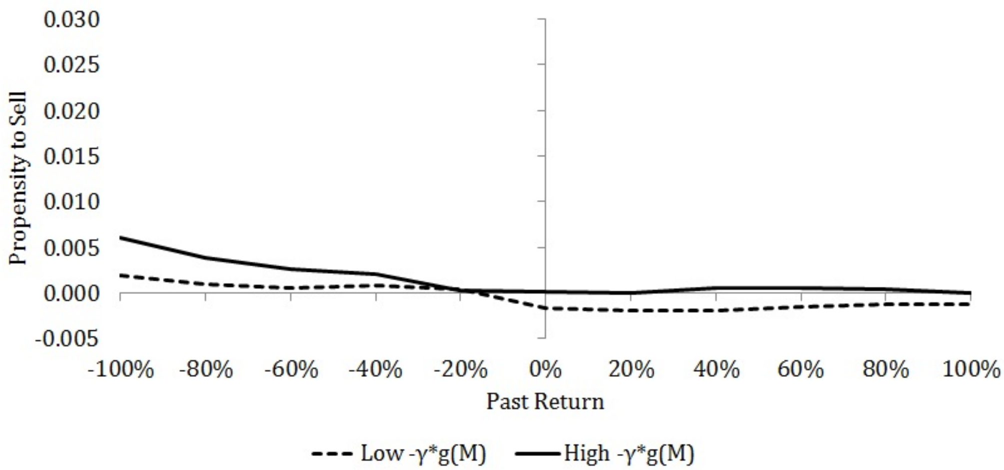
We report the results from monthly regressions forecasting the CAPM alpha for four factor portfolios using the portfolio-specific tax-selling capital gains overhang. We form the low-minus-high-overhang portfolio, TAX, by going long a value-weight portfolio of the bottom twenty percent of stocks and short a value-weight portfolio of the top twenty percent of stocks, in each case based on NYSE breakpoints. HML (high minus low book-to-market) and SMB (small minus big size) portfolio returns are constructed as in Fama and French (1993). We construct our momentum portfolio in the same way Ken French constructs his UMD portfolio. Our measurement of each factor's capital gains overhang comes from portfolios that only include stocks that have capital gains overhang data available. However, we forecast the returns on the factors that are available from Ken French's website. $RMRF$ is the excess return on the market portfolio. We interact RMRF with our measure of the market's capital gains overhang, g_M, described in Table V. Dummy variables corresponding to periods of the year as well as our tax-selling premium variable, γ, are also included in the interactions. These dummy variables as well as γ are defined in Tables V and II, respectively. The time-series of the $RMRF$ interaction, $\gamma * g_M$, is standardized to aid interpretability. The sample starts in February of 1954 and ends in January 2014.

	Panel A: TAX			Panel B: HML		
	(1)	(2)	(3)	(1)	(2)	(3)
$Intercept * RoY$	-0.025	-0.025	-0.024	0.002	0.002	0.002
	(-13.25)	(-13.52)	(-9.19)	(1.98)	(1.95)	(1.28)
$Intercept * Dec$	-0.035	-0.030	-0.028	0.004	0.004	0.002
	(-5.76)	(-4.67)	(-3.19)	(1.19)	(1.16)	(0.50)
$Intercept * Jan$	0.030	0.026	0.014	0.013	0.012	0.011
	(4.98)	(4.33)	(1.62)	(4.20)	(3.70)	(2.38)
$\gamma * g * RoY$			0.096			-0.012
			(0.74)			(-0.17)
$\gamma * g * Dec$			0.118			-0.097
			(0.32)			(-0.50)
$\gamma * g * Jan$			-0.943			-0.075
			(-2.01)			(-0.30)
$RMRF * RoY$		0.332	0.330		-0.120	-0.119
		(7.48)	(7.41)		(-5.12)	(-5.08)
$RMRF * Dec$		0.069	0.060		-0.127	-0.121
		(0.37)	(0.32)		(-1.31)	(-1.23)
$RMRF * Jan$		0.237	0.207		-0.094	-0.096
		(1.89)	(1.64)		(-1.42)	(-1.44)
$\gamma * g_M * RMRF * RoY$		-0.028	-0.027		0.021	0.021
		(-1.11)	(-1.04)		(1.59)	(1.56)
$\gamma * g_M * RMRF * Dec$		-0.429	-0.403		-0.104	-0.125
		(-2.50)	(-2.12)		(-1.15)	(-1.25)
$\gamma * g_M * RMRF * Jan$		0.381	0.284		0.091	0.083
		(5.77)	(3.46)		(2.61)	(1.92)
$RMRF$	0.341			-0.118		
	(8.31)			(-5.60)		
R^2	0.28	0.32	0.33	0.06	0.08	0.08

	Panel C: SMB			Panel D: UMD		
	(1)	(2)	(3)	(1)	(2)	(3)
$Intercept * RoY$	0.000	0.000	0.002	0.008	0.008	0.007
	(0.39)	(0.29)	(1.20)	(5.04)	(4.99)	(3.25)
$Intercept * Dec$	0.003	0.004	0.010	0.019	0.016	0.013
	(0.77)	(1.19)	(1.89)	(3.81)	(3.03)	(1.79)
$Intercept * Jan$	0.018	0.016	0.005	-0.017	-0.015	-0.011
	(5.32)	(4.82)	(0.95)	(-3.42)	(-3.07)	(-1.50)
$\gamma * g * RoY$			0.103			-0.050
			(1.42)			(-0.47)
$\gamma * g * Dec$			0.308			-0.184
			(1.49)			(-0.61)
$\gamma * g * Jan$			-0.912			0.355
			(-3.46)			(0.92)
$RMRF * RoY$		0.136	0.134		-0.122	-0.121
		(5.41)	(5.34)		(-3.34)	(-3.29)
$RMRF * Dec$		0.019	-0.003		0.008	0.020
		(0.18)	(-0.03)		(0.05)	(0.13)
$RMRF * Jan$		0.064	0.035		-0.038	-0.026
		(0.90)	(0.49)		(-0.36)	(-0.25)
$\gamma * g_M * RMRF * RoY$		0.032	0.033		0.077	0.076
		(2.17)	(2.31)		(3.64)	(3.58)
$\gamma * g_M * RMRF * Dec$		-0.185	-0.117		0.374	0.333
		(-1.90)	(-1.09)		(2.64)	(2.12)
$\gamma * g_M * RMRF * Jan$		0.165	0.071		-0.205	-0.169
		(4.40)	(1.54)		(-3.77)	(-2.49)
$RMRF$	0.123			-0.143		
	(5.35)			(-4.26)		
R^2	0.08	0.12	0.14	0.08	0.13	0.13



(a) Turn of the year



(b) Turn of the quarter

Figure 1: This figure shows the propensity of taxable investors to sell winners and losers at (a) the turn of the year and (b) the turn of the quarter using the dataset studied in Odean (1998). For each stock in the dataset, we calculate an unrealized capital gain/loss from the time the investor purchased the stock until it was eventually sold. For each of eleven evenly-spaced bins ranging from -100% to > 100%, we compare these unrealized gains and losses to observed gains and losses. In the top plot (a), we plot the difference in the percentage of realized gains and losses in December versus January. Similarly, in (b) we plot these differences averaged across the turns of the first three quarters of the year. The data is split into years predicted to have either a low or a high tax-selling propensity for the market portfolio, $-\gamma * g(M)$, as discussed in the paper. Solid (dashed) lines represent the propensity to sell before the turn of the year or quarter when the tax-selling propensity is predicted to be high (low).

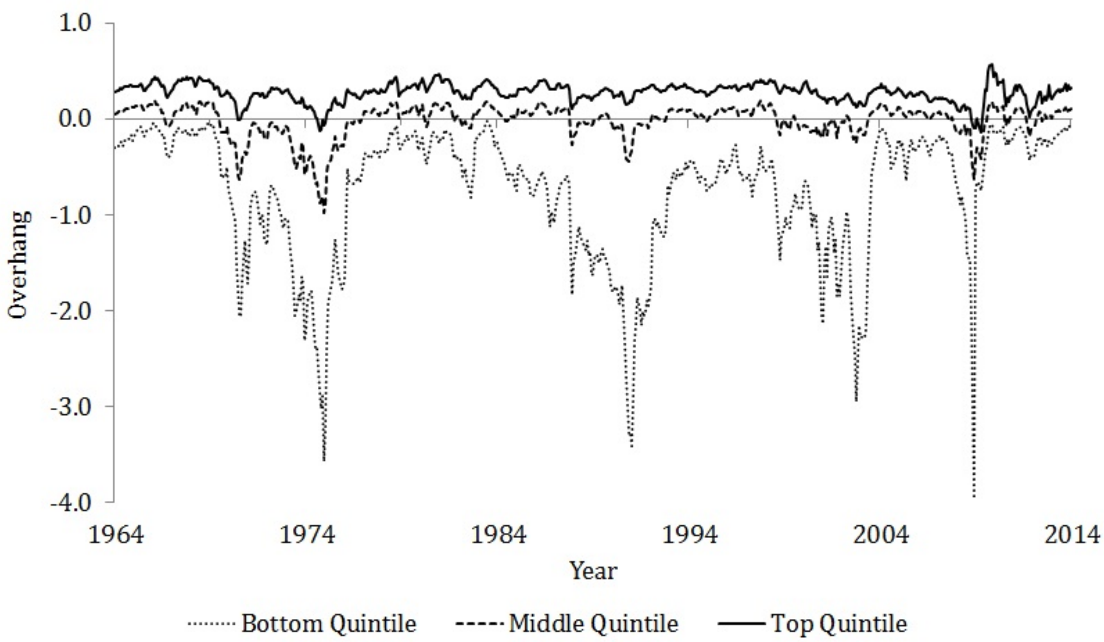


Figure 2: This figure plots the value-weight capital gains overhang of the bottom, middle, and top capital-gains-overhang-sorted quintile portfolios. The sorts are based on NYSE breakpoints.

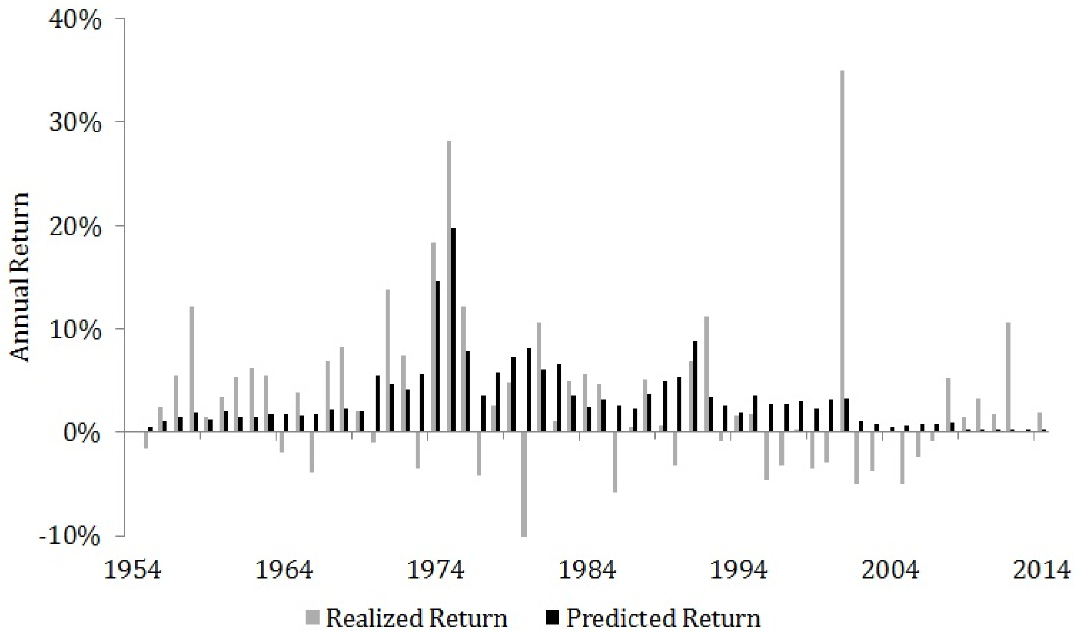


Figure 3: This figure plots the realized January returns on our TAX factor over the course of the sample. To form TAX, each month we sort all NYSE stocks on our overhang measure and calculate 20th and 80th percentile breakpoints. We then buy all NYSE-AMEX-NASDAQ stocks that are below the NYSE 20th percentile and sell all NYSE-AMEX-NASDAQ stocks that are above the NYSE 80th percentile. The positions in the long and short sides are value-weighted. In each bin, we plot next to the realized January return, our forecast of the expected January rebound based on the product of i) our tax-selling premium variable, γ, defined in Table II and ii) the net overhang for the TAX factor, g_{TAX}. That forecast comes from the regression, $TAX_{JAN,t} = a_0 + a_1 \gamma_{t-1} g_{TAX,t-1} + \epsilon_{JAN,t}$. The estimate of a_0 is 0.00227 (t-statistic of 0.19), estimate of a_1 is -2.11 (t-statistic of -3.80), and the adjusted R^2 is 18.5%.

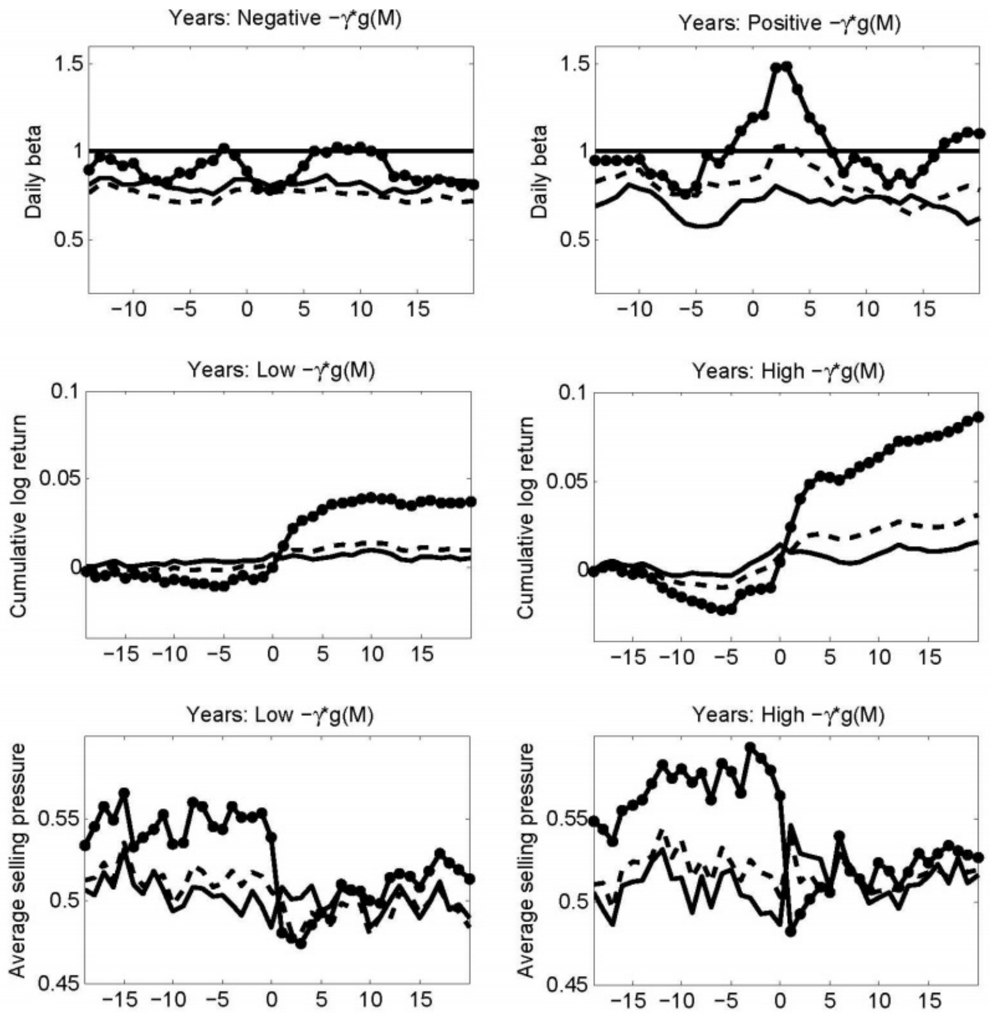


Figure 4: This figure shows characteristics of capital-gains-overhang quintile portfolios in the days surrounding the turn of the year. The solid, dashed, and solid-dashed lines represent the highest, middle, and lowest overhang quintile portfolios, respectively. On the x-axis, 0 represents the last trading day in December and 1 represents the first trading day in January. The top two graphs show daily betas for these portfolios, where daily beta is a five-day rolling beta estimate (as explained in Section 3.3). The left (right) graph plots rolling daily beta conditional on a predicted negative (positive) January rebound as determined by $-\gamma * g(M)$. The middle two graphs show cumulative log returns for these portfolios. The left (right) graph plots cumulative returns for those time periods where the market's January rebound is predicted to be below-median (above-median). The bottom two graphs show the selling pressure for these portfolios, where selling pressure is the ratio of sell trades relative to all trades. Therefore, the left (right) panel graphs the average selling pressure for those time periods where the market's January rebound is predicted to be below-median (above-median).