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Capital Gains Tax Overhang and Price Pressure

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ABSTRACT

I study whether the capital gains tax is an impediment to selling by some investors and if so, to what degree associated delayed selling affects stock prices. I find that selling decisions by institutions serving tax-sensitive clients are sensitive to cumulative capital gains, a pattern not observed for institutions with predominantly tax-exempt clients. Moreover, tax-related underselling impacts stock prices during large earnings surprises for stocks held primarily by tax-sensitive investors. The corresponding price reactions are less negative (more positive) with higher cumulative capital gains. This price pressure pattern is more severe when arbitrage is more costly.

WHEN INVESTORS SELL STOCK AT A PROFIT they realize capital gains and pay related taxes that they could otherwise defer indefinitely if they chose instead not to sell. The capital gains tax poses a cost of selling that can be an order of magnitude greater than the conventional transaction costs such as commissions and bid–ask spreads. In general, a considerable literature provides evidence that barriers to trading affect the willingness of investors to trade and, in turn, asset prices. Here, I investigate whether the capital gains tax is, in fact, an impediment to selling and, if it is, to what degree stock prices are affected by investors' delayed selling.

The first half of the paper explores whether institutions that serve tax-sensitive clients are sensitive to those clients' cumulative capital gains when selling. Matching a database of large U.S. institutions' stock holdings with data

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on those institutions' client profiles reveals that institutions that serve predominantly taxable clients and those that serve predominantly tax-exempt clients exhibit different trading patterns. I find that both the likelihood and magnitude of selling by institutions that serve tax-sensitive clients are negatively related to cumulative capital gains on a stock. Large capital gains discourage, and large capital losses encourage, selling, ceteris paribus. Consistent with the hypothesized impact of the capital gains tax, the behavior of institutions that serve predominantly tax-exempt clients does not seem to be related to cumulative capital gains. To test this hypothesis I control for capital losses on other holdings that institutions could potentially use to offset capital gains. I further account for the strong possibility that tax-sensitive investors might try to minimize their tax liabilities. The result, namely, that tax-sensitive institutional investors seem to react to the capital gains tax in a sensible way, is robust to alternative ways of constructing the capital gains measure.

The second half of the paper looks for evidence of the impact of tax-related underselling on stock prices. I examine price reactions to large quarterly earnings surprises. When there is a large earnings surprise trading volume increases dramatically, suggesting that many investors change their beliefs about the stock around the time of the surprise and therefore trade. The tax-sensitive selling hypothesis predicts that a capital gains tax overhang might create an order imbalance by affecting sellers and buyers asymmetrically. Specifically, taxable sellers might decide to sell less or sell slowly, whereas buyers are not affected. A large number of sellers affected by a capital gains tax overhang can thus create an order imbalance. An extensive literature documents the existence of price pressure when demand for a stock is not perfectly elastic and arbitrage activities are limited. Empirically, I find that during the 3-day announcement window, for a stock held by a large number of tax-sensitive investors, larger capital gains are associated with higher abnormal returns. Such a pattern does not exist for stocks held predominantly by tax-exempt investors. Further analysis suggests that this pattern is stronger when the arbitrage force is weaker.

In Section I, I review the related literature and outline the theoretical foundation for the empirical tests reported in this paper. Section II contains explanations of the data and of the procedure for constructing the measures used in the empirical tests. Section II also contains a detailed discussion of the criteria used to select the a priori tax-sensitive and tax-insensitive institution subsamples, so as to avoid misclassification of these definitions. In Section III, I present empirical evidence that tax-sensitive institutions react to the capital gains tax in a sensible way, by deferring the sale of those stocks that incur large capital gains, and that a similar pattern does not obtain for tax-insensitive institutions. Section IV presents evidence of price pressure following large quarterly earnings announcements for stocks held by large numbers of tax-sensitive investors as well as evidence that such price pressure is related to proxies of the costs of arbitrage. Section V concludes.[1]

[1] Investors might be subject to behavioral bias, such as the disposition effect documented by Barber and Odean (2000). In addition, creative financial engineering might allow investors to

I. Theoretical Foundation and Related Literature

There are two major reasons for investors to delay the realization of capital gains: (1) to exploit the option to reset capital gains and losses at death, which forgives the tax on any embedded capital gains or losses at the time of death and requires that the tax bases of the inherited assets be reset to prevailing market prices, and (2) to exploit the option to combine capital gains with capital losses.[2] A tax-sensitive investor who rationally times the realization of capital gains could achieve a substantial lifetime reduction in capital gains tax. Accordingly, Feldstein, Slemrod, and Yitzhaki (1980) and Poterba (1987a,b) argue that the true capital gains tax rate is substantially lower than the statutory capital gains tax rate (on the order of 25%).[3] The appendix presents a simple numerical example that illustrates the effect of delaying the realization of capital gains on after-tax proceeds from selling.

Theoretical modeling of investor behavior under the capital gains tax can be traced to Constantinides (1983, 1984), Dammon, Spatt, and Zhang (2001a,b), and Gallmeyer, Kaniel, and Tompaidis (2005). Dammon et al. (2001a), for example, characterize optimal portfolio decisions in the presence of capital gains taxes and short-sale restrictions and establish that the incentive to re-diversify the portfolio is inversely related to both the size of the embedded capital gains and investor age. These results are driven by the option to reset tax bases at death.[4]

Most theoretical models assume that while stocks are fairly priced, investors nonetheless want to sell given diversification or liquidity considerations. In practice the reason for selling could also be that investors disagree on the true value of a stock. In the case of investors who believe a stock is overvalued, the capital gains tax overhang can occasion mispricing to the extent that it constitutes a barrier for some pessimistic investors to sell. This might hinder the market's ability to aggregate information (Hong and Stein (2003), Chen, Hong, and Stein (2001)). At the least, reluctance to sell might serve to unbalance supply and demand and, absent perfectly elastic demand for the stock, create price pressure.

It is widely documented that there can be downward-sloping demand curves for stocks, and further, that price pressure can result when arbitrage is imperfect. Theoretical work such as De Long et al. (1990) and Shleifer and Vishny

circumvent some of the capital gains tax. While these are important issues, they are unlikely to significantly affect the tax-sensitive trading pattern documented here. Jin (2004) offers an extensive discussion of these considerations.

[2] Among other motivations not elaborated here is the "charitable contribution" option. Donating stocks eliminates the capital gains tax liability altogether, but the full market value of the stock is counted towards the tax deduction. Thus, if a fixed dollar amount of donation is expected anyway the donor might prefer to donate with stock and withhold the sale of stocks with large capital gains.

[3] More recently, Chay, Choi, and Pontiff (2005) demonstrate that tax-timing options can effectively reduce the tax burden by about one-half for marginal investors.

[4] To maintain tractability, Dammon et al. (2001a) focus on the case of a single risky asset and thus ignore another major source of the value of tax timing: By postponing the realization of a capital gain, investors preserve the option to combine it with capital loss trading on other risky assets and thereby greatly enhance the value of the "option to delay realizing capital gain." Dammon et al. (2001b) and Gallmeyer et al. (2005) address that issue by studying multiple risky assets.

(1997) shows how perfect arbitrage can break down. Empirically, studies of the price effects of S&P 500 listings (Shleifer (1986), Harris and Gurel (1986), Lynch and Mendenhall (1997), and Wurgler and Zhuravskaya (2002)) provide compelling evidence of price pressure. Using data on Dutch auction repurchases, Bagwell (1991a,b, 1992) also provides strong support for the view that shareholder valuations are far from homogeneous and that there exists a downward-sloping demand curve for stocks. Mitchell, Pulvino, and Stafford (2004), Coval and Stafford (2004), Corwin (2003), and Liang (1999) document price pressure around mergers, mutual fund asset fire sells, seasoned equity offerings, and stock recommendations by the *Wall Street Journal*, respectively, and Carhart et al. (2002) find that price pressure is related to stock purchases in mutual funds at end-of-quarter. Cohen, Gompers, and Vuolteenaho (2002) and Hotchkiss and Strickland (2003) present evidence that during public earnings announcements institutional investors actively buy from retail investors and that the composition of institutional shareholders affects stock price. Finally, researchers also document the long-lasting asset pricing impact of demand shifting. For example, Gompers and Metrick (2001) find that from 1980 to 1996, large institutional investor demand helped significantly increase overall demand for large stocks and decrease demand for small stocks. The compositional shift can explain part of the disappearance of the historical small-company stock premium.[5]

This paper also adds to the large empirical literature on the link between taxation and investor behavior.[6] Existing work particularly relevant to this paper includes that of Blouin, Raedy, and Shackelford (2003) and Ivkovich, Poterba, and Weisbenner (2004). Motivated by the theoretical work of Shackelford and Verrecchia (2002), Blouin et al. (2003) show that for appreciated stocks, share returns rise and trading volumes fall with a measure for incremental taxes (long-term minus short-term capital gains rate) around both earnings announcements and additions to the S&P 500 index. They argue that these findings are consistent with the hypotheses that investors defer sales of appreciated stocks until they qualify for long-term capital gains tax treatment, and that withdrawal of appreciated securities constrains the supply of equity, thereby temporarily boosting equity prices. Ivkovich et al. (2004) compare individual investor realizations in taxable and tax-deferred accounts and find a strong lock-in effect for capital gains in taxable accounts relative to tax-deferred accounts. They also find tax-loss selling is most pronounced in December, particularly

[5] Warther (1995), Zheng (1999), and Bakshi and Chen (1994), among others, use an imperfectly elastic demand curve for stocks to explain large-scale price movements across broad asset classes. Stulz and Wasserfallen (1995) and Andrade, Chang, and Seasholes (2004) use the same mechanism to study foreign equity investments.

[6] An extensive and active literature documents how investors behave under taxes and the potential implications for asset prices. Representative work includes that of Ayers, Lefanowicz, and Robinson (2003), Barber and Odean (2004), Bergstresser and Poterba (2002), Callaghan and Barry (2003), Gibson, Safieddine, and Titman (2000), Graham, Michaely, and Roberts (2003), Green and Hollifield (2003), Grinblatt and Keloharju (2004), Grinblatt and Moskowitz (2004), Kaplan (1981), Klein (2001), Perez-Gonzalez (2003), Poterba (2001), Poterba and Weisbenner (2001), Reese (1998), and Sias and Starks (1997), among others. Graham (2003) and Scholes and Wolfson (1992) summarize the impact of taxes on a large body of economic activities.

if there is an opportunity to combine it with capital gains realized during the year.

The findings in this paper are consistent with these earlier results. Specifically, the paper relates a number of significant insights, addressing in particular the relation between capital gains tax-related selling incentives and returns. The paper first establishes a direct link between investor tax-related trading behavior and asset prices. Whereas Blouin et al. (2003) conjecture that investor response to capital gains tax changes drives returns and volume during earnings surprises, and Ivkovich et al. (2004) study the trading patterns of taxable individual investors, this is the first paper that simultaneously addresses both findings and provides concrete evidence that the trading patterns of taxable investors do indeed have asset pricing implications. Second, extending the results of Blouin et al. (2003), my results suggest that the capital gains tax can affect trading even beyond the consideration of the short-term and long-term capital gains tax rate difference: As explained below, in 5 out of 11 years, the sample difference between short-term and long-term capital gains tax rates is either 0% or 3%. Third, I show that not only individual investors, but also financial institutions, can exhibit tax-sensitive trading patterns. It is often argued that institutions are pivotal investors to set prices, therefore their behavior will likely have a greater impact on prices.

II. Data, Measures, and Empirical Methodologies

A. Data Sources

I obtain the data used in this study from the Spectrum 13F institutional investor holdings database. Institutional investment managers who exercise investment discretion of $100 million or more in Section 13F securities must report to the Securities and Exchange Commission (SEC) on Form 13F holdings of more than 10,000 shares or holdings valued in excess of $200,000. Data are available from 1980 to 2002, but a number of institutions are improperly classified in 1998 and beyond.[7]

Spectrum reports five types of institutional investors: bank trust departments, whose clients can be either taxable or tax-exempt; insurance companies, which are taxable overall but could have tax-exempt accounts for clients; investment companies (open-end or closed-end mutual funds), whose clients can be either taxable or tax-exempt; independent investment advisors, whose clients can be either tax-sensitive or tax-insensitive; and "others" such as foundations, Employee Stock Ownership Plans, university endowments, and internally managed private and public pension funds, many of which are tax-exempt.

Institutional holdings data are supplemented with Investment Adviser Public Disclosure (IAPD) data obtained from the SEC. IAPD data contain investment advisors' self-reported client bases broken down into 10 categories: individuals (other than high net worth individuals); high net worth individuals;

[7] Gompers and Metrick (2001) provide a detailed explanation of the 13F data.

banking or thrift institutions; investment companies (including mutual funds); pension and profit sharing plans (other than plan participants); other pooled investment vehicles (mostly hedge funds); charitable organizations; corporations or other businesses not listed above; state or municipal government entities; and "others" such as non-U.S. government entities. Investment advisors must report the percentage of business represented by each client category.

I limit the data to a period extending from the first quarter of 1987 through the first quarter of 1997. There are several reasons to focus on this time period besides the aforementioned data problems in 1998 and beyond. First, because this interval lies between two major tax law changes (in 1986 and 1997), the tax regime is relatively constant: While the statutory short-term capital gains tax rates did fluctuate, the long-term capital gains tax rate remained unchanged at 28% from January 1, 1987 to May 6, 1997.[8] Second, a capital gains measure constructed during this period is likely to be more robust to assumptions about initial holding positions. As detailed below, to the extent that institutional holdings information prior to 1980 is lacking, assumptions need to be made with respect to initial stock holdings in constructing the subsequent capital gains measure. The capital gains measures over 1987 to 1997 are more robust to our assumptions than the measures for the earlier years, 1980 to 1986. Third, during 1987 to 1997, capital gains were considerable and thus economically relevant: The value-weighted U.S. market index rose by about 300% during this period.

B. Identifying Tax-Sensitive versus Tax-Insensitive Institutional Investors

There are several reasons to study institutional rather than individual investors. First, data are more available for the former. Second, retail investors might be more subject to the disposition effect documented by researchers such as Barber and Odean (2000), who show that individual investors of a brokerage firm hold on to losers too long and sell winners too soon, even if doing so violates efficient tax planning. Professional money managers, on the other hand, being more sophisticated and likely more disciplined, might be less subject to such behavioral biases. Moreover, the capital gains tax is a relatively more important component of transaction costs for institutions since many are able to negotiate better bid–ask spreads and broker commissions. Fourth, because institutions hold large amounts of stock their impact on stock price and liquidity will likely be much greater if they act in a coordinated way.

Institutions, however, can serve both tax-sensitive and tax-insensitive clients, and even institutions that serve primarily tax-sensitive clients might not exhibit tax-sensitive selling behavior if there exists an agency problem and managers are not rewarded for being tax savvy. For an institution to be tax-sensitive we need either (1) the existence of tax-sensitive investors capable of

[8] The statutory short-term capital gains tax rate for individuals was 38.5% in 1987, decreased to 28% from 1988 to 1990, and climbed to 31% during 1991 and 1992, before settling at 39.6% thereafter.

exerting pressure on managers, or (2) managers who for personal reasons care about the tax consequences of the portfolios they manage. Among institutional investors that, a priori, might be expected to react to taxes are investment managers for high net worth individuals and hedge funds. The interests of the former are served by their relatively small number, which facilitates communication and collaboration and, ultimately, the monitoring and collective discipline of fund managers. In the case of managers of hedge funds, for incentive reasons, they are typically required to invest a significant portion of their personal wealth in the funds they manage and thus are likely to care about tax consequences for personal reasons. Managers' personal tax considerations often play a significant role in the trading activities of such institutions. Insurance companies (of the type identified in the Spectrum 13F database) also tend to exhibit tax-savvyness.[9]

Of the five types of institutions identified by Spectrum, banks and mutual funds are excluded from this study as no concrete information about their taxable investor bases can be obtained.[10] Insurance companies are universally treated as tax-sensitive.[11] The profiling information from IAPD is used to distinguish independent investment advisors who serve primarily tax-sensitive clients from those who serve primarily tax-insensitive clients. I classify as tax-sensitive those independent investment advisors whose clientele consists primarily ($\geq$50%) of high net worth individuals and hedge funds. I also include investment advisors who do not file the IAPD forms but are identified in the hedge funds section of the Money Manager Directory. As reported by Brunnermeier and Nagel (2004), only institutions that conduct nonhedge fund businesses such as advising mutual funds and pension plans are expected to file for the IAPD disclosure. That they are classified as hedge funds in the Money Manager Directory and not listed on the IAPD form indicates that the majority of their business is in hedge funds. Investment advisors are classified as

[9] Many of the industry experts we talked to indicated that taxes are an important consideration for some institutions. For example, Morgan White, managing director of Woodside Asset Management, Inc., which manages money for high net worth individuals and families, stated in an e-mail correspondence dated November 11, 2003: "Indeed, we do pay close attention to taxes when making selling decisions." He went on to explain that they strictly follow "Highest-In, First-Out" selling of multiple lots to minimize tax liability, postpone realization of gains, and expedite realization of losses to offset gains realized in the same year.

[10] Another important consideration is that banks (mutual fund families) typically have many separate accounts (funds) under one roof. To the extent that these accounts/funds don't have the same level of tax-savvyness and that 13F reports only aggregate holdings data, documenting the existence of tax-sensitive trading using aggregate data might be expected to be more difficult. The multiple account problems might still exist in other types of institutions, but would be less severe.

[11] There are some caveats. Life insurance and property insurance companies have different tax treatments and could have different reactions to a capital gains tax overhang. Moreover, insurance companies invest in their own accounts large amounts of money on which they pay taxes, but they also invest on behalf of their clients through potentially tax-advantaged accounts. The 13F data does not allow us to differentiate on these characters. To the extent that this could generate noise, I run the tests reported in this paper excluding insurance companies. The results are not affected qualitatively.

tax-insensitive institutions if pension funds, state and local governments, and charitable organizations account for more than 50% of their clientele. This classification of tax-sensitive and tax-insensitive institutions is fairly conservative: Inasmuch as only 5 out of 10 types of clients are clearly identified as either taxable or nontaxable; there are many investment advisors who fall into neither category. For institutions categorized in 13F data as "other," I conduct word searches for "pension," "endowment," "foundation," and variations thereof, and identify as tax-insensitive any for which these words come up in their names.

C. Measuring Capital Gains

Institutions are not required to report accumulated capital gains for each stock held. However, with the time series of holdings data and reasonable assumptions, I estimate in the following manner the capital gains on each of the stocks in the portfolios of the institutions in the sample:

1. I assume that securities held at the beginning of the data series, Quarter One of 1980, were purchased during that quarter. Admittedly, this might be an imprecise measure of the purchase price of stocks held during the first quarter, as the data tell us only that the securities existed in Quarter One of 1980. Indeed, they could have been purchased much earlier and at a potentially lower price. As a robustness check I also calculate capital gains assuming that the first quarter's securities holdings were (1) purchased 5 years earlier, or (2) purchased at one-half the 1980 Quarter One stock prices. Neither modification changes the results qualitatively. This is expected particularly since I focus the empirical study subsequently to 1987, so holdings of the first quarter of 1980 exert only a minor impact.
2. Because the date of purchase is not known I can only approximate the purchase price level in calculating capital gains for stocks purchased during a quarter. For robustness, I calculate the tax basis using three measures of the quarterly stock prices:
   - end-of-quarter closing price;
   - average price for beginning- and end-of-quarter;
   - turnover-weighted average daily closing price during the quarter. The resulting measures of capital gains are quite similar and our empirical results do not depend on how price is measured. For expositional purposes the results reported in the paper use the capital gains measure calculated with the turnover-weighted average price.
3. To make prices and numbers of shares held compatible across time, I make adjustments according to the Center for Research in Security Prices (CRSP) factors for adjusting share prices and numbers of shares.
4. I calculate the number of shares purchased during a quarter as the end-of-quarter shares held minus the beginning-of-quarter shares held, adjusted for stock splits.
5. Calculating the cumulative tax basis, and thus the capital gain on a stock at any given time, is straightforward if an institution has never sold any shares of the stock prior to the time in consideration. Once an institution

has sold shares of the stock, to obtain a measure of the capital gains of the remaining stock it becomes necessary to determine which lot of the shares, purchased at different times and at different prices, would have been sold first. I accomplish this in two ways.

First, an institution can sell existing shares proportionally, which is to say that all shares, regardless of purchase date and tax basis, are equally likely to be sold. Second, tax-savvy institutions can optimize their selling to reduce taxes. Under current U.S. tax law, institutions can designate the lot of stocks to be sold. So, for example, unless doing so would trigger a different tax rate (such as short-term capital gains vs. long-term capital gains), an institution could sell shares purchased at the highest price first so as to maximize capital losses or minimize capital gains.[12] I therefore construct an alternative measure of the tax basis by assuming that the institution sells stocks acquired at the highest price first, as long as doing so does not trigger a higher tax rate. The empirical results do not differ qualitatively between the two methods. For brevity the results that appear in the paper use the "optimized tax selling" strategy.[13]

Institutions seldom hold just one stock. At any given time some of their holdings might observe capital gains and others capital losses. A tax-sensitive institution might want to combine the selling of the two types of securities to exploit the tax shield afforded by the losses. Because current tax code permits capital losses to be carried over for only a limited number of years, institutions are motivated to offset their capital losses as soon as they are incurred with capital gains sales.[14] This has two implications. First, capital gains might be realized promptly to offset an existing or anticipated capital loss. Second, in the absence of an existing or anticipated capital loss, institutions might postpone selling a stock with capital gains until they can find an opportunity to combine its sale with that of a stock that has incurred capital losses.

Given the inclination of tax-sensitive institutions to combine capital losses with capital gains, the measure of capital gains for a stock used in the tests is the amount that cannot be offset by the current level of accrued capital losses from other securities held in the institution's portfolio. More precisely, I measure "uncovered" capital gains and "covered" capital losses. If a tax-sensitive investor combines capital gains with capital losses, only the uncovered portion of the gains (namely, the gains in the stock that cannot be offset by losses, if any, on other stocks in the portfolio) might constitute an impediment to selling. An institution, on the other hand, will want to quickly realize the capital

[12] Dickson, Shoven, and Sialm (2000) offer a rigorous discussion of the benefit of using a Highest-In First-Out allocation rule when selling stocks.

[13] In cases in which optimal selling does trigger the short-term capital gains tax, I make adjustments case-by-case to minimize current taxes. I calculate the tax liability from selling different lots and choose the one that minimizes the tax or maximizes the tax credit.

[14] If an institution's losses exceed its gains no deduction is permitted currently. Instead, the net realized loss is carried back and deducted against the net capital gain for the previous 3 years. Any remaining loss offsets the net capital gain in the subsequent 5 years, after which it expires unutilized. See Rendleman and Shackelford (2003).

losses given opportunities to use the tax credit to offset taxes on other realized capital gains. This institution has an incentive to quickly realize capital losses that are covered (namely, can be realized right away to offset the current-period realization of capital gains from other holdings in the institution's portfolio). A capital loss will be uncovered (i.e., not usable) only if (1) capital gains in the portfolio to date are insufficient to offset it, and (2) the institution perceives the likelihood of utilizing the capital loss tax credit in the next few years to be slim. An institution will hesitate to realize such uncovered capital losses for fear of wasting them. This was a rare occurrence during the 1987 to 1997 period: With rapidly rising stock prices, institutions almost always had sufficient capital gains to offset their capital losses. For brevity I report only results using uncovered capital gains (i.e., I subtract from the dollar amount of the capital gains on a stock any accrued capital losses from other holdings in the portfolio) and unadjusted capital losses (i.e., I assume all capital losses are usable right away). The raw measures unadjusted for portfolio holdings yield qualitatively similar results.[15,16]

Short-term capital gains are often taxed at a higher rate than long-term capital gains. To see whether short-term capital gains discourage selling disproportionally more, I also conduct tests allowing the short-term and long-term capital gains to have different impacts on selling. These differences in impacts are not statistically significant.

After calculating the tax basis using the procedure described above, the capital gains measure I use in the regressions is Capital gains = ln (current stock price/value-weighted tax basis).

For each institution that I identify as either tax-sensitive or tax-insensitive, I collect data on all stock holdings reported in the 13F database and construct capital gains measures accordingly. The observations are unique quarter-institution-stock combinations for the period 1987 through 1997.

Summary statistics for the sample included in this study are provided in Table I. Among the observations reported in the table, there are altogether 88,526 quarterly observations for the tax-sensitive institutions. The mean capital gains measure is 2.84%, with a median of 1.29%. Also evident is the considerable cross-sectional variation in the measure of capital gains for both types of institutions.

[15] There is evidence that the capital loss tax credit might not be very important in practice. As observed by Blouin et al. (2003), the Internal Revenue Service reported that in 1997 individuals in the maximum tax bracket (39.6%), who accounted for 61% of all net capital gains, reported $169 billion of long-term capital gains, and only $5 billion of long-term capital losses, and $16 billion of short-term capital gains, and only $8 billion of short-term capital losses. As a robustness check, I define the capital gains without adjusting for the aggregate capital losses from other securities holdings. The empirical results are qualitatively similar, although some of the coefficients are not as significant. All coefficients are nevertheless statistically significant at the 5% level.

[16] As a robustness check, I also test the regression specifications allowing for the covered and uncovered capital gains to have different impacts on selling. Such a distinction turns out to not matter empirically: While the uncovered capital gain has a larger coefficient than the covered capital gain, the difference is statistically insignificant.

Table I
Summary Statistics of Capital Gains and Selling Patterns by Tax-Sensitivity of Institutions

Tax-sensitive institutions are high net worth individual managers, hedge funds, and insurance companies. Tax-insensitive institutions are managers for charitable organizations, pensions and endowments, and state and local governments. A capital gain is defined as the log of the ratio of the current price and the average acquiring price on a stock, $\log(P_1/P_0)$. The variable "percentage selling" measures the probability that an institution holding a stock might sell that stock during a quarter, and the summary statistics are first obtained over all institutions selling a stock during a quarter, then averaged across all stocks and quarters. The variable "percentage sold when selling" measures the average percentage selling of stocks by the selling institutions, when the institution does sell the stock. To be consistent with the setup of the regression run later, the mean, median, and standard deviation are first taken across all institutions and stocks during a quarter. The resulting mean, median, and standard deviation are then averaged over all quarters to generate the summary statistics.

	All Tax-Sensitive	All Tax-Insensitive
Number of observations	88,526	64,382
Capital gain		
Mean	0.0284	0.0004
Median	0.0129	0.0025
Standard deviation	0.2911	0.1641
Percentage selling		
Mean	0.2963	0.3393
Median	0.2640	0.2860
Standard deviation	0.3118	0.3264
Percentage sold when selling		
Mean	0.4872	0.5216
Median	0.4857	0.5144
Standard deviation	0.4621	0.3982
Value-weighted portfolio return		
Mean	0.0133	0.0132
Median	0.0134	0.0115
Standard deviation	0.0362	0.0331
Log (dollar institution equity holding)		
Mean	20.7918	21.5133
Median	19.6925	21.8307
Standard deviation	1.3279	1.7395
Return of individual stocks		
Mean	0.0109	0.0081
Median	0.0123	0.0068
Standard deviation	0.2079	0.1809
Portfolio inflow during a quarter		
Mean	0.0185	0.0114
Median	0.0030	0.0025
Standard deviation	0.2196	0.1446

D. Testing Unconditional Differences in Holding Patterns

Bennett, Sias, and Starks (2003), among others, document that institutions' security holdings and trading preferences vary, and might be shifting over time toward smaller and riskier securities. As a consequence, when I analyze how

Table II
Characteristics of Holding and Trading Patterns for Tax-Sensitive and Tax-Insensitive Investors

This table reports the holding and trading characteristics of tax-sensitive and tax-insensitive investors. For each stock during each quarter, I characterize it as a value or growth stock and a large or small stock using the Book equity to Market equity (BE/ME) breakpoints and ME breakpoints reported by Fama and French, downloaded from Ken French's website. I then calculate the value-weighted percentage of an institution's portfolio invested in each of the size/book-to-market categories. I then average over all institutions within the tax-sensitive and tax-insensitive categories. Similarly, I calculate the quarterly portfolio turnover (defined as the absolute dollar value of the transaction divided by the beginning-of-quarter total dollar holding), and percentage dividend yield of each institution's portfolio, and then average across all institutions along tax sensitivity. Significance at the 1% level is indicated by **, and significance at the 5% level is indicated by *.

Type of Institution	Number of Stocks in Portfolio	BM $> 70^{th}$ Percentile	BM $< 30^{th}$ Percentile	ME $> 50^{th}$ Percentile	Percentage Dividend Yield	Quarterly Portfolio Turnover
[1] Tax-sensitive	100.56	0.08	0.66	0.81	2.29	0.23
[2] Tax-insensitive	162.25	0.07	0.64	0.90	2.66	0.20
[3] Difference ([1] − [2])	61.69**	−0.00**	−0.02**	0.09**	0.37**	−0.03*

taxes differentially affect the trading patterns of stocks, I verify that I am not inadvertently picking up variations in preferences across institutions and over time.

The dynamic pattern of institutional preferences is addressed by my test design: I use the Fama–MacBeth method, which is inherently a cross-sectional regression, so that I do not compare the trading patterns across different time periods. However, I need to ensure that any documented trading patterns that emerge, conditional on a tax burden, are not merely driven by the unconditional cross-sectional differences in institutional preferences. I do this by categorizing the holding and trading characteristics of the two groups of investors in Table II. I report for the two groups the average number and characteristics of the stocks held (value vs. growth, small vs. large, and percentage dividend yields). I also report for these two groups of investors the quarterly portfolio turnover, defined as the ratio of quarterly trading (sum of the absolute value of the dollar amounts) to the overall holding in a quarter.

Unconditionally, the tax-insensitive institutions tend to hold more stocks, likely reflecting the fact that the average tax-insensitive institution is larger than the average tax-sensitive institution. However, the size and value characteristics of the holdings are quite similar among the tax-sensitive and tax-insensitive institutions. In particular, both tax-sensitive and tax-insensitive institutions focus on large stocks (with 81% and 90% of portfolio holdings being large stocks, respectively) and growth stocks (66% and 64% of portfolio holdings, respectively). The stocks held by tax-sensitive institutions have lower dividend yields, on average, than those held by tax-insensitive institutions: As can be seen from Table II, the average dividend yield of stocks held by tax-sensitive institutions is 2.29%, while that of stocks held by tax-insensitive institutions

is 2.66%. This difference is statistically significant at the 1% level, thus I explicitly control for dividend yield in the regression analysis. Institutions might also have different investment styles, with some tending to be contrarian investors while others buy and sell on momentum. The tests in this paper thus also directly control for past returns for the stocks under study.

Interestingly, the unconditional quarterly portfolio turnover characteristics of the two groups of institutions differ slightly, with tax-sensitive institutions turning over their portfolios somewhat more rapidly than tax-insensitive institutions. Although this might seem counterintuitive given the tax-related selling hypothesis, the higher unconditional turnover for tax-sensitive investors such as hedge funds could be consistent with the fact that many are more active traders of stocks generally than tax-insensitive investors such as pension funds. The result is significant only at the 5% level, due to the fact that both groups exhibit large variation in the turnover measures. The more rapid turnover on the part of tax-sensitive institutions implies that any causal relationship that emerges in which higher capital gains reduce selling cannot be attributed to inherent differences between tax-sensitive and tax-insensitive institutions. Moreover, I document in Tables III–VI that, conditional on a large capital gains tax overhang, tax-sensitive institutions trade less frequently. Because the unconditional results go against the conditional results it is hard to attribute the tax-related trading patterns documented below to any unconditional patterns between the two groups of investors.

III. Differential Reactions of Tax-Sensitive and Tax-Insensitive Investors to a Selling Event

One of the main objectives of this paper is to assess whether tax-sensitive and tax-insensitive investors react differently to a selling event. I evaluate first whether the likelihood that a particular institution will sell is related to the cumulative capital gains accrued by the institution. Second, if the institution in question does sell in a particular quarter, I examine whether the magnitude of selling is related to the selling institution's capital gains.

I analyze the likelihood of selling as a function of cumulative capital gains by running two probit regressions, one for tax-sensitive and one for tax-insensitive institutions. These regressions estimate the likelihood of selling a stock. The dependent variable takes the value of 1 if the institution sells the stock during the quarter in question and 0 otherwise. The independent variable is the capital gain or loss that the institution has accrued on that stock at the beginning of the quarter. I include the following control variables: The institution's past performance, as measured by the value-weighted return on its portfolio during the last period, which might affect selling because winning and losing institutions' willingness to sell might differ; the size of the portfolio, as measured by the log of the institution's total dollar holdings of equity at the beginning of the period, which might affect the speed of adjustment—if larger portfolios are harder to turn over selling might be slower; the institution's percentage of net money inflow during the quarter, as measured by the total dollar value of the position changes divided by the institution's total dollar holdings, because money

inflow might mitigate the need for an institution to liquidate one position to finance the purchase of another; the return of the stock during the previous quarter, because higher past returns might affect selling if the institutions analyzed systematically pursue momentum or contrarian trading strategies; and dividend yield, which might affect differentially the willingness of tax-sensitive and tax-insensitive institutions to hold and sell the stock, and which might also affect the accumulated capital gains as stocks with lower dividends mechanically have higher accumulated capital gains, ceteris paribus (ignoring dividend yield could thus potentially lead to an omitted variable bias).[17]

The regression takes the form

$$\text{Probability of selling} = a + b * \text{capital gain} + c * \text{controls}. \quad (1)$$

The unit of observation is a unique {institution, stock, quarter} combination.

Two types of probit regressions are run, one using the Newey–West (1987) adjustment for serial correlation up to eight quarters, the other controlling for random effects. The results of these tests, reported in Table III, are consistent with each other. As can be seen in the table, for a tax-sensitive institution, the likelihood of selling by a specific institution is negatively related to its cumulative capital gains on the stock. Higher capital gains diminish, and higher capital losses increase, the likelihood that an institution will sell. For example, in Column 1 of Table III the coefficient for the capital gains measure is -0.299. Other factors of significance are the intercept, the portfolio return from the last period (coefficient estimate of 0.290), and the portfolio inflow during the quarter (coefficient estimate of -2.345). These results suggest that if the other significant factors are at the median levels reported in Table I (0.0134 for the portfolio return from last period and 0.0030 for the portfolio inflow during the quarter), the probability of selling at zero capital gains would be $\Phi(0.290 \times 0.0135 - 2.345 \times 0.0030) = 32.4\%$, whereas a unit increase in the capital gains measure would reduce the selling probability to $\Phi(-0.299 \times 1 + 0.290 \times 0.0135 - 2.345 \times 0.0030) = 22.5\%$, a 9.9% reduction. On the other hand, no statistically reliable result holds for the control sample of a priori tax-insensitive institutions: Neither higher nor lower capital gains seem to influence the likelihood that these institutions will sell. Other regressions yield similar results.

To determine whether tax-sensitive and tax-insensitive institutions behave differently I run a probit regression with an interaction term on the tax sensitivity of the institution (which takes a value of 1 if the institution is tax-sensitive, 0 otherwise) and cumulative capital gains:

$$\text{Prob. of selling} = a + b * [\text{capital gains} * \text{Dummy}_{\text{tax-sensitive}}] + c * \text{capital gains} + d * \text{control}. \quad (2)$$

[17] I directly include in all reported regressions the raw measures of the control variables. As a robustness check I run the tests using "standardized" control variables, all of which have the same mean (0) and standard deviation (1). Following the discussion in Bennett et al. (2003), such standardization should better handle potential differences in preferences between types of institutions. The robustness check yields qualitatively similar results.

Table III
Probit Regression of Selling on Capital Gains

The dependent variable is an index variable, which takes the value of 1 if an institution is selling a stock, and 0 otherwise. The independent variables are the cumulative capital gains measured by the log of the price ratio ($\log(P_1/P_0)$), the value-weighted portfolio return of an institution in the last period, the log of the total dollar holdings of the equity of the institution, the percentage inflow for the institution during the current quarter, the return on the stock during the past quarter, and dividend yield. Two regressions are run, namely, a probit regression with a Newey–West adjustment for serial correlation up to eight lags, and a probit model controlling for random effects at both the institution level and the stock level. Tax-sensitive institutions are high net worth individual managers, hedge funds, and insurance companies. Tax-insensitive institutions are managers for charitable organizations, pensions and endowments, and state and local governments. The robust standard deviations are reported under each coefficient. ** denotes significance at the 1% level.

	Probit with Newey–West Adjustment		Random Effect Probit Model	
	[1] Tax-Sensitive Institutions	[2] Tax-Insensitive Institutions	[3] Tax-Sensitive Institutions	[4] Tax-Insensitive Institutions
Intercept	−0.453**	1.452**	−0.237**	1.725**
	0.051	0.157	0.019	0.138
Capital gain	−0.299**	0.072	−0.351**	0.070
	0.023	0.062	0.027	0.061
Portfolio return from last period	0.290**	0.448**	0.245**	0.538**
	0.078	0.109	0.086	0.125
Log (total dollar holding of portfolio)	−0.005	−0.101**	−0.011**	−0.116**
	0.004	0.004	0.005	0.006
Percentage inflow during this quarter	−2.545**	−2.018**	−1.669**	−2.482**
	0.124	0.184	0.069	0.077
Return on stock during last period	0.039	−0.035	0.041	−0.030
	0.032	0.036	0.035	0.040
Percentage dividend yield	−0.002	−0.003**	−0.002	−0.003**
	0.003	0.001	0.003	0.001
Number of observations	88,526	64,382	88,526	64,382

As before, two types of regressions are run, the model with the Newey–West (1987) adjustment with eight lags, and the model with random effects. Three regressions are run and reported for each method. The first does not control separately for the capital gains term, while the second does; the third allows for different coefficient estimates for all other control variables by including interaction terms of the tax-sensitiveness dummy and control variables. The results are reported in Table IV.

In all regression specifications the interaction term "capital gains*tax-sensitive dummy" is statistically significant at the 1% level. Higher capital gains interacted with the tax-sensitive investor dummy will reduce the likelihood of selling. For example, in Column 1 of Table IV the coefficient for the interaction term between capital gains and the tax-sensitivity measure is −0.246. Other factors of significance are the intercept (coefficient estimate of 0.764), the portfolio return from the last period (coefficient estimate of 0.337), the log of the

Table IV
Probit Regression of Selling on Capital Gains

The dependent variable takes the value of 1 if an institution is selling a stock, and 0 otherwise. The independent variables are the cumulative capital gains measured by the log of the price ratio, the value-weighted portfolio return of an institution in the last period, the log of the total dollar holding of its equity portfolio, the percentage inflow for the institution during the current quarter, the return on the stock during the past quarter, the dividend yield, and the interaction terms with the tax dummy which takes the value of 1 if the institution is classified as tax-sensitive, and 0 otherwise. Two regressions are run: a probit regression with a Newey–West adjustment for serial correlation up to eight lags, and a probit model controlling for random effects at both the institution level and the stock level. Tax-sensitive institutions are high net worth individual managers, hedge funds, and insurance companies. Tax-insensitive institutions are managers for charitable organizations, pensions and endowments, and state and local governments. The robust standard deviations are under each coefficient. ** denotes significance at the 1% level.

	Probit with Newey–West Adjustment			Random Effect Probit Model		
	[1]	[2]	[3]	[4]	[5]	[6]
Intercept	0.7648**	0.728**	0.557**	0.984**	0.937**	0.893**
	0.064	0.058	0.060	0.129	0.096	0.073
Capital gain		0.031	0.079		0.041	0.074
		0.037	0.040		0.043	0.052
Tax-sensitivity ∗ capital gain	−0.246**	−0.271**	−0.375**	−0.355**	−0.410**	−0.507**
	0.021	0.042	0.047	0.027	0.054	0.054
Portfolio return from last period	0.337**	0.348**	0.477**	0.398**	0.391	0.520**
	0.066	0.064	0.103	0.075	0.073	0.117
Tax-sensitivity ∗ portfolio return from last period			−0.285			−0.223
			0.169			0.141
Log(total dollar holding of portfolio)	−0.061**	−0.058**	−0.046**	−0.077**	−0.069**	−0.057**
	0.003	0.002	0.003	0.003	0.003	0.004
Tax−sensitivity ∗ log(total dollar holding of portfolio)			0.008**			0.008**
			0.001			0.001
Percentage inflow during this quarter	−1.688**	−1.676**	−2.087**	−2.055**	−1.947**	−2.338**
	0.127	0.124	0.192	0.050	0.049	0.079
Tax−sensitivity ∗ percentage inflow during this quarter			0.355			0.369**
			0.228			0.106
Return on stock during last period	0.001	−0.001	−0.031	0.004	0.001	−0.031
	0.023	0.022	0.037	0.027	0.026	0.040
Tax-sensitivity ∗ return on stock during last period			0.064			0.065
			0.049			0.058
Percentage dividend yield	−0.002**	−0.003**	−0.003**	−0.002**	−0.002**	−0.003**
	0.001	0.001	0.001	0.001	0.001	0.001
Tax-sensitivity ∗ percentage dividend yield			0.001			0.002
			0.003			0.003
Number of observations	152,908	152,908	152,908	152,908	152,908	152,908

total dollar holding of the portfolio (coefficient estimate of −0.061), the portfolio inflow during the quarter (coefficient estimate of −1.688), and the percentage dividend yield (coefficient estimate of −0.002). These results suggest that if the other significant factors are at the median levels reported (0.0134 for the

portfolio return from last period, 19.69 for the portfolio dollar holding, 0.0030 for the portfolio inflow during the quarter as reported in Table I, and 2.29 for the dividend yield as reported in Table II), the probability of selling at zero capital gains would be $\Phi(0.337 \times 0.0134 - 0.061 \times 19.69 - 1.688 \times 0.0030 - 0.002 \times 2.29 + 0.764) = 32.6\%$, whereas a unit increase in the capital gains measure would reduce the selling probability to $\Phi(0.337 \times 0.0134 - 0.246 - 0.061 \times 19.69 - 1.688 \times 0.0030 - 0.002 \times 2.29 + 0.764) = 24.3\%$, a 8.3% reduction. Controlling for capital gains separately reveals that changes in the selling likelihood do indeed come from the interaction term, suggesting that capital gains have different impacts on the likelihood of tax-sensitive and tax-insensitive investors selling. Permitting different coefficient estimates for all other controls makes the result slightly stronger. Overall, the results are significant and robust to the various regression specifications and econometric methodologies employed here.

Next, conditional on an institution selling a stock in a given quarter, I study whether the magnitude of selling is related to the amount of capital gains (losses). To ascertain whether the percentage of holdings traded is related to cumulative capital gains I run the following regression:

$$\text{Percentage traded} = a + b * \text{capital gains} * \text{Dummy}_{\text{selling}} + c * \text{control variables}. \quad (3)$$

Specifically, given that the capital gains tax should affect only selling, for each institution and each stock I measure the current quarter's percentage trading (positive for selling and negative for buying) and regress it on the beginning-of-period cumulative capital gains interacted with a selling dummy, while allowing all other control variables to affect buying and selling decisions symmetrically. The control variables are the same as those in Table III.

To be consistent with a large body of literature in finance I use the Fama–MacBeth (1973) methodology to compute robust standard errors on the coefficient estimates. Specifically, I first run cross-sectional regressions for each year separately, controlling for fixed effects at the institution and stock levels, and report the time-series averages of the coefficient estimates using the time-series standard errors of the average slopes to draw inferences. The Fama–MacBeth methodology is a convenient and conservative way to account for potential cross-correlation in residuals. As reported by Fama and French (2002), the Fama–MacBeth standard errors are often two to five times the ordinary least squares (OLS) standard errors from pooled panel data regressions that ignore residual cross-correlations. Because the Fama–MacBeth procedure does not take into account residual autocorrelations, I further correct for potential residual autocorrelation by following the procedure in Pontiff (1996) and adjusting the time-series standard deviations to allow for autocorrelations in the coefficient estimates.

The regression results, reported in Table V, confirm that for a priori tax-sensitive institutions, capital gains do indeed affect the amounts sold. This result is statistically as well as economically significant. For tax-sensitive

Table V

Regression of Percentage Trading on Capital Gains

The dependent variable is the percentage selling of a stock by an institution, in the event of selling. Tax-sensitive institutions are high net worth individual managers, hedge funds, and insurance companies. Tax-insensitive institutions are managers for charitable organizations, pensions and endowments, and state and local governments. The independent variables are the cumulative capital gains measured by the log of the price ratio, the value-weighted portfolio return of an institution during the last quarter, the log of the total dollar holdings of the equity of the institution, the return on the stock during the previous quarter, the percentage of money inflow for an institution during the current quarter, and the dividend yield. The regression is run each quarter, controlling for fixed effects both at the institution level and at the stock level, and then the time-series mean and standard deviation are used to make inferences. The *t*-statistics, reported under each coefficient, are further adjusted for potential time-series correlation. ** denotes significance at 1% level.

	[1] Tax-Sensitive Institutions	[2] Tax-Insensitive Institutions
Capital gain * selling dummy	−0.19**	−0.04
	−8.12	−1.08
Portfolio return from last period	0.03	0.05
	0.24	0.30
Log(total dollar holding of portfolio)	−0.01**	−0.03**
	−2.99	−4.80
Return on stock during last period	−0.03	−0.06**
	−1.72	−2.65
Percentage inflow during this quarter	0.01	0.06
	1.08	0.31
Dividend yield	−0.01	−0.02**
	−1.17	−7.08
Number of observations	88,526	64,382

institutions, a capital gains measure of one (corresponding to a 171.8% price appreciation) decreases the amount sold by about 19%, as reported in Column 1. Such a pattern is largely nonexistent in the a priori tax-insensitive sample.

To test whether the magnitude of selling due to a capital gains overhang differs for tax-sensitive and tax-insensitive institutions, I regress current-period percentage trading on the beginning-of-period cumulative capital gains interacted with a selling dummy, and the interaction term between capital gains, a selling dummy, and the tax status, controlling for other factors that might affect selling. The regression takes the form:

$$\begin{aligned}\text{Percentage trading} &= a + b * [\text{capital gains} * \text{Dummy}_{\text{tax-sensitive}} * \text{Dummy}_{\text{selling}}] \\ &\quad + c * \text{capital gains} * \text{Dummy}_{\text{selling}} + d * \text{control variables}. \qquad (4)\end{aligned}$$

Three regressions are run, with results reported in Table VI. As in the earlier set of tests, the first does not control separately for capital gains, the second

Table VI
Regression of Trading on Capital Gains

The dependent variable is the percentage selling of a stock by an institution, in the event of selling. The tax-sensitive institutions and tax-insensitive institutions are defined as in Table I. The independent variables are the cumulative capital gain measured by the log of the price ratio, the value-weighted portfolio return by an institution in the last period, the log of the total dollar holdings of the institution, the return on the stock during the previous quarter, the percentage of money inflow for an institution during the current quarter, the dividend yield, and the interaction term between capital gain and the tax-sensitivity dummy, which takes the value of 1 (0) if an institution is classified as tax-sensitive (tax-insensitive). The regression is run each quarter, controlling for fixed effects at both the institution level and the stock level, and then the time-series mean and standard deviation are used to make inferences. The *t*-statistics, reported under each coefficient, are further adjusted for potential time-series correlation. ** denotes significance at the 1% level.

	[1]	[2]	[3]
Capital gain * selling dummy		−0.04	−0.04
		−1.11	−1.08
Tax-sensitivity * capital gain * selling dummy	−0.19**	−0.15**	−0.15**
	−8.53	−3.30	−3.00
Portfolio return from last period	0.21	0.22	0.18
	1.52	1.21	0.69
Tax-sensitivity * portfolio return from last period			0.19
			0.89
Log (total dollar holding of portfolio)	−0.02**	−0.02**	−0.02**
	−4.53	−4.16	−4.84
Tax-sensitivity * log(total dollar holding of portfolio)			0.00**
			3.34
Return on stock during last period	−0.08**	−0.07**	−0.08**
	−3.19	−2.87	−2.71
Tax-sensitivity * return on stock during last period			0.04
			1.56
Percentage inflow during this quarter	0.01	0.01	0.02
	0.81	1.03	0.59
Tax-sensitivity * percentage inflow during this quarter			−0.02
			−1.07
Dividend yield	−0.02**	−0.02**	−0.02**
	−7.79	−8.10	−8.18
Tax-sensitivity * dividend yield			0.02**
			3.29
Number of observations	152,908	152,908	152,908

does, and the third accommodates separate coefficient estimates for all control variables by using interaction terms.

The interaction term between capital gains and tax-sensitivity is negative and statistically significant. It is also economically significant: A capital gains measure of one will reduce the magnitude of selling by about 15%, though only for tax-sensitive investors. Again, the results are robust across the various regression specifications tested.

Tables III–VI report the magnitude and significance of the control variables used in the various tests. Tables III and IV suggest that past performance

influences the selling decision. Institutions that have better past performance are more willing to sell the stock. As reported in Tables V and VI, however, the magnitude of selling is not significantly affected by an institution's past performance. These patterns hold for both tax-sensitive and tax-insensitive institutions, as shown in both the separate regressions for each type in Tables III and V, and the pooled regressions that allow for different coefficients in the two types of institutions in Tables IV and VI. Portfolio size affects both the likelihood and magnitude of selling negatively, with larger portfolios less likely to observe stock sales. Tax-insensitive institutions appear to be more affected by such size-related trading inactivity, most likely because they are larger and hold more stock in their portfolios. Money inflow negatively affects the likelihood of selling a stock. However, conditional on a stock being sold the magnitude of selling does not seem to be materially affected by money inflow. When we control for other factors the past return on the stock per se does not significantly affect the likelihood of selling and only marginally negatively affects the magnitude of selling. Dividend yield decreases both the likelihood and magnitude of selling, but the impact is statistically significant only for tax-insensitive institutions, which appear to slightly prefer dividends. This could be consistent with the prudent man rule that affects institutions such as pension funds.

The above regression analysis suggests that trading by tax-sensitive and tax-insensitive investors differs significantly along the tax dimension. In particular, for stocks with large capital gains, tax-sensitive investors will be less likely to sell and, if they do, will sell less. Such a pattern is absent among tax-insensitive investors.

IV. Evidence of Price Pressure: Event Study Using a Large Earnings Surprise

In this section, I attempt to determine whether the documented differences in the selling patterns of tax-sensitive and tax-insensitive investors affect stock prices. Focusing on the case of large quarterly earnings surprises that generate significant price and trading volume reactions during the announcement window, I assess whether price pressure from a capital gains tax overhang manifests in a decrease in tax-sensitive investors' willingness to sell.

A large earnings surprise triggers dramatic increases in trading volume, which suggests that the event causes many investors to change their beliefs about the stock. A capital gains tax overhang affects sellers and buyers asymmetrically; taxable sellers might decide to sell less or to sell more slowly, whereas buyers are unaffected. An order imbalance, similar to those demonstrated by the extensive empirical evidence reviewed above, can result if large numbers of sellers are affected by the capital gains tax overhang.

There could be another channel that leads to a higher cumulative abnormal return (CAR) for stocks held by a large number of tax-sensitive investors during the event: As suggested by Hong and Stein (2003) and empirically tested by Chen et al. (2001), if some investors are more pessimistic about the stock going forward but are prohibited from selling (or shorting) stock, the market price will

fail to incorporate these pessimistic signals. This could also inflate the stock price.

To ascertain the impact, if any, of tax-sensitive investors' trading behavior on stock prices I test for the existence of price pressure using selected stocks held by large numbers of tax-sensitive investors. I select stocks that have the highest concentration of tax-sensitive investors and see whether the existence of tax-sensitive trading affects prices during announcements. Because the goal is to document the existence of capital gains-related price pressure, rather than to ascertain its prevalence with respect to all stocks, I focus on a subsample of stocks for which I have relatively high confidence that a large number of tax-sensitive investors exist.

A. Defining Tax-Sensitive versus Tax-Insensitive Stocks

I define a stock as tax-sensitive if, at the beginning of a quarter, a large proportion of its institutional investors are tax-sensitive. For a particular stock, I use the proportion of 13F holdings held by tax-sensitive institutions to proxy for the proportion of holdings construed to be tax-sensitive. Specifically, I divide the number of shares held by tax-sensitive 13F institutions by the total number of shares held by all 13F institutions. For each quarter I rank sort this measure for all stocks reported in 13F and select as my sample of tax-sensitive stocks those with the highest 10% of this proportion measure. I define the sample of tax-insensitive stocks symmetrically, choosing the 10% of stocks with the highest measure of the proportion of tax-insensitive institutional holdings.

It should be noted that the ratio of tax-sensitive institutional holdings to total 13F holdings is likely to be a conservative estimate of a stock's true tax-sensitive investor base for two reasons. First, the ratio does not take into account other investor types (individuals and insiders) that are largely taxable. Second, because I am able to identify only a portion of the 13F institutional investors as definitely tax-sensitive or definitely tax-insensitive, the ratio of tax-sensitive to overall institutions could be much higher in reality: Other potentially tax-sensitive institutions such as mutual funds and banks, which cannot be categorized as either tax-sensitive or tax-insensitive in this study, are not included in the numerator but, because they are part of the overall 13F institutional holdings, nonetheless count toward the denominator.

Because differentiating tax-sensitive from tax-insensitive stocks is critical to the analysis, I perform a series of robustness checks to verify that the results are not biased by the criteria for identifying the two groups. First, I repeat the analysis using thresholds of 1% and 5% in the proportion measures used to identify the two samples. Second, I construct an alternative tax-sensitive (tax-insensitive) sample, requiring that at least 50% (33%, 25%) of the 13F institutional holdings be shown to belong to tax-sensitive institutions. Third, I limit the analysis to stocks for which institutional holdings constitute a significant portion of overall holdings, where the thresholds are such that at least 10% (20%, 30%) of the total shares outstanding are held by institutional investors. Finally, I generate results for tax-sensitive stocks defined as those for which a

large percentage of the overall shares outstanding (as opposed to institutional holdings) are held either by tax-sensitive institutions as defined above or by individual investors.[18] The results of all four robustness tests, not reported for brevity, are qualitatively unchanged.

B. Measuring Capital Gains

Without a way to secure holdings data for all tax-sensitive investors, institutional or individual, the level of capital gains incurred by a representative investor must be approximated. I proxy the capital gains incurred by an average investor using (split-adjusted) price appreciation during the previous 5 years up to the last trading day. Specifically, the natural log of the (split-adjusted) price ratio, $\ln(P_{-5}/P_0)$, is used to proxy for capital gains and losses. This measure of capital gains is acknowledged to be imperfect: Because a tax-sensitive investor might have bought a stock 10 years ago or just yesterday, the capital gains can vary across investors. The error introduced by the imprecise measurement of capital gains creates an attenuation bias toward 0 in the estimated coefficient on the impact of capital gains. If we find evidence of price pressure due to capital gains in the presence of the attenuation bias, the real magnitude of the price pressure is likely to be more significant.

The concern about error in measuring the average capital gains is addressed with two robustness checks. I first run the test using a price appreciation ratio for 3 or 10 years; the results are not qualitatively different.[19] I also construct a measure of cumulative capital gains for each of the tax-sensitive institutional investors identified in the previous section and obtain the weighted-average measure of these capital gains, the weights being the institutions' dollar holdings in the stock. Again, the results are qualitatively the same.[20]

C. Constructing CARs during the Event

Data from I/B/E/S are used to identify events of large quarterly earnings surprises. I obtain detailed stock price, volume, and shares outstanding information from CRSP. Following the literature (e.g., Ball and Bartov (1996)), I define the announcement period as the 3 days spanning the announcement $(-2, 0)$, where day -2 is 2 days before the quarterly earnings announcement date

[18] I measure the individual investor base as investors who are neither institutions nor insiders.

[19] Burman and Ricoy (1997) report that in 1993, roughly the mid-year of our sample, the average stock sold had been held for about 3 years. Three years might be a conservative measure of the average holding period of stocks still being held given that in the generally rising market, tax-sensitive investors might be inclined to sell first, and at a higher purchase price, the shares bought more recently to realize less capital gains or incur a greater capital loss.

[20] One concern with respect to this alternative measure is that, as shown in both Cohen et al. (2002) and Parrino, Sias, and Starks (2003), the trading pattern of tax-sensitive institutional investors might differ significantly from that of tax-sensitive noninstitutional investors and thus the measure of the institutional average capital gain might not be representative overall.

reported in I/B/E/S and day 0 is the announcement date. I define the forecast error as the difference between the average analyst forecast just before the announcement and the announced earnings, divided by the stock price on day -2,[21] and select as my sample of stocks with large earnings surprises those that have an absolute value of the forecast error that exceeds the median level of the absolute forecast error during that quarter.

The CAR of each stock during the announcement period is calculated by subtracting the returns on a characteristic-matched portfolio based on size, book-to-market, and momentum profit, defined according to Fama and French (1993) and Carhart (1997), respectively.[22] Specifically, I follow Daniel et al. (1997) and construct 125 benchmark portfolios according to size, book-to-market, and 1-year momentum profit. I then measure the characteristic-adjusted CAR of a stock as the cumulative return minus the return of the corresponding benchmark portfolio.[23]

The summary statistics for the tax-sensitive and tax-insensitive stocks used in this analysis are reported in Table VII. Whereas many other characteristics of tax-sensitive and tax-insensitive stocks are similar, the measures of log price appreciation differ significantly between the two samples, with the log of the past 5-year price appreciation of tax-sensitive stocks having a higher mean and median. This is consistent with the hypothesis that to accommodate a tax-sensitive clientele, if such a clientele exists, these tax-sensitive stocks might pay out less through dividends and more through share repurchases. Tax-sensitive stocks might thus exhibit higher price appreciation over time.[24]

[21] This definition of the forecast error follows the literature. As a robustness check, in all the following tests I measure the forecast error as the difference between mean forecast and announced earnings, divided by the standard deviation of analyst earnings forecasts just ahead of the announcement; that is, forecast error $=$ (earnings$_{\text{mean forecast}}$ $-$ earnings$_{\text{announced}}$)/standard deviation of forecasts. This normalization is motivated by the following consideration: If analyst forecasts for one firm are quite tight and for another firm highly diverse (which might be the case if, for example, the first firm gives strong earnings guidance or employs earnings management), the same level of earnings surprise might elicit a much larger stock price reaction from the first than from the second firm. The results, unreported for brevity, are qualitatively the same.

[22] As a robustness check I also define the CAR for days -4 to 0. The results do not change qualitatively.

[23] As a robustness check I directly control for the size, book-to-market, and momentum of individual stocks by adding these as control variables. In addition, I control for the factor loadings by first running a regression to ascertain the exposure of a stock's return to these factor returns and then using these factor loadings as control variables. These robustness checks confirm the results reported in the paper.

[24] To be fair, a higher price appreciation can be caused by either higher returns in the past or a lower taxable distribution such as dividends (repurchased or retained earnings do not lower the stock price, whereas dividend payout does). Therefore, just observing a higher price appreciation ratio does not necessarily lead to any conclusion. To shed light on this problem I check the "taxable distribution" measure (defined as the difference between the cumulative return with and without dividend) directly using the CRSP measures RET and RETX, respectively. The results, which are statistically as well as economically significant, confirm that taxable stocks have lower taxable distribution ratios. I also find that these taxable stocks have a higher ratio of stock repurchasing over total payout (including dividend and stock repurchasing).

Table VII

Summary Statistics of Tax-Sensitive and Tax-Insensitive Stocks: 1987 to 1997

For each stock we calculate the proportion of institutional holdings that are held by tax-sensitive institutions. A stock is termed "tax-sensitive" if its proportion of tax-sensitive institutional holdings is in the top 10 percentile of all stocks in that quarter. Similarly, a stock is termed "tax-insensitive" if its proportion of tax-insensitive institutional holdings is in the top 10 percentile of all stocks in that quarter. The cumulative abnormal return is calculated as the 3-day characteristic-adjusted abnormal return (−2 to 0) around the announcement of a negative earnings surprise. Log (5-year price appreciation), a proxy for capital gains, is calculated as the logarithm of the ratio of stock prices, at the close of the last trading day, and 5 years ago. Forecast error is the difference between the announced earnings and the pre-announcement consensus forecast, divided by the stock price on day −2. ln(ME), ln(BE/ME), and ln(A/BE) proxy for size, book-to-market and leverages, respectively, and are defined according to Fama and French (1992). Earnings volatility is the standard deviation of the earnings/price ratio using the past 5 years' data.

	Tax-Sensitive Stocks	Tax-Insensitive Stocks
Number of observations	3,776	3,015
Cumulative abnormal return during days (−2, 0)		
Mean	−0.0005	−0.0010
Median	−0.0002	−0.0010
Standard deviation	0.0155	0.0130
Log (5-year price appreciation)		
Mean	0.3033	0.1945
Median	0.3408	0.2274
Standard deviation	0.6943	0.6624
Forecast error		
Mean	−0.0439	−0.0375
Median	−0.0250	−0.0300
Standard deviation	0.2216	0.2391
Ln(ME)		
Mean	5.6639	6.7831
Median	5.6145	6.8745
Standard deviation	1.4858	1.6372
Ln(BE/ME)		
Mean	−0.3507	−0.2880
Median	−0.2850	−0.2448
Standard deviation	0.6264	0.5864
Ln(A/BE)		
Mean	1.0122	1.0461
Median	0.8106	0.8365
Standard deviation	0.7373	0.7250
Volatility of earnings in previous 5 years		
Mean	0.0768	0.0749
Median	0.0320	0.0283
Standard deviation	0.1453	0.1593
Percentage dividend yield		
Mean	2.1529	3.2680
Median	1.5438	2.8822
Standard deviation	2.4358	2.8005

D. The Impact of Cumulative Capital Gains on Event-Window Abnormal Returns

Turning to the main issue at hand, the question is: Do trading decisions based on capital gains tax incentives create price pressure around large earnings surprises? Given the identified groups of tax-sensitive and tax-insensitive stocks, and the measures for the CARs, I can now address this question directly by examining the relation between the natural log of price appreciation and the event-time abnormal returns of stocks. I first test separately for tax-sensitive and tax-insensitive stocks using a regression of the CAR during the event window on the measure of capital gains, controlling for forecast error and other factors that might explain the cross-sectional differences in CARs. Thus,

$$\text{CAR} = a + b * \text{price appreciation} + c * \text{forecast error} + d * \text{other control variables}. \quad (5)$$

In addition to the forecast error, I control for (but for brevity do not report): industry, using a dummy measured using the one-digit SIC code, to accommodate the potential for different reactions of CARs across industries; firm leverage, used by Fama and French (1992) as a determinant of the cross-sectional difference of expected stock returns; volatility of earnings in the previous 5 years, to measure the extent to which earnings vary and, thus, how serious the earnings surprise is; dividend yield, which might be associated with the willingness of tax-sensitive and tax-insensitive investors to sell the stock; and, market portfolio returns over the past 5 years, which might affect the cumulative capital gains (losses) that the representative investor could combine with capital gains (losses) for the stock in question. Because the events are not much clustered in calendar time, the regression results reported hereafter are obtained using a conventional pooled panel data regression rather than a Fama–MacBeth procedure.[25]

As stated earlier, in order to be included in the regressions a stock must have a large earnings surprise during the quarter, and must be clearly identifiable as either tax-sensitive or tax-insensitive. The unit of observation is the unique {stock, quarter} combination. The results are reported in Table VIII.

It can be seen from Table VIII that for tax-sensitive stocks the 3-day event-window abnormal return is higher (lower) for stocks that have higher (lower) cumulative capital gains. A one-unit increase in the natural log of the price appreciation ratio (corresponding to a 171.8% price increase over 5 years) will cause the 3-day CAR to be 39 basis points higher. In contrast, for the control group of tax-insensitive stocks the relation between the event-period abnormal return and the measure of cumulative capital gains is insignificant.

[25] Robustness checks are performed on all the tests using the Fama–MacBeth procedure and the Pontiff adjustment to further control for potential serial correlation in the coefficient estimates. The results, although in some cases less significant, are nonetheless always still highly significant at the conventional levels with t-statistics uniformly above three for our main variables of interest.

Table VIII
Price Reaction to Large Earnings Surprise: Tax-Sensitive Versus Tax-Insensitive Stocks: 1987 to 1997

A stock is termed "tax-sensitive" if its proportion of tax-sensitive institutional holdings is in the top 10 percentile of all stocks in that quarter. Similarly, a stock is termed "tax-insensitive" if its proportion of tax-insensitive institutional holdings is in the top 10 percentile of all stocks in that quarter. The cumulative abnormal return is calculated as the 3-day characteristic-adjusted abnormal return (−2 to 0) around the announcement of a negative earnings surprise. Log (5-year price appreciation) is calculated as the logarithm of the ratio of stock prices, at the close of the last trading day, and 5 years ago. Forecast error is the difference between the announced earnings and the pre-announcement consensus forecast, divided by the stock price on day −2. Control variables included (but not reported for brevity) are industry dummy, firm leverage, volatilities of the earnings in the previous 5 years, dividend yield, and past market returns. The robust t-statistics, reported under each coefficient, are adjusted for heteroskedasticity using White's (1980) correction. ** denotes significance at the 1% level.

	Tax-Sensitive Stocks [1]	Tax-Insensitive Stocks [2]
Log(5-year price appreciation)	0.0039**	−0.0013
	8.20	−1.16
Forecast error	0.1860**	0.2142**
	9.69	11.01
Adjusted R^2	0.21	0.24
Number of observations	3,776	3,015

These results support the view that price pressure exists for tax-sensitive stocks after a long period of price appreciation. Capital gains tax considerations might motivate some tax-sensitive investors to postpone selling their stocks during the announcement of a large earnings surprise, which in turn affects supply and demand during the event window, and, ultimately, returns. The average size of CAR is statistically significant. Economically, for a median level of the log of 5-year price appreciation (0.39 as reported in Table VII), the economic impact is an average abnormal return of 15 basis points during the event. For most tax-insensitive investors who incur a nontrivial transaction cost, the expected profit would not be sufficient to justify the risk involved in the arbitrage activities. Therefore, although one could imagine that some tax-insensitive investors might try to arbitrage away the abnormal returns, the arbitrage might not be complete.

I next test the hypothesis that tax-sensitive and tax-insensitive stocks exhibit the same reactions to cumulative capital gains during the event window. I do this by adding an interaction term between the tax sensitivity of stocks and the measure of capital gains. Specifically, I run the regression

$$\text{CAR} = a + b * (\text{price appreciation} * \text{Dummy}_{\text{tax-sensitive}}) + c * \text{price appreciation} + d * \text{forecast error} + e * \text{control variables}, \quad (6)$$

where the variable $\text{Dummy}_{\text{tax-sensitive}}$ takes the value of 1 if the stock is classified as tax-sensitive, and 0 otherwise. As in the previous results, other control variables included (but not reported for brevity) are an industry dummy variable using the one-digit SIC code, a measure of the firm's leverage, the volatility of earnings over the previous 5 years, dividend yield, and past market return. Table IX shows the results from three regressions. The first regression controls separately for the (noninteracted) log of price appreciation, the second does not, and the third accommodates different coefficients for all control variables by including interaction terms. In all three specifications the interaction term between price appreciation and the tax-sensitive dummy is positively related to event-period abnormal returns: A higher price appreciation is associated with a higher event-window abnormal return, but only for tax-sensitive stocks. This confirms the earlier results reported in Table VIII. The coefficient on the forecast error is consistently positive and significant. In addition, in column 3 of Table IX we do not see a systematic difference in the coefficients on the forecast errors across the tax-sensitive and tax-insensitive stock groups. The coefficients on other control variables are not consistently significant.

Table IX

Regression of Cumulative Abnormal Returns during a Large Earnings Surprise: 1987 to 1997

Tax-sensitive stocks are those with proportion of tax-sensitive institutional holdings in the top 10 percentile of all stocks in that quarter. Tax-insensitive stocks are those with proportion of tax-insensitive institutional holdings in the top 10 percentile of all stocks in that quarter. The cumulative abnormal return is the 3-day characteristic-adjusted abnormal return (−2 to 0) around a negative earnings surprise. Log(5-year price appreciation) is calculated as the logarithm of the ratio of stock prices, at the close of the last trading day, and 5 years ago. Forecast error is the difference between the announced earnings and the pre-announcement consensus forecast, divided by the stock price on day −2. The interaction terms are the dummy for tax-sensitive stock multiplied by the log of price appreciation or forecast error. Control variables included (but not reported for brevity) are industry dummy, firm leverage, volatility of the earnings in the previous 5 years, dividend yield, past market returns, and, in the last column, the interaction terms with the tax-sensitive stock dummy. The robust *t*-statistics, reported under each coefficient, are adjusted for heteroskedasticity using White's (1980) correction. ** denotes significance at the 1% level.

	[1]	[2]	[3]
Tax-sensitive stock dummy		−0.0004	−0.0004
		−0.90	−0.96
Tax-sensitive stocks ∗ log(price appreciation)	0.0034**	0.0044**	0.0044**
	8.55	6.86	7.26
Log(5-year price appreciation)		−0.0009	−0.0009
		−1.57	−1.72
Forecast error	0.1765**	0.1787**	0.2080**
	16.90	16.59	9.70
Tax-sensitive stocks ∗ forecast error			−0.0225
			−0.97
Adjusted R^2	0.20	0.21	0.22
Number of observations	6,791	6,791	6,791

E. The Role of Arbitrage

The preceding analysis suggests that for the aggregate sample of tax-sensitive stocks, arbitrage forces do not seem to completely eliminate event-window abnormal returns. For an average price appreciation the expected abnormal return due to a capital gains overhang is around 10–20 basis points. A natural follow-up question would be: How does the cost of arbitrage relate to the pattern documented for the tax-sensitive stocks? In particular, one might want to know whether the pattern would be more evident for the group of stocks for which arbitrage forces are more limited.

Returning to the issue of whether cumulative capital gains affect announcement-window abnormal returns, I extend the analysis conducted in the previous subsection (see Table VIII) to incorporate the role of arbitrage for the subsample of tax-sensitive stocks. A number of researchers including Mitchell, Pulvino, and Stafford (2002) and Ofek, Richardson, and Whitelaw (2003) measure the costs of arbitrage by the costs of short-selling stocks. They demonstrate that mispricing is limited by the magnitude of such short-selling constraints. These studies rely on proprietary data to measure short-selling costs.

Lacking the proprietary data to directly measure the cost of arbitrage, I use two proxies that have been shown to be linked to the cost of arbitrage. In a recent study D'Avolio (2002) uses proprietary data to analyze the cost of borrowing a stock in order to short-sell it. He finds that short-selling constraints in the form of the costs of borrowing stocks are increasing in the divergence of opinions among investors, which gives rise to the first proxy for the cost of arbitrage: The divergence of analyst opinion is defined as the standard deviation of analysts' forecasts, normalized by the absolute value of the mean analyst forecast reported in I/B/E/S (D'Avolio (2002, p. 290)). The second proxy for the cost of arbitrage is the market capitalization of stocks. Because larger stocks are generally more liquid and have proportionally smaller bid–ask spreads, the stock prices are arguably more efficient. I divide the sample of tax-sensitive stocks in Table VIII into two subsamples, selecting the top and bottom quartiles according to either divergence of analyst opinion or market capitalization. The quartile with higher divergence of analyst opinion or smaller market capitalization is taken to be the sample with a higher cost of arbitrage; the quartile with lower divergence of analyst opinion or larger market capitalization is taken to be the sample with a lower cost of arbitrage. I re-run the regression in equation (6) on these samples. The results are reported in Table X. For the subsample of stocks with low short-selling costs the embedded capital gains have a statistically insignificant and economically small impact on the event-time abnormal return. For the subsample of stocks with high short-selling costs the measure of price appreciation has a meaningful impact on the event-time abnormal return: For each unit increase in the measure $\ln(P_0/P_{-5})$ the abnormal return increases by about 70 basis points and the coefficient is statistically significant. Thus, the capital gains tax-related price pressure is more significant, both economically and statistically, in the subsample with higher short-selling constraints. Higher short-selling constraints seem to reduce the effectiveness

Table X

Price Reaction to a Large Earnings Surprise: Higher versus Lower Cost of Arbitrage: 1987 to 1997

Tax-sensitive stocks are those with proportion of tax-sensitive institutional holdings in the top 10 percentile of all stocks in that quarter. The top and bottom quartiles by cost of short selling are used in the analysis. The proxy for the short-selling cost in the first two columns is the standard deviation of analyst forecasts divided by the absolute value of the mean forecast for the stock. Following D'Avolio (2002), a higher level of dispersion indicates a higher cost of short-selling. The proxy for short-selling cost in the next two columns is the size of the stock, where smaller size indicates a higher cost of short-selling. The dependent variable CAR and the independent variables log (5-year price appreciation) and forecast error are calculated as in Table VII. Control variables included (but not reported for brevity) are industry dummy, firm leverage, volatilities of the earnings in the previous 5 years, dividend yield, and past market return. The robust *t*-statistics, reported under each coefficient, are adjusted for heteroskedasticity using White's (1980) correction. ** indicates significance at the 1% level.

	Using Analyst Diversity of Opinion to Proxy for Cost of Arbitrage		Using Size to Proxy for Cost of Arbitrage	
	[1] Lower Short-Selling Cost	[2] Higher Short-Selling Cost	[3] Lower Short-Selling Cost	[4] Higher Short-Selling Cost
Log (5-year price appreciation)	−0.0002 −0.16	0.0069** 5.84	0.0002 0.11	0.0075** 6.96
Forecast error	0.3271** 3.84	0.1826 1.40	0.3658** 5.13	0.1919** 3.58
Adjusted R^2	0.16	0.19	0.17	0.19
Number of observations	891	891	926	926

of arbitrage activity and increase the event-time abnormal return related to a capital gains tax overhang.

V. Conclusion

Using institutional stock holdings data matched by data on clientele profiles I show first that tax-sensitive institutional investors react to a capital gains tax overhang in a sensible manner: Large capital gains discourage, and large capital losses encourage, selling, ceteris paribus. This pattern is not observed for institutions with predominantly tax-exempt clients. Second, for stocks held primarily by tax-sensitive investors, this tax-motivated selling behavior affects prices during large earnings announcements. This price pressure is more severe when the arbitrage force is weaker. Overall, the evidence in this paper is consistent with the hypothesis that a capital gains tax plays an important role in tax-sensitive investors' selling decisions and, moreover, can exert price pressure under certain circumstances.

Appendix: A Numerical Example of the Effect of Delayed Realization of Capital Gains

A simple numerical example illustrates the effect of the delayed realization of capital gains. Assume a simple world in which the interest rate is 0% and

the capital gains tax rate is fixed at 20%. Assume that the stock was purchased at $50 and is currently selling at $100. An investor who believes that the stock is overvalued and that its price will go down permanently by 2%, absent taxes, and other transaction costs, should sell immediately to receive $100. To sell now would incur a $10 capital gains tax (20% tax rate multiplied by $50 capital gain), so the net proceeds from selling would be $90. Assume that by postponing the sale the investor has a 25% chance of ever paying the capital gains tax (either by being able to eventually combine the capital gains with capital losses from other stocks or by passing away and thus resetting all the unrealized capital gains). Then the net proceeds from the delayed selling would be $95.6, which is $98 of future stock price (which incorporates the 2% permanent price correction) less 25% times the future capital gains tax of $9.6 (20% tax rate times $48 capital gain). It is easy to show that to be willing to sell now the investor must believe that the stock price will go down permanently by at least $8. Thus, a capital gains tax can create a potentially large barrier to selling. Of course, the foregoing calculation ignores the possibility that there might be another tax timing option: Given capital gains tax rates fluctuate over time, it might be worthwhile to time the realization of capital gains and wait until a subsequent regime lowers the capital gains tax rate.

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