Everything is Relative: The Disposition Effect and Households' Stock Trades*

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Abstract

We present novel empirical evidence regarding the nature and extent of the disposition effect and tax motivations in stock sales. An issue that arises in empirical study of the disposition effect is that the theory does not specify the appropriate benchmark against which gains and losses should be measured. Indeed, our survey evidence suggests that many investors consider both absolute and relative benchmarks when deciding whether to sell stock. Using a large data set of stock investments made by individual investors, we find that both returns relative to the market and absolute performance matter in determining stock sales, but in different ways. We find strong evidence for a disposition effect related to returns *relative* to the market. Individual investors appear to shift their reference point when deciding whether to sell a stock, with their benchmark set to an expectation of the stock performing as well as the market. Further, once we control for performance relative to the market, the relation between absolute returns and the sale propensity is *negative*, but only in taxable accounts. Thus, tax-motivated trading is much stronger than previous studies suggest.

Among the most thoroughly studied individual investors' motivations for selling (or continuing to hold) common-stock investments are the disposition effect, proposed by Shefrin and Statman (1985) as an extension of Kahneman and Tversky's prospect theory (1979), and tax considerations involving early realization of taxable losses and deferral of taxable gains (see, e.g., Constantinides (1984)). The disposition effect, driven by regret aversion and mental accounting (Shefrin and Statman (1985)), implies that investors have a higher propensity to sell the investments on which they have had a gain and, conversely, a lower propensity to sell those on which they have had a loss. Odean (1998), Grinblatt and Keloharju (2001), and Ivković, Poterba, and Weisbenner (2005), among others, find that, both in the United States and in Finland, individuals exhibit behavior consistent with the disposition effect.

A countervailing motivation for sale of common-stock investments is capital gains tax minimization. Realization-based capital gains taxation in the U.S. implies that selling assets held in taxable accounts that have appreciated in value since purchase triggers capital gains taxes, whereas selling those that have depreciated in value since purchase creates tax losses that can be offset against capital gains and, to a limited extent, against ordinary income. Accordingly, investors have incentives to hold appreciated and sell depreciated taxable investments, suggesting a negative relation between propensity to sell and the performance of their taxable stock investments since purchase.

Traditionally, studies of U.S. investor behavior have considered a simple and intuitive benchmark for common-stock investment performance: capital appreciation since purchase. In that framework, disentangling the opposing effects of disposition and taxation is challenging. Although a positive relation between propensity to sell and performance suggests that the disposition effect *dominates* the tax motivation, further identification is required for the assessment of the presence and impact of tax motivation on investors' selling decisions and the relative "strengths" of disposition and tax motivations. Ivković, Poterba, and Weisbenner (2005) address this issue by comparing investors' selling behavior across their taxable and tax-deferred investments (the latter clearly do not necessitate any tax-motivated behavior). Aside from the disposition effect, they also find strong and robust evidence of a capital gains lock-in effect in taxable accounts.

Psychological theories do not specify the appropriate benchmark—or benchmarks—against which "gains" and "losses" should be measured. As Kahneman and Tversky (1979, p.

286) state, "there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo . . . an entrepreneur who is weathering a slump with greater success than his competitors may interpret a small loss as a gain, relative to the larger loss he had reason to expect." Thus, two plausible candidates for disposition-effect motivated benchmarks are a return of zero, implying that gains should be measured as absolute or raw returns, that is, capital appreciation of the stock since purchase, and a benchmark consisting of the performance of a market index, implying that gains and losses should be measured relative to market performance since the purchase of the stock. Indeed, as shown in the next section, our survey evidence suggests that individual investors regard both "absolute" performance and performance relative to the market ("relative") as important benchmarks when deciding whether to sell their stocks. Specifically, around 45% of the surveyed investors reported that both "relative" and "absolute" benchmarks are important, around 25% reported that only a "relative" benchmark is important, around 15% reported that only an "absolute" benchmark is important, with the remaining 15% reporting that neither is important in deciding whether to sell (or continue to hold) the stock.[1]

The literature on U.S. individual investors (starting with Odean (1998)) has largely focused on the "absolute" benchmark—the simple, yet powerful notion that whether the stock "went up" or "went down" since purchase is an intuitive way to interpret gain and loss both from the perspective of the disposition effect and tax-motivated trading. If one associates the disposition effect with absolute returns and includes only absolute returns in a regression of stock sales, however, it may be difficult to disentangle the disposition and capital gains lock-in effects and assess their relative importance because the two effects have offsetting implications for the effect of past returns on realizations. Simply put, if individuals evaluate their stock holdings based on their relative instead of absolute performance, the previously documented positive relation between past absolute performance and stock sales may instead reflect an omitted variable bias (the positive relation with absolute returns reflects the actual disposition effect based on relative performance since purchase). Further, not considering both absolute and

[1] Of course, as mentioned previously, the importance of "absolute" performance benchmarks could be motivated by taxation issues.

relative performance simultaneously will likely bias against finding evidence of tax motivations for sale.[2]

Using data on the stock trades made by a large number of individuals through a discount broker from 1991 to 1996, we present novel empirical evidence regarding the extent and nature of the disposition effect. In contrast to previous work on U.S. investors that studies the disposition effect in terms of absolute returns, we simultaneously focus on not only absolute performance, but also on stock returns relative to a market index, as well as returns measured relative to the highest price that the stock had attained since purchase date (the so-called "high-water" mark).[3] We find very strong evidence for a disposition effect based on returns relative to the market. Moreover, once we include a stock's relative performance in the sale-decision regression, we find that the relation between the propensity to sell and "absolute" performance since purchase is negative—instead of the dominance of the disposition effect over tax-motivated trading documented in Odean (1998), we find that higher absolute gains since purchase are associated with *lower* propensity to sell, consistent with tax-motivated trading. We also find that the "high-water" mark has a striking effect on the probability of sale. Controlling for other benchmarks, households are much more (less) likely to sell the stock investments trading close to (away from) the highest price since purchase.

The simultaneous importance of the disposition effect concerning "relative" returns and the "high-water" mark benchmark on one hand and of tax-motivated trading concerning "absolute" returns on the other hand is extremely robust. It holds in the presence of individual investor non-parametric baselines (a loose equivalent of individual fixed effects in hazard models), thus addressing the issue of investor heterogeneity, as well as in the presence of non-linear terms associated with "absolute" performance since purchase, thus alleviating the concern that "relative" returns are merely picking up non-linear responses of "purely-absolute-performance-based" disposition-prone investors. It also holds in the presence of numerous additional covariates that we consider in the process of establishing robustness to a variety of

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[2] Taxes are determined based on absolute and not relative performance. If the disposition effect is at least partially based on a relative benchmark, then allowing relative returns as an additional control in the regression will allow the coefficient on absolute returns to more fully reflect tax considerations.

[3] In their study of Finnish investor behavior, Grinblatt and Kelaharju (2001) consider the difference between the current stock price and the highest and lowest prices observed in the preceding month. Poteshman and Serbin (2003) find that exercises of exchange-traded options are influenced by the high-water mark, and Heath, Huddart, and Lang (1999) find

alternative explanations, some of which are previously unaddressed in the literature in this context. These alternative explanations include investor beliefs rooted in past performance, investors' potential ability to infer future stock performance, portfolio rebalancing, broad framing, as well as investor preferences regarding certain stock characteristics such as dividends, "locality," and market volatility (some of which may be tied to the disposition effect).

A paper related to our study, the Grinblatt and Keloharju (2001) study of Finnish investor behavior, also includes measures of relative returns and the relation of the current price to the "high-water" mark of the previous month among the covariates in a (logit) regression. In contrast to our work, their relative return and high-water mark variables are not measured from the purchase date, but rather extend over non-overlapping periods ranging from the present to around six months into the past and thus do not cover the entire period since purchase (or, in case of short holding periods, extend beyond the period since purchase). Although indicative of investor reactions to recent stock performance, which we also control for in our regressions, these measures are not naturally interpreted as corresponding to a disposition effect based on relative returns and the high-water benchmark because they do not reflect performance over the investor's *holding period* of the stock. Both tax considerations and the disposition effect suggest examining performance since purchase, not just over the recent past. Grinblatt and Keloharju (2001) find a negative relation between the propensity to sell and the existence of capital loss since purchase (they do not consider the amount of capital gains since purchase in their specifications), consistent with a disposition effect, in contrast to the relation that we find and interpret as evidence of tax-motivated trading. The difference in results likely reflects that our regression specifications allow both absolute and relative returns *since purchase* to affect the sale decision.

We uncover further evidence of tax-motivated trading by comparing trading patterns in taxable and tax-deferred accounts. Whereas there is a strong, highly significant, capital gains lock-in effect in taxable accounts throughout the year (not just in December), there is no significant relation between the propensity to sell and "absolute" performance in tax-deferred accounts. Thus, in tax-deferred accounts, where tax considerations are mute, sale decisions are

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that employee stock option exercises are influenced by reference points such as the maximum stock price achieved over the past year.

based on relative and "high-water" mark benchmarks, with absolute performance since purchase not playing any role.

We also assess the economic importance of considering both absolute and relative performance benchmarks when modeling individuals' stock sales by using our Cox proportional hazards model estimates to compute the cumulative probability that a stock would be sold within five years since purchase. We show that, whereas a parsimonious model of stock sales that only includes absolute performance leads to a much higher likelihood of realizing gains than losses, the reverse is true once relative performance and the high-water mark are also included in the regression. The reversal in cumulative probabilities of sale is substantial.

The remainder of this paper is divided into five sections. Section I presents our survey evidence concerning the benchmarks investors employ in deciding whether to sell/hold their stock investments and describes the brokerage data used in our empirical analyses. Section II presents our key results—a negative relation between propensity to sell and "absolute" performance (consistent with tax-motivated trading), a positive relation of propensity to sell and the stock return relative to a market benchmark, and evidence consistent with the disposition effect in regard to the high-water mark. Alternative hypotheses and the introduction of additional controls are addressed in Section III. Section IV discusses the economics significance of the results, quantifying the capital gains lock-in effect for individual investors. Section V briefly concludes.

I. Data Description and Summary Statistics

A. Survey Evidence Concerning "Absolute" and "Relative" Benchmarks

The results we report in this section shed light on the importance that individual investors attach to "absolute" benchmarks (i.e., whether the stock has simply gone up or down since purchase) and "relative" benchmarks (i.e., whether the stock has outperformed or underperformed the market since purchase) when considering whether to sell stock. In a detailed survey of just over 1,000 individuals regarding their investments in taxable accounts (as described in Ivković and Weisbenner (2006)), we ask the respondents, among other questions, how important are "absolute" and "relative" benchmarks when deciding whether to sell/hold their stock investments. For the purpose of presentation, we dichotomize their answers (originally offered on a four-point scale ranging from "Very Important" to "Not Important") into "Important"

(combines "Very Important" and "Important") and "Unimportant" (combines "Somewhat Important" and "Unimportant").

Table I reports the results obtained for several samples. The first column lists the percentage of investors who thought that both "absolute" and "relative" benchmarks are important. The next two columns list the percentages of respondents who thought that only "relative" (but not "absolute") and that only "absolute" (but not "relative") benchmarks are important, respectively. Finally, the fourth column lists the percentages of those who thought that neither benchmark is important in deciding whether to sell (or continuing to hold) the stock.

The first row in Table I presents the four percentages for the entire sample of surveyed investors. The general pattern is that around 45% of those surveyed consider both benchmarks to be important in their sale/hold decision, 25% focus only on the "relative" benchmark, 15% focus only on the "absolute" benchmark, with the remaining 15% focusing on neither benchmark. Over the next five pairs of rows, we split the sample by portfolio size, income, education (i.e., whether the respondent holds a 4-year college degree), education or experience in business, economics, or finance, and self-assessment of their investment skill (as rated on a scale from 1 to 10). Overall, whereas the probabilities may vary occasionally by a few percentage points, the general 45/25/25/15 proportion is preserved fairly well across the various subsamples. Finally, the last two rows of Table I focus once again on the full sample, but weigh observations by the total number of stocks held in the respondents' portfolios and the number of trades typically made by the respondents on an annual basis, respectively. The percentages reported in these last two rows of the table are once again very similar to those reported in the first row.

In sum, across various groups of individual investors (i.e., big portfolio/small portfolio, large income/small income, high education/low education, etc.) both absolute and relative benchmarks are important considerations in their sale/hold decision-making process. Whereas these survey results suggest which benchmarks individual investors employ, they do not shed light as to *why* this is the case. For example, because psychological theories do not specify benchmarks against which "gains" and "losses" should be measured, disposition-prone investors may consider "relative" benchmarks as relevant in their decision-making processes. On the other hand, because the survey focused on individuals' taxable investments, the importance of "absolute" performance benchmarks could reflect taxation issues. Moreover, other motivations such as portfolio rebalancing and a belief in momentum may also be consistent with investors

caring about performance benchmarks. To disentangle these countervailing motivations for the sale/hold decision, we now examine the actual trades made by individual investors through a large brokerage house.

TABLE I ABOUT HERE

B. Brokerage Data Description

Monthly positions and trades of 78,000 households made in the period from January of 1991 to November of 1996 come from a large discount broker. These investments are predominantly common stocks (around two-thirds of the overall value of the investments in the sample), followed by mutual funds and a range of other securities such as bonds, foreign securities, and derivatives. Each household can have multiple accounts, ranging up to 21 accounts (the median number of accounts per household is two). Around 24,000 households held stock with this brokerage and had both taxable accounts and tax-deferred accounts (IRAs and Keogh plans). Retirement plan accounts provided through employment, such as 401(k)-type plans, are not included in the data set. For a detailed description of the data set see Barber and Odean (2000).

We focus on trades of common stocks. Stock returns and most stock characteristics come from the Center for Research in Security Prices (CRSP), whereas other firm characteristics come from COMPUSTAT. To capture investors' differential behavior regarding capital gain and loss realizations in their taxable accounts and tax-deferred accounts we focus on the stock trades made by the households that had both types of accounts.[4]

We include in our sample all purchases that did not have matching sells in the sample period, as well as the buys and the sells that we could match unambiguously. Examples of trades that we could not match unambiguously include sales that do not have a preceding purchase by the same household earlier during the sample period, as well as sales that are preceded by multiple buys. In the instances in which multiple sales follow a single purchase only the first sale is admitted into the sample, which means that our analyses may slightly understate the actual holding periods for these stocks. However, that bias is negligible because the vast majority of

[4] Regression results and the conclusions drawn from them are essentially unchanged if we instead focus on the full sample of trades (as opposed to the sample of trades made by households that had both taxable and tax-deferred accounts).

common-stock sales in the sample (93.1 percent) are complete liquidations of the respective stock positions.

C. Brokerage Data Summary Statistics

Table II presents summary information on the number of stock purchases, stock sales, and the dollar values of such trades in our sample. Applying the criteria outlined above results in 414,047 buys made over the sample period, representing 23,877 households. Among all the purchases in the sample there were 97,266 stock purchases of $10,000 or more. These large purchases represent 23% of all buys in the sample (67% dollar-weighted). Slightly below three-fifths of all stock purchases were executed in taxable accounts (just below two-thirds for large purchases), with the balance executed in tax-deferred accounts. Around one-half of the purchases (52%, accounting for 60% of the dollar-weighted purchases) were followed by sells before the end of the sample period.

TABLE II ABOUT HERE

Table III presents several characteristics of stock purchases in taxable accounts conditional on various holding periods ranging from one month to four years. Panel A presents summary statistics for all purchases in the sample and Panel B considers only large purchases (dollar amount of $10,000 or more). Each panel shows the respective stock returns and percentages of stocks that experienced gains (losses) since the purchase using both absolute and relative returns.

Comparison of the two panels reveals that the subset of large purchases generally had somewhat better performance than the entire sample, but both groups of investors generally performed poorly on average. For the entire sample, average returns relative to the market were negative for every holding period shown in the table. The market return used to calculate the performance relative to the market is the capital appreciation in the value-weighted CRSP index. Relative returns for the subsample of large purchases were also negative for holding periods between one and 24 months, but smaller in absolute value for holding periods of 12 and 24 months, and were positive for the holding periods of 36 and 48 months.

TABLE III ABOUT HERE

II. Measure of Performance since Purchase and the Disposition Effect

A. Motivation

An issue that arises in empirical study of the disposition effect is that behavioral theories do not specify the benchmark—or benchmarks—against which gains and losses should be measured. Natural candidates are a benchmark of a return of zero, implying that gains should be measured as raw or absolute returns, and a benchmark consisting of the performance of a market index, implying that gains and losses should be measured on a market-adjusted or market-relative basis. Another natural candidate is the highest stock price since purchase, implying that disposition-prone investors should be more (less) likely to sell the stock trading close to (away from) that "high-water mark."

Previous work concerning U.S. investors, such as Odean (1998), largely focused on a disposition effect based on absolute returns, without addressing the possibility that other benchmarks might also predict the propensity to sell. Moreover, in the tax code, capital gains and losses are based on absolute, not relative returns or the high-water mark.

The disposition and capital gains lock-in effects have offsetting implications for the relation between propensity to sell and stock investment performance since purchase. Examining only the relation between the propensity to sell and "absolute" returns makes it difficult to disentangle the two effects and assess their relative importance. For example, because the disposition and capital gains lock-in effects are confounding, the principal evidence in Ivković, Poterba, and Weisbenner (2005) for a capital gains lock-in effect consists of the differences between the sale propensities estimated from taxable and tax-deferred accounts. To the extent that the disposition effect may be based on both relative returns and absolute returns, including both variables in the analysis allows for better identification of the disposition effect and tax-motivated trading. In the domain of "absolute" returns, the disposition effect may still somewhat offset the capital gains lock-in effect in taxable accounts. As a result, our estimates based on investors' taxable accounts may understate the importance of tax-motivated trading. In our final analyses in this section, we address this possibility by considering separately the investor trades in taxable and tax-deferred accounts in the same specification and directly comparing the

resulting regression coefficients associated with the role of various benchmarks in shaping the decision whether to sell the stock investment.

An example of existing work that considers these issues beyond focusing on "absolute" returns only is the Grinblatt and Kelaharju (2001) study of Finnish investors. That study allows for the possibility that that multiple benchmarks could play a role in redemption decisions by considering relative returns and capital loss (but not including capital gain) since purchase, as well as "high-water" mark variables. Its design, though considerably more encompassing than other existing studies of the disposition effect, still does not allow for the identification of the capital gains lock-in effect and is therefore only partially able to disentangle the disposition effect from tax motivations for trade. Further, in contrast to our work, their relative return and "high-water" mark variables are not measured from the purchase date, but rather extend over non-overlapping periods ranging from the present to around six months into the past and thus do not cover the entire period since purchase (or, in case of short holding periods, extend beyond the period since purchase). Although indicative of investor reactions to recent stock performance, which we also control for in our regressions, these measures are not naturally interpreted as corresponding to a disposition effect based on relative returns and the "high-water" mark benchmark because they do not reflect performance over the investor's *holding period* of the stock. Both tax considerations and the disposition effect suggest examining performance since purchase, not just over the recent past.

B. Cox Proportional Hazard Models with Nonparametric Baseline Hazards and the Gompertz Parameterization

We model the decision to sell or not sell a stock as a discrete choice.[5] In our analyses the time until the sale takes place is the critical variable of interest. In such a setting it is natural to use the hazard function approach. We estimate Cox (1972) proportional hazard models in which the shifts in the probability of sale are related to a number of variables.[6] The key variables of interest are GAIN = max(return, 0), the maximum of the stock return since the purchase date and zero, LOSS = min(return, 0), the minimum of the stock return since the purchase date and zero, GAIN_REL_MKT = max(return – market return, 0), the maximum of the return relative to the

[5]As discussed in the preceding section, we consider only the first date on which an investor sells part of his position in the stock investment. In our data, 93.1 percent of sales consist of sales of an investor's entire position in a stock.
[6] The use of hazard models follows Ivković, Poterba, and Weisbenner (2005), and Feng and Seasholes (2005).

market since the purchase date and zero, and LOSS_REL_MKT = min(return – market return, 0), the minimum of the return relative to the market since the purchase date and zero, where return is defined as the capital appreciation of the stock since purchase and the market return is defined as the capital appreciation of the value-weighted CRSP index since purchase, and the "high-water" mark return variable, defined as the ratio between the price entering the month and the maximum of the end-of-month prices since purchase (by construction, this variable ranges between zero and one).[7] Standard errors (shown in parentheses) allow for heteroskedasticity as well as correlation across observations of the same household. We also include various firm characteristics as controls, and use both household and firm-specific baseline hazard rates to control for unobserved household and firm characteristics. The non-parametric estimation of the baseline hazard rates follows Han and Hausman (1990) and Meyer (1990).

If $h(t)$ denotes the hazard rate in month t (i.e., the probability the stock is sold in month t given it has been held through month t–1) the probability that the stock is still held at the end of month t is $\Pi_{s=1,t}(1-h(s))$. The probability that the stock is sold in month t is $h(t)\times\Pi_{s=1,t-1}(1-h(s))$. The proportional hazard specification assumes that $h_i(t)$, the hazard function for sale of purchase i during month t after purchase, is expressed as $\lambda_0(t)\times e^{X_{i,t}\beta}$, where $\lambda_0(t)$ denotes the baseline hazard rate, $X_{i,t}$ is a vector of covariates for the ith purchase observed at the beginning of the tth month following purchasing, and β is a vector of coefficients to be estimated. For example, the full specification we estimate in Table IV is as follows:

$$
\begin{aligned}
X_{i,t}\beta = {} & \beta_1*\text{GAIN}_{i,t-1} + \beta_2*\text{GAIN}_{i,t-1}*\text{December}_{i,t} + \\
& \beta_3*\text{LOSS}_{i,t-1} + \beta_4*\text{LOSS}_{i,t-1}*\text{December}_{i,t} + \beta_5*\text{December}_{i,t} + \\
& \beta_6*\text{GAIN\_REL\_MKT}_{i,t-1} + \beta_7*\text{GAIN\_REL\_MKT}_{i,t-1}*\text{December}_{i,t} + \\
& \beta_8*\text{LOSS\_REL\_MKT}_{i,t-1} + \beta_9*\text{LOSS\_REL\_MKT}_{i,t-1}*\text{December}_{i,t} + \\
& \beta_{10}*\text{HIGH\_WATER}_{i,t-1} + \beta_{11}*\text{HIGH\_WATER}_{i,t-1}*\text{December}_{i,t} + \varepsilon_{i,t}.
\end{aligned}
\tag{1}
$$

[7] We also explored two alternative measures of overall stock market performance—the S&P 500 index and the Dow Jones Industrial index—and, not surprisingly, obtained virtually identical regression results with each of these two measures as when market performance is measured with the value-weighted CRSP index.

C. Results for the Cox Proportional Hazards Model

Table IV shows the results of estimating the Cox proportional hazard model on the full sample using GAIN, LOSS, GAIN_REL_MKT, LOSS_REL_MKT, the "high-water" mark, a dummy variable taking the value one in December, as well as interaction terms between the return variables and the December dummy variable, to shift the baseline hazard rate. Panel A of Table IV is based on baseline hazard rates $\lambda_0(t)$ that are the same for all observations, whereas the estimation featured in Panel B uses household-specific baseline hazard rates $\lambda_i(t)$ to control for heterogeneity in trading propensity across households (roughly analogous to including household fixed effects).

The first column in Panel A is consistent with the results presented in Ivković, Poterba, and Weisbenner (2005). The specification includes only the variables constructed from absolute returns and the December dummy. Consistent with previous work (e.g., Odean (1998), Ivković, Poterba, and Weisbenner (2005)), the results show evidence of a disposition effect, as well as some evidence of tax-motivated behavior. The positive coefficient on GAIN indicates that, conditional on a positive absolute return since purchase, the propensity to sell is positively related to the amount of the capital gain. The positive coefficient on LOSS, on the other hand, suggests that a larger loss is associated with a reduced probability of sale (the variable LOSS is negative by construction). Both findings are consistent with a disposition effect (i.e., sell winners and hold on to losers). In terms of relative magnitudes, the coefficient on LOSS is much larger than the coefficient on GAIN. For example, a 20 percent gain in stock price since purchase boosts the monthly hazard rate of sale by 2 percent ($e^{0.11\times 0.2} - 1$), while a 20 percent loss reduces it by 19 percent ($e^{1.03\times (-0.2)} - 1$). Finally, consistent with several previous studies, the coefficient on the interaction variable LOSS*December is negative and significant, indicating that the relation between the propensity to sell and capital loss is reversed in December, with losses boosting stock sales in December (i.e., end-of-the-year tax-loss selling).

The second column of Panel A show the results for a specification that includes variables constructed from both absolute and relative returns, as well as the high-water mark variable. A comparison of the coefficients on GAIN and GAIN*December in the first and the second columns suggests that simultaneous inclusion of multiple benchmarks in the specification reveals the importance of both tax-motivated behavior and a disposition effect that is pronounced in regard to relative returns and the "high-water" mark. In other words, the slightly positive

coefficient on GAIN in the parsimonious regression that only includes absolute returns in the first column actually reflects two countervailing effects that that are manifested in the richer regression specification presented in the second column: absolute gains strongly decrease the likelihood that a stock will be sold, while relative gains strongly increase the probability of sale. The inclusion of multiple benchmarks in the hazard rate regressions improves the identification of both the disposition effect and the greater presence of tax-motivated trading.

The magnitudes of the coefficients on GAIN and GAIN*December reported in the second column are much larger than the corresponding coefficients in the first column (and both are highly statistically significant). For example, controlling for relative performance and the high-water mark, a 20 percent gain in stock price since purchase is associated with a 15 percent reduction in the monthly hazard rate of stock sale, and the estimated reduction is as large as 27 percent for the month of December. These results, though opposite of what a disposition effect based on absolute returns would predict, are consistent with tax-motivated trading, that is, with a capital gains lock-in effect. The negative coefficients on LOSS and LOSS*December are also consistent with tax-motivated trading, that is, with the realization of losses for the tax deduction not only in December, but also throughout the year (the corresponding coefficients on LOSS and LOSS*December are –0.30 and –1.84, respectively, and are both statistically significant).

Turning to the coefficients on the variables constructed from relative returns, the coefficients on both GAIN_REL_MKT and LOSS_REL_MKT are positive and highly significant. These results are consistent with a disposition effect based on returns relative to the market. Thus, individual investors appear to shift their reference point when deciding whether to sell a stock, with their benchmark set to an expectation of the stock performing as well as the market.

The final benchmark used in the specifications is the "high-water" mark, that is, the maximum price achieved by the stock since purchase. This benchmark has been found to be relevant in other contexts. Specifically, in their study of Finnish investor behavior, Grinblatt and Kelaharju (2001) consider the difference between the current stock price and the highest and lowest prices observed in the preceding month and find these reference points affect stock sales. Poteshman and Serbin (2003) find that exercises of exchange-traded options are influenced by the high-water mark, and Heath, Huddart, and Lang (1999) find that employee stock option

exercises are influenced by reference points such as the maximum stock price achieved over the past year.

The high-water mark return variable is defined as the price entering the month divided by the maximum of the end-of-month prices since the purchase date; by construction, it ranges from zero to one. The estimated coefficient on the high-water mark (Price Entering Month / Max Price Since Purchase) in the second column of Panel A is positive and statistically significant, consistent with a disposition effect in which the benchmark is the "high-water" mark, that is, the highest price the stock investment has achieved since purchase. Thus, consistent with the previously cited work, we also find that the price path matters; controlling for absolute and relative performance since purchase, households are much more (less) likely to sell the stocks that are trading close to (away from) the high-water mark.[8] For example, given its absolute and relative performance, a stock trading at a price that represents one-half of its high price since purchase is 47% less likely to be sold than is a stock that is currently trading at its high point since it was purchased ($e^{1.27\times(0.5)}/e^{1.27\times(1.0)} - 1$). Our results are consistent with Heath, Huddart, and Lang (1999), who find that employee stock option exercises are influenced by reference points such as the maximum stock price achieved over the past year.

Panel B presents results based on the same specifications, but with a fairly general form of heterogeneity across households implemented through household-specific baseline hazard rates $\lambda_i(t)$. These baselines, similar in spirit to the use of fixed effects, address the concern that the inherent heterogeneity in households' propensity to trade could drive the results. In short, the major findings reported in Panel A carry over to Panel B. That is, a comparison across the two panels indicates that some of the estimated coefficients are slightly larger and some slightly smaller, but the general pattern of coefficients is not affected by the use of household-specific baseline hazard rates.[9] Thus, allowing for a fairly general form of heterogeneity among households does not have a substantial effect on the direction and magnitude of our key results: households appear to consider both absolute and relative benchmarks when considering whether

[8] The disposition effect relative to the high stock price since purchase holds for both stocks with accrued capital gains and accrued capital losses. For example, when the coefficient on the variable defined as the ratio of the price entering the month divided by the maximum of the end-of-month prices since the purchase date is allowed to take on different values by whether the stock has an accrued gain or loss, in the full sample the coefficient for stocks with gains and losses is 1.29 and 0.96, respectively. Thus, if the stock is trading significantly below its high price since purchase, selling will be depressed regardless of the absolute stock performance since purchase.

[9] Two minor exceptions are the absence of statistical significance of the LOSS variable and an increase of the magnitude and statistical significance of the coefficient associated with LOSS_REL_MKT*December.

to sell or continue to hold their stock investments, for taxation and disposition-related reasons, respectively, consistent with the survey results presented in Section I.

TABLE IV ABOUT HERE

D. Robustness to Inclusion of Nonlinear Measures of Absolute Performance

A possible concern with the interpretation of the estimated coefficients on the relative return variables is that they might simply reflect a non-linear relation between stock sales and absolute gains and losses. A stock with a substantial gain (loss) relative to the market is likely also to be a stock with a large absolute gain (loss), implying that the relative and absolute gain and loss variables are likely to be highly correlated.[10] If the probability of sale is a non-linear function of the absolute gain and loss variables but the hazard rate regression that we estimate includes only linear terms, the estimated coefficients on the relative gain and loss variables might be significantly (and spuriously) different from zero because the relative gain and loss variables are correlated with the omitted non-linear terms in the absolute gain and loss variables. If quadratic or cubic terms in the absolute GAIN and LOSS variables were included in the model, the relative performance variables might lose their significance.

In unreported results, we confirm that including quadratic and even cubic functions of the absolute GAIN and LOSS variables does not alter the previous key conclusions. Adding non-linear terms actually increases the magnitude of the positive coefficient on GAIN_REL_MKT. The estimated coefficient on LOSS_REL_MKT is reduced in magnitude; although still positive, it is no longer significantly different from zero for the full sample of purchases. Thus, the conclusion of a strong disposition effect based on market performance since purchase of the stock remains essentially unchanged.

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[10] The sample can be divided into four groups of stocks: (i) those with both absolute and relative gains since the purchase date; (ii) those with absolute gains and relative losses; (iii) those with absolute losses and relative gains; and, finally, (iv) those with both absolute and relative losses. For the full sample of taxable purchases, across all months over which the purchase is included in the Cox model regressions, the stock enters the month in the four absolute/relative return groups with the following frequencies: 39 percent of monthly observations have both absolute and relative gain, 15 percent have absolute gain and relative loss, 0.6 percent have absolute loss and relative gain, and 45.5 percent have both absolute and relative loss. Of these samples, sample (iii), stocks with an absolute loss and a relative gain, clearly has the smallest number of observations. To be included in this group requires a negative market return over the holding period of the stock. The longest holding period over which a stock has a capital loss, but has actually performed better than the market is 22 months for some stocks bought in February of 1993.

E. Robustness to Size of Initial Purchase

The results presented in Table IV are suggestive of a strong presence of tax-motivated trading. Following Ivković, Poterba, and Weisbenner (2005), we explore whether the strength of the relation between propensity to sell and absolute performance since purchase (controlling for other benchmarks) differs by the initial purchase size. Indeed, if the negative coefficients on the absolute return variables stem from tax-motivated trading, the absolute magnitudes of these estimated coefficients should be greater for the subsample consisting of large ($10,000+) initial purchases because the tax consequences of suboptimal behavior are larger for the larger initial investments.

In unreported results, we confirm this intuition. Comparing the regression coefficient for the subsamples of purchases less than $10,000 and purchases of at least $10,000, we find that the coefficient estimates on the absolute return variables are consistent with tax-motivated trading: they are substantially larger for the subsample of large purchases than for the sample of small purchases.[11] Also, the disposition effect appears to be stronger for the large purchases: the coefficients on GAIN_REL_MKT and the high-water mark benchmarks are bigger for large purchases ($10,000+) than for smaller purchases.

G. Differences Between Taxable and Tax-Deferred Accounts

Table V further explores the differences in investors' trading behavior across their taxable and tax-deferred investments. We employ the identification strategy from Ivković, Poterba, and Weisbenner (2005) by considering separately the investor trades in taxable and tax-deferred accounts in the same specification and directly comparing the resulting regression coefficients associated with the role of various benchmarks in shaping the decision whether to sell the stock investment.

Specifically, the first column repeats the results for taxable accounts already reported in the second column of Table IV, whereas the second and third columns report results from estimating the model on both taxable and tax-deferred accounts, where for each variable we add

[11] Specifically, the regression coefficients associated with measures of absolute performance in the subsample of small initial purchases (<$10,000) are: GAIN = –0.72; GAIN*December = –0.57; LOSS = –0.14 (not significant); and LOSS*December = –1.63. By contrast, the corresponding coefficients in the subsample of large initial purchases (≥$10,000) are GAIN = –1.28; GAIN*December = –1.05; LOSS = –0.98; and LOSS*December = –2.14. The differences between all four pairs of coefficients across the two subsamples are highly statistically significant.

to the regression specification an interaction term constructed from that variable and a dummy taking the value one for taxable accounts. The second column reports the coefficient estimates that apply to the tax-deferred accounts (i.e., IRAs and Keogh plans), and the third column reports the coefficient estimates on the interaction terms. Thus, by construction, the estimates in the second and third columns sum to the estimates in the first column.

This specification disentangles each regression coefficient obtained in the course of analyzing taxable investments and, under the assumption that the disposition effect concerning absolute performance since purchase does not vary with the tax status of the investment, explicitly accounts for the role of tax status for each regression coefficient (our sample contains only stock investments made by households holding both types of accounts, thus alleviating selection concerns).

The results sharpen the evidence of tax-motivated trading. Strikingly, while there is a strong, highly significant, capital gains lock-in effect in taxable accounts throughout the year (not just in December), there is no significant relation between the propensity to sell and "absolute" performance in tax-deferred accounts. Thus, in tax-deferred accounts, where tax considerations are mute, sale decisions are based on relative and "high-water" mark benchmarks, with absolute performance since purchase not playing any role.

Aside from these differences, the relation between the propensity to sell and both "relative" and "high-water mark" benchmarks differs only somewhat across taxable and tax-deferred investments. The disposition effect associated with the "high-water mark" benchmark is virtually identical across taxable and tax-deferred stock investments—the corresponding regression coefficients are very close in magnitude and are statistically indistinguishable. Results further feature moderate differences in the magnitudes associated with relative gains and losses, both of which are somewhat larger in taxable accounts, suggesting perhaps that the disposition effects associated with "relative" benchmarks might be somewhat more pronounced in taxable accounts, particularly for gains relative to the market since purchase.[12]

[12] Barber and Odean (2004) find that turnover is higher in taxable than in tax-deferred accounts, which may suggest differences in the way investors view these accounts. To the extent that the disposition effect might be more pronounced in taxable than in tax-deferred accounts, the interaction terms of the taxable account indicator with GAIN and LOSS will still understate the magnitude of tax-motivated trading.

TABLE V ABOUT HERE

III. Potential Alternative Explanations and Additional Controls

The previous section documents very robust evidence that the propensity to sell common stocks is positively related to relative returns and negatively related to absolute returns. We interpret the absolute return result (and its absence in a tax-deferred setting) to indicate the importance of tax considerations in the decision to sell stocks. We interpret the finding that the propensity to sell stock is increasing in relative returns as consistent with a disposition effect based on relative returns. That is, we interpret the two results in terms of preferences. However, two plausible alternative interpretations come to mind. The first is that sale decisions are related to the investors' assessments regarding the future stock performance (formed in part on the basis of past performance of the stock). That is, one might interpret the results in terms of investors' beliefs. For example, the negative relation between likelihood of sale and past absolute performance may reflect a belief in performance persistence, as opposed to tax-motivated trading (ignoring for the time being why that belief would only surface in trades made in taxable accounts and not in tax-deferred accounts). Still another possibility is that investors' higher (lower) propensity to sell stocks with high (low) relative returns might be related to their desires to rebalance their portfolios and thus maintain their asset allocation.[13]

In this section we explore these alternative hypotheses and introduce some additional controls, and seek to confirm that the results about the roles of absolute and relative returns are robust. That is, aside from establishing whether these measures are related to propensity to sell, our central interest is whether inclusion of the momentum variables affects the estimated coefficients on the GAIN, LOSS, GAIN_REL_MKT, and LOSS_REL_MKT variables in an important way.

A. Controlling for Stock Performance—Momentum Quintiles and Future Returns

A potentially important consideration in the study of the disposition effect is the ability to account not only for investor preferences, but also for their beliefs. One possibility is that

[13] Often, an investor's position in a stock that outperforms (underperforms) a broad market index will comprise a larger (smaller) fraction of his or her wealth at the end of the holding period than it did at the beginning—the investor will be

investor beliefs regarding future stock performance, and thus their current sale decisions, might be based on their observation of past performance. Our empirical representation of plausible characteristics of past performance is quintiles of past performance over 1-month and 11-month horizons ("momentum quintiles"). Controlling for momentum is particularly important. For one, our measures of momentum are correlated with both the absolute and relative return variables that explain sales of common stocks. Moreover, momentum quintiles are a plausible set of non-linear functions of past returns to consider as possible explanatory variables.

Accordingly, we augment the specifications with various measures of past performance. These include momentum quintiles both as of the month in which the stock was purchased and as of the month of possible sale. Specifically, we include four zero/one indicator variables measuring momentum as of the date of purchase. They take the value one if: (i) the previous one-month return entering the month of purchase was in the top quintile; (ii) the previous one-month return entering the month of purchase was in the bottom quintile; (iii) the previous 11-month return entering the month of purchase was in the top quintile; and (iv) the previous 11-month return entering the month of purchase was in the bottom quintile. We also include the corresponding four indicator variables based on momentum as of the month of possible sale, and interaction terms formed from products of the month of possible sale momentum variables and the absolute gain and loss variables.

We also allow for the possibility that investors might have some foreknowledge of future returns by including in the regressions the stock return over the year following the purchases date. Admittedly, even if investors have valuable information about future returns the realized return is an imprecise estimate of investors' expectations. Nonetheless, to the extent that investors are trading based on valuable information about future stock returns we would expect to find some correlation between their sale decisions and subsequent stock returns.

B. Portfolio Rebalancing

One of the plausible alternative hypotheses is that sales of stock with high relative returns might stem from portfolio rebalancing. If portfolio rebalancing indeed drives sales, the data should feature a substantial percentage of partial liquidations of positions following large relative

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"overweight" ("underweight") in that stock. In fact, this will be the case unless the balance of the investor's portfolio also outperforms (underperforms) the market index by at least as much as the individual stock did.

returns. As pointed out earlier, 93.1 percent of sales involve sales of the entire position, but this still leaves open the possibility that the frequency of partial liquidations could differ following positive and negative relative returns. In unreported analyses we compute the proportions of sales that involve selling the entire position, both for positions that experienced gains or losses since purchase and for positions that experienced relative gains or losses since purchase. Averaging over positions of all sizes, and regardless of the gain or loss since purchase (both in absolute terms, relative to the market, as well as relative to the remainder of the household portfolio), the proportions of sales that involve selling the entire position are approximately 94 percent for all return categories. As the size of the original purchases increases, the proportion of complete liquidation decreases to around 80-85 percent for original purchases of $50,000 or more, but it remains very high. Separate consideration of sales following absolute gains and losses suggests that complete liquidation probabilities decline slightly and very closely to one another. The differential probability of complete liquidation is very small—within a few percentage points; the only exception takes places for the largest original purchase size (in excess of $50,000), for which the differential is around 5 percentage points in favor of sales following gains. Analogous conclusions follow from the consideration of relative gains and losses.

In addition to presenting these compelling summary statistics, we examine the issue of rebalancing in our regression specifications by including the stock's share of the household's account in the hazard rate regressions. Specifically, we use both the stock's share of the household portfolio on the purchase date and the change in the stock's share of the portfolio from the purchase date. The motivation for including the change in the share is directly linked to rebalancing: if a stock's share in a portfolio was optimal on the purchase date, an increase in the share suggests that the portfolio is "overweight" in that stock, creating a demand for rebalancing through the sale of the stock.

The stock's share on the purchase date could affect the sale probability because of rebalancing. Suppose that an investor initially had a particular reason to buy a stock. At some point in the future the investor's beliefs might change, or, more generally, the reason to hold the stock might no longer be so compelling. At that point, the investor is likely to feel overweight in the stock. The benefit from rebalancing, and thus the probability of sale, is likely to increase in the size of the position.

C. Broad Framing

The tests conducted thus far view the stock investment in isolation. It is plausible that investors might incorporate the performance of the remainder of their stock portfolio into their decision to sell the stock investment under consideration. Investors could be more prone to the disposition effect if the remainder of their portfolio performs well. Also, the performance of the remainder of the household stock portfolio may have tax implications. For example, the capital gains lock-in effect could be strengthened in case of strong performance of both the stock and the remainder of the portfolio. Also, if the stock has incurred a capital loss since purchase, yet the remainder of the household portfolio has been performing well, selling the losing stock may create an opportunity to use the losses to offset the gains realized elsewhere in the portfolio.

We test for the importance of the relation between propensity to sell and the performance of the overall household portfolio[14] by including in the hazard rate regressions measures of the household portfolio gain or loss and interaction terms constructed from the absolute GAIN and LOSS and an indicator variable taking the value one in the event of a positive household portfolio return. We construct household-level capital-gains returns in the period from February 1991 to December 1996 from the monthly position summaries available for each household in the sample at the end of each month during the sample period (January 1991 to November 1996). We use the household monthly summaries at the end of a given month to compute the households' daily capital-gains returns over the following month. Throughout the month, the weights we apply to the individual stocks held by the household are determined by the relative sizes of the positions at the end of the previous month. Given the nature of this strategy of computing household returns, it follows that weights are rebalanced monthly.[15]

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[14] Although the market return may be correlated with the return on the household's portfolio to some extent, the two returns will be perfectly correlated only for households with fully diversified portfolios. Most individual investors, however, hold poorly diversified portfolios (see, e.g., Odean, 1998).

[15] This strategy for constructing household returns does not capture a certain level of detail. First, a stock present in a household's portfolio at the end of a month could be sold before the end of the next month. Second, a household may buy a stock at any time, whereas the presence of the stock in the household's portfolio would not be reflected in the household return computations until the beginning of the month following the month of the purchase. Nevertheless, we regard this approximate household return computation as a close approximation to the precise household returns, where the deviation from the precise household returns likely decreases with the horizon. An additional limitation is that households may hold assets that are not included in their accounts with the retail brokerage firm.

D. Dividends

The analyses presented thus far study the relation between a wide range of capital gains return variables (that is, returns that do not include dividends) and the propensity to sell shares. This section examines how the dividend components of returns affect investors' propensity to sell. The motivation is twofold. First, the disposition effect is also consistent with the intuition that investors prefer a "bird in the hand" (dividends) to one "in the bush" (capital gains), and it is plausible that investors' response to dividends could be different from their response to capital gains because a dividend payment is already "guaranteed," whereas a capital gain may be fleeting in nature. Second, this is also motivated by Shefrin and Statman's (1984) development of the Thaler and Shefrin (1981) theory of self-control that predicts investors' preference for cash dividends.

TABLE VI ABOUT HERE

E. Results

Table VI reports results from hazard model regressions that augment the specifications used in Table IV with the additional variables described just above. To facilitate comparisons of the results with and without the new variables, the first column of Table VI repeats the results from the second column of Table IV. The second column features the specification that includes the new variables discussed above. In the last two columns, we also introduce various controls for unobserved heterogeneity, namely controls for differences in selling propensities across stocks (through the inclusion of firm-specific baseline hazard rates in the model or the inclusion of firm-specific variables to move the baseline hazard rate up or down) and across households (through the inclusion of household-specific baseline hazard rates in the model).

The table is split into three panels. Panel A focuses on the independent variables from Table IV (i.e., the absolute, relative, and "high-water" mark return variables). Panel B features the independent variables, described earlier in this section, that we include into the specification to test the alternative hypotheses and introduce additional controls. Finally, Panel C focuses on firm-specific controls in the last, fourth specification presented in the table.[16]

[16] Thus, the specification from the first column is presented only in Panel A; the specifications from the second and third columns are presented jointly in Panels A and B; and, finally, the specification from the last, fourth column (featuring firm-specific controls) is presented jointly in all three panels.

Coefficient estimates for the return variables presented in Panel A confirm that the principal conclusions from Section II are robust to the inclusion of the long list of additional variables that are included in these hazard rate regressions. Key coefficient estimates, those for GAIN, GAIN_REL_MKT, and the return from the high-water mark, are highlighted in boldface. Scanning across the columns of the table, the estimated coefficients on GAIN in the first row are consistently significantly negative, providing evidence of a robust capital gains lock-in effect. Similarly, the estimated coefficients on GAIN_REL_MKT and the return from the high-water mark are consistently significantly positive, confirming robust disposition effects based on relative returns and returns from the high-water mark. Review of the other rows reveals that the signs of the coefficient estimates are generally stable across columns.

Panel B of Table VI shows that some **past performance variables** are significantly related to investors' propensities to sell shares. Focusing initially on the momentum of the stock investment entering the month of the possible sale, the regression coefficients reported in columns (2) through (4) suggest that extremely strong performers (those in top quintiles over the one-month and eleven-month horizons) are more likely to be sold, with regression coefficients ranging from 0.29 to 0.08 and 0.29 to 0.13, respectively, and all of these estimates are significantly different from zero at the one percent level. Analogous results for bottom performers have the opposite sign, but the statistical significance is not as pronounced in all specifications. These results are consistent with the results concerning households' motivations for trade in Grinblatt and Keloharju (2001). U.S. investors, not unlike their Finnish counterparts, exhibit a positive relation between the propensity to sell and recent stock performance over short- or intermediate-term horizons.[17] Grinblatt and Keloharju (2001) interpret such findings as evidence of a disposition effect. In this paper, we focus on a more natural anchor for assessing investment performance from the investors' perspective—performance since purchase (be it "absolute" or "relative"). This does not preclude, of course, the existence of disposition-like effects over fixed recent time intervals, as is reported in both studies. Important for our purposes,

[17] On the other hand, the interpretation of the estimated coefficients on the measures of momentum *at the time of purchase* is less clear. Coefficients are generally, but not uniformly, positive and significantly different from zero. Perhaps the most consistent pattern across most specifications (but not the last one, featuring firm-specific controls and household-specific baselines) is the positive relation between propensity to sell and strong, top quintile performance of the stock over the past month and over the past eleven months before the stock was purchased.

the inclusion of short-term stock performance measures does not materially affect any of the conclusions drawn regarding the relation between stock sale decision and holding-period returns.

For stock investments with capital appreciation since purchase (i.e., GAIN > 0), there is evidence, consistent across columns (2) through (4), that stock performance over the past 11 months moderates the propensity to sell stocks with a capital gain: controlling for other covariates, past 11-month winners (top quintile) are less likely to be sold than mediocre performers over the past 11 months and past 11-month losers (bottom quintile) are more likely to be sold than mediocre performers over the past 11 months (with the coefficient in the last column lacking statistical significance). These results are consistent with investors' sale decisions being influenced by momentum-based beliefs about future returns—the lock-in effect is enhanced if the stock has done well in the past year and is somewhat mitigated (but not fully) if the stock has done poorly in the past year.

Sale decisions concerning stock investments with a capital loss since purchase (i.e., LOSS < 0) also appear to be moderated by recent stock performance. Similarly, and again consistently with momentum-based beliefs, interactions of LOSS with quintile dummies for the past performance assume the appropriate sign. The coefficient estimates on both LOSS*(Previous One-Month Return in top quintile) are consistently positive and statistically significant, and the estimated coefficients on LOSS*(Previous One-Month Return in bottom quintile) and LOSS*(Previous 11-Month Return in bottom quintile) are consistently negative (and, with the exception of the last column, statistically significant). Thus, tax-loss selling is mitigated if the stock has recently done well and enhanced if the stock has recently done poorly.

We next explore the possibility that sale decisions might be based on the information regarding **future stock performance**. Our specifications in Table VI feature three related variables: Return Over Next Year (listed in the middle of Panel B in Table VI); GAIN*(Return Over Next Year > 0) (listed among the GAIN interactions with categorical variables); and LOSS*(Return Over Next Year > 0) (listed among the LOSS interactions with categorical variables). The estimated coefficients on these variables are largely insignificant at conventional levels, providing little support to the hypothesis that sale decisions are based on information about future stock returns.

The role of **broad framing**, however, appears to be significantly more pronounced. The estimated coefficients on Household Portfolio Return Since Purchase of Stock, reported toward

the bottom of Panel B in Table VI, and are uniformly significantly positive across columns (2) through (4). That is, controlling for other variables, sales are significantly more likely when the household portfolio has done well. This is consistent with a role for broad framing, and is the first evidence of broad framing of which we are aware.

The interaction terms involving the household portfolio return offer evidence of tax-motivated trading. The negative coefficients on the interaction terms GAIN*(HH portfolio return is positive), significant in all but the last column, suggest that, given a positive household portfolio return, the propensity to sell is decreasing in the GAIN variable. Indeed, if household portfolio returns are positive, the (absolute) gain on the stock is subject to the lock-in effect that is especially reinforced because solid performance of the rest of the portfolio makes the household portfolio less likely to contain an offsetting loss. The negative estimated coefficients on LOSS*(HH portfolio return is positive) imply that the propensity to sell is higher when there is a large loss (LOSS is non-positive by definition). This is also consistent with tax-motivated trading because positive household portfolio returns make it more likely that an (absolute) loss in the stock could be matched up with an offsetting gain in the remainder of the portfolio.

In unreported results, we verify that our results regarding broad framing are not driven by households holding only a few stocks. Specifically, when the regression reported in column (2) is run on a subsample of observations associated with households that hold at least five stocks (or, alternatively, that hold at least ten stocks), we continue to find a positive and significant coefficient on the Household Portfolio Return variable and negative and significant coefficients on the interaction of the Household Portfolio Return with the GAIN and LOSS variables that are, if anything, enhanced in magnitude.

Results pertaining to **rebalancing** are mixed. Consistent with rebalancing, the estimated coefficients imply that the relation between sale probability and the stock's share of the household's account on the purchase date is positive. That is, stocks that comprise a larger share of the portfolio are more likely to be sold. However, the results for the *change* in the household portfolio share are not robust, as the magnitudes and significance levels of the regression coefficient vary across columns.

The coefficients on the **dividend** variable, Cumulate Dividend Return Since Purchase, provide strong support for the hypothesis that dividend payments reduce the propensity to sell, even after allowing for different baseline hazard rates of sale across different firms/stocks or

including a battery of firm-specific controls.[18] In unreported results, we included a number of different measures of dividends and dividend initiations into the specifications, and found that the negative effect of dividends on the propensity to sell is robust to the measure of dividends used. We are not aware of any theory that directly and explicitly predicts these results. Shefrin and Statman (1984) present a behavioral theory of dividends based on Thaler and Shefrin's (1981) theory of self-control. Shefrin argues that dividends fit into this theory of self-control because, by committing to consume only out of dividends, investors avoid deciding how many shares to sell and how much to consume, and thus commit themselves not to consume too much. Therefore, an investor facing this self-control problem would prefer dividends to capital gains, and the benefit of the commitment provided by dividends might be large enough to offset their tax disadvantage. Although the self-control theory does not speak directly to the propensity to sell, it seems reasonable that a preference for dividends might be manifested in a lower propensity to sell stocks that pay dividends.

Moreover, dividends seem to be favored by investors above and beyond current consumption issues: in unreported results we also find that the receipt of dividends depresses sales in tax-deferred brokerage accounts (from which no current consumption takes place). This finding fits the notion that dividends are a "bird in the hand," as compared to capital gains that may be more fleeting in nature, and the disposition effect is consistent with the intuition that investors prefer a "bird in the hand" (i.e., the "guaranteed" return). In this sense, our results regarding dividends are also consistent with the disposition effect. But Shefrin and Statman (1985) do not address dividends, and it is not obvious that their arguments have implications for investors' responses to dividend payments.

Thus, although the results regarding dividends are not clearly and directly an implication of behavioral models, results in this paper provide direct evidence that investors do in fact like dividends, in the sense that investors are less likely to sell shares that pay dividends. For this reason, our results complement recent work by Baker and Wurgler (2004a, 2004b), who hypothesize that investors demand dividends as part of their analysis of "catering incentives."

[18] The dividend return is calculated as the difference between the total cumulative return on the stock and the capital appreciation of the stock, which implicitly assumes that dividends are reinvested in the stock.

Finally, Panel C reports the coefficient estimates and standard errors for the **firm-specific control variables** used in the last column of Table VI.[19] These variables control for the possibility that investors with different expected holding periods may sort themselves on firm characteristics. Aside from controls for the book-to-market ratio and market capitalization (both expressed via the dummy variables for top and bottom quintiles of the respective cross-sectional distribution at the time of purchase) and a measure of stock volatility (standard deviation of returns over the 24 months preceding the month of purchase), which is also interacted with a dummy variable indicating whether the stock has risen in price since purchase, the specification in column (4) also include the local stock dummy that takes a value one if the headquarters of the company is within 50 miles of the investor's residence.

The inclusion of the latter variable is motivated by the result, reported in Ivković and Weisbenner (2005), that individual investors local to the firm headquarters tend to hold its stock longer than non-local investors do. The results confirm this finding by indicating a somewhat longer holding period associated with local stocks—the corresponding regression coefficient is negative and statistically significant, though not large in magnitude. Investors also appear to be more likely to hold on to value stocks, to stocks with either very large or very small market capitalization, and to riskier stocks (those with high volatility). Preference for all these characteristics, though, is related to neither disposition nor tax effects. However, the interaction of monthly volatility and the gain accrued since purchase is directly related to the disposition effect. It is positive, large in magnitude, and highly statistically significant, thus suggesting that investors are considerably more likely to sell very risky investments that have registered an absolute gain since purchase, as predicted by the disposition effect, even if that will trigger a tax liability. Thus, the lock-in effect of capital gains is mitigated for stocks whose performance is volatile in nature.

IV. Economic Significance–Cumulative Probabilities of Sale

In this section, we assess the economic significance of the key variables studied in this paper by using our Cox hazard model estimates to compute the cumulative probabilities of having sold a

[19] It is not possible to have both firm-specific and household-specific baseline hazard rates, so in column (4) we include firm-specific characteristics in the hazard rate regression. Thus, in this specification, baseline hazard rates of sale are allowed to vary by household, with the baseline hazard rates moved up or down depending on the characteristics of the firm the household has invested in.

stock within five years after purchase. Each of the three panels of Figure 1 shows the cumulative sale probabilities as functions of the time elapsed since purchase using the coefficient estimates from various hazard-rate regression specifications presented in Tables IV and V (conditioning on different values of the return variables). These differences in the sale probabilities are a relevant measure of the economic significance of the results.

FIGURE 1 ABOUT HERE

An examination of the role of absolute returns without controlling for other relevant benchmarks in the regression specification yields a replication of the Odean (1998) result that households are more likely to sell winners than losers. Indeed, the solid black line in Chart A of Figure 1 shows that, in this case, the probability that a stock with capital appreciation of 2% per month is sold within 5 years after purchase is 8 percentage points higher than that for a loss of –2% for month (i.e., 65%–57%), whereas the solid grey line shows the difference in cumulative sale probability between capital appreciation of 1% per month and capital loss of –1% per month of just over 4 percentage points. In contrast, the dashed black and grey lines are based on estimates from a specification that includes the benchmarks relative to the market and the "high-water" mark since purchase. Once these other benchmarks are also included in the model the probabilities are reversed (the relative return is assumed to be zero to isolate the effect of absolute performance). Thus, while a parsimonious model of stock sales that only includes absolute performance leads to a much higher likelihood of realizing gains than realizing losses, the reverse is true once performance relative to the market benchmark and the high-water mark are also included in the regression.

Chart B of Figure 1 highlights the extent to which our richer model allows better identification of tax-motivated trading. In particular, the various lines show the differences between the cumulative sale probabilities in taxable versus tax-deferred accounts for five different values of absolute returns between 2% and –2% per month. Investors are much more likely to realize losses for an assumed loss of –2 percent per month in tax-deferred accounts than in taxable accounts (the difference in sale probability is 6 percentage points over 5 years), and are much less likely to realize gains for an assumed gain of 2 percent per month in taxable accounts than in tax-deferred accounts (the difference in sale probability is 11 percentage points over 5 years). The analysis in Chart B could also be replicated for our more parsimonious specification (i.e., estimate differences in sale probability across taxable and tax-deferred

accounts controlling only for past absolute performance). This is essentially the approach taken in Ivković, Poterba, and Weisbenner (2005). Whereas this methodology also uncovers tax-motivated trading, the lock-in effect for accrued gains (measured as the difference in the cumulative probability of sale over five years in a taxable account relative to a similar stock purchased in a tax-deferred account) is about three times larger in the richer specification than in the parsimonious one (i.e., 58 – 69 = –11% vs. 65 – 69 = –4%), while tax-loss selling is also about three times as large (i.e., 65 – 59 = 6% vs. 57 – 77 = –2%).

Finally, in Chart C of Figure 1 we document the importance of benchmarks relative to the market in individuals' trading decisions. As shown by the black line, over a five-year period, an individual is 7 percentage points more likely to sell a stock with a 1% per month gain when the market is flat (i.e., the relative return is 1% per month) than when the market and the stock have the same performance (i.e., the relative return is 0% per month).

V. Conclusion

The results in this paper provide a novel characterization of the importance of the disposition effect and tax considerations on the propensity to sell of hold their stock investments. Survey evidence presented in the paper suggests that many investors consider both absolute and relative benchmarks in shaping their sale decisions. Consistently, using data on individuals' trading activity through a large brokerage house, we find strong evidence for a disposition effect related to returns *relative* to the market. Regression results also provide evidence for a disposition effect based on the return from a high-water mark (i.e., the probability of stock sale is reduced the farther away the stock price is from its high since purchase, controlling for absolute and relative performance). Consistent with tax-motivated trading, once we include relative returns in the hazard rate regressions, we find *absolute* gains in stock price are associated with a *reduced* probability of sale, but only in taxable accounts (in tax-deferred accounts there is no relation between the likelihood of selling a stock and its absolute performance since purchase). Thus, once we control for other plausible benchmarks that may affect trading activity of households (e.g., relative performance, closeness to previous high price since purchase, overall portfolio performance) we attain a substantially deeper understanding of what drives stock sales and provide evidence that the disposition effect is important, but find that this effect appears to be driven by performance relative to the market and its high-water mark rather than the absolute

performance of the stock. This richer specification also enables us to discover that tax-motivated trading is much stronger than previous studies would suggest.

The results regarding the role of relative returns are important because theoretical work on the disposition effect provides no guidance regarding the appropriate benchmark, that is, whether gains should be measured as absolute returns, relative to the performance of a market index, or relative to some other benchmark. The results in this paper provide empirical evidence of disposition effects based on returns relative to the market and returns relative to the maximum stock price since purchase that are strikingly strong.

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Table I: Importance of Various Benchmarks in Individuals' Stock Sale/Hold Decisions

This table reports select results from a detailed survey of just over 1,000 individuals regarding their investments in taxable accounts (as described in Ivković and Weisbenner (2006)). Specifically, the survey asks the respondents how important they find "absolute" and "relative" benchmarks when considering whether to sell or hold their stock investments. For the purpose of presentation, we dichotomize their answers (originally offered on a four-point scale ranging from "Very Important" to "Not Important") into "Important" (combines "Very Important" and "Important") and "Unimportant" (combines "Somewhat Important" and "Unimportant"). The first column lists the percentage of investors who thought that both "absolute" and "relative" benchmarks are important. The next two columns list the percentages of respondents who thought that only "relative" (but not "absolute") and that only "absolute" (but not "relative") benchmarks are important, respectively. Finally, the fourth column lists the percentages of those who thought that neither benchmark is important in deciding whether to sell (or continue to hold) the stock. The first row presents the four percentages for the entire sample of surveyed investors. Over the next five pairs of rows, the sample is split by portfolio size, income, education (i.e., whether the respondent holds a 4-year college degree), education or experience in business, economics, or finance, and self-assessment of their investment skill (as rated on a scale from 1 to 10). The last two rows focus once again on the full sample, but weigh observations by the total number of stocks held in the portfolio and the number of trades typically made on an annual basis, respectively.

	Benchmark Importance			
Sample	Both Relative and Absolute	Only Relative	Only Absolute	Neither Relative nor Absolute
All Investors	45.2	25.1	14.1	15.6
By Portfolio Size				
Large (> 500 k)	41.8	26.4	10.9	20.9
Not Large (≤ 500 k)	46.0	25.6	14.1	14.3
By Income				
Large (> 250k)	46.5	19.8	13.9	19.8
Not Large (≤ 250 k)	45.4	26.7	13.5	14.4
By Education				
High (4-year college degree)	42.5	27.7	14.3	15.5
Low (less than college 4-year college degree)	45.8	24.2	15.3	14.7
By Education or Experience in Finance				
Education or Experience in Finance	45.7	27.1	14.0	13.2
Neither Education nor Experience in Finance	44.6	21.6	14.5	19.3
By Self-Assessment of Investment Skill				
High (6-10 on a 10-point scale)	44.6	29.4	12.5	13.5
Low (1-5 on a 10-point scale)	45.8	20.2	16.3	17.7
All Investors (Weighted by Number of Stock Holdings)	42.5	24.7	13.1	19.7
All Investors (Weighted by Number of Trades per Year)	44.8	25.7	13.7	15.8

Table II: Summary Statistics of Common Stock Purchases and Sales

The sample consists of 23,877 households that had both taxable and tax-deferred accounts and had at least one stock purchase over the sample period from January 1991 to November 1996. Median dollar amount of purchase is reported in parentheses. Dollar weighted averages are reported in brackets for the fraction of purchases that are at least $10,000 (the third column) and the probability a stock is sold by the end of the sample period, that is, November 1996 (the fourth column).

	Number of Buys	Average $ Amount of Buys (Median)	Percentage of Buys ≥ $10K [$ weighted]	Percentage of Buys Sold During the Sample Period [$ weighted]
All Accounts	414,047	9,329 (4,762)	23 [67]	52 [60]
Taxable Accounts	241,046	10,404 (5,063)	26 [71]	53 [60]
Tax-Deferred Accounts	173,001	7,831 (4,310)	20 [60]	51 [60]

Table III: Characteristics of Stock Purchases in Taxable Accounts Given Holding Period

The table presents certain characteristics of stock purchases in taxable accounts conditional on various holding periods ranging from one month to four years. Panel A presents summary statistics for all purchases in the sample and Panel B considers only large purchases (dollar amount of at least $10,000). Each panel shows the respective stock returns and percentages of stocks that experienced gains (losses) since the purchase using both absolute and relative returns.

	Panel A: All Stock Purchases in Taxable Accounts					
	After 1 Month	After 6 Months	After 12 Months	After 24 Months	After 36 Months	After 48 Months
Return (in %)	0.7	2.3	6.4	15.7	26.8	41.3
% Gain	49.7	50.6	52.3	55.0	58.0	63.8
% Loss	48.2	48.8	47.3	44.7	41.9	36.1
Return Relative to Market (in %)	-0.4	-3.2	-4.9	-5.1	-2.8	-5.9
% Relative Gain	47.0	41.9	39.2	37.6	37.3	33.1
% Relative Loss	52.9	58.1	60.8	62.4	62.7	66.9
# Observations	200,941	130,898	91,631	54,122	33,669	19,065
	Panel B: Stock Purchase in Taxable Accounts of ≥ $10,000					
	After 1 Month	After 6 Months	After 12 Months	After 24 Months	After 36 Months	After 48 Months
Return (in %)	0.1	2.3	8.3	20.1	32.2	51.6
% Gain	49.2	51.3	54.6	57.9	60.9	68.1
% Loss	49.3	48.1	45.1	41.9	38.9	31.9
Return Relative to Market (in %)	–0.8	–3.4	–3.6	–1.0	2.5	4.5
% Relative Gain	46.0	41.9	40.3	39.4	40.1	36.3
% Relative Loss	54.0	58.1	59.7	60.6	59.9	63.7
# Observations	45,897	26,436	17,760	10,119	6,201	3,485

Table IV: Relating Sale of Common-Stock Shares in Taxable Accounts to "Absolute" and "Relative" Performance Since Purchase

The Cox proportional hazards model employs a non-parametric estimate of the baseline hazard (i.e., the probability of selling the stock investment during month t after the buy conditional on no prior sale). Panel A reports results allowing for a common baseline hazard $\lambda_0(t)$, whereas Panel B reports results allowing for household-specific baseline hazards $\lambda_i(t)$. GAIN = max(return, 0) and LOSS = min(return, 0), where return is defined as the capital appreciation of the stock since purchase. GAIN_REL_MKT = max(return – market return, 0), and LOSS_REL_MKT = min(return – market return, 0), where market return is defined as the capital appreciation of the market since purchase. All regressions are estimated over the full sample of 3,449,531 observations. Standard errors (shown in parentheses) allow for heteroskedasticity as well as correlation across observations of the same household.

Variable	Panel A: Common Baseline		Panel B: Household-Specific Baselines	
	(1)	**(2)**	**(3)**	**(4)**
GAIN	0.11**	–0.83**	0.21**	–0.82**
	(0.01)	(0.06)	(0.01)	(0.07)
GAIN*December	–0.02	–0.72**	–0.06*	–0.63**
	(0.02)	(0.16)	(0.03)	(0.18)
LOSS	1.03**	–0.30**	1.38**	0.12
	(0.03)	(0.08)	(0.03)	(0.09)
LOSS*December	–2.23**	–1.84**	–2.35**	–1.54**
	(0.05)	(0.20)	(0.06)	(0.23)
GAIN_REL_MKT		0.96**		1.06**
		(0.06)		(0.07)
GAIN_REL_MKT* December		0.76**		0.63**
		(0.17)		(0.20)
LOSS_REL_MKT		0.28**		0.15*
		(0.06)		(0.07)
LOSS_REL_MKT* December		–0.11		–0.31*
		(0.13)		(0.16)
Price Entering Month / Max Price Since Purchase		1.27**		1.35**
		(0.06)		(0.06)
(Price Entering Month / Max Price Since Purchase)*December		–0.25		-0.46**
		(0.17)		(0.18)
December	0.12**	0.37*	0.10**	0.55**
	(0.01)	(0.16)	(0.01)	(0.18)

**, * denote significance at the 1 percent and 5 percent levels, respectively.

Table V: Cox Model of Selling Stock in Taxable and Tax-deferred Accounts, Full Sample

The Cox proportional hazards model employs a non-parametric estimate of the baseline hazard (i.e., the probability of selling the stock investment during month t after the buy conditional on no prior sale), estimated separately for taxable and tax-deferred accounts. GAIN = max(return, 0) and LOSS = min(return, 0), where return is defined as the capital appreciation of the stock since purchase. GAIN_REL_MKT = max(return – market return, 0), and LOSS_REL_MKT = min(return – market return, 0), where market return is defined as the capital appreciation of the market since purchase. All regressions are estimated over the full sample of 5,997,368 observations, of which 3,449,531 observations come from taxable accounts. Standard errors (shown in parentheses) allow for heteroskedasticity as well as correlation across observations of the same household.

Variable	Taxable accounts	All accounts	
		Tax-deferred accounts	Interaction w/ taxable accounts
GAIN	–0.83 **	*–0.11*	–0.73 **
	(0.06)	*(0.06)*	(0.08)
GAIN*December	–0.72 **	*–0.60* **	–0.12
	(0.16)	*(0.17)*	(0.24)
LOSS	–0.30 **	*0.16*	–0.46 **
	(0.08)	*(0.09)*	(0.13)
LOSS*December	–1.84 **	*0.08*	–1.92 **
	(0.20)	*(0.27)*	(0.34)
GAIN_REL_MKT	0.96 **	*0.19* **	0.77 **
	(0.06)	*(0.06)*	(0.09)
GAIN_REL_MKT* December	0.76 **	*0.70* **	0.06
	(0.17)	*(0.18)*	(0.25)
LOSS_REL_MKT	0.28 **	*0.12* *	0.16
	(0.06)	*(0.06)*	(0.09)
LOSS_REL_MKT* December	–0.11	*–0.05*	–0.06
	(0.13)	*(0.19)*	(0.23)
Price Entering Month / Max. Price Since Purchase	1.27 **	*1.23* **	0.03
	(0.06)	*(0.07)*	(0.09)
(Price Entering Month / Max. Price)*December	–0.25	*–0.19*	–0.06
	(0.17)	*(0.22)*	(0.27)
December	0.37 *	*0.22*	0.15
	(0.16)	*(0.21)*	(0.27)
# Observations	3,449,531	5,997,368	

**, * denote significance at the 1 percent and 5 percent levels, respectively.

Table VI, *Panel A*: Cox Proportional Hazards Model of Stock Sales, Inclusion of Controls for Alternative Hypotheses, Taxable Accounts, Full Sample

GAIN = max(return, 0), LOSS = min(return, 0), GAIN_REL_MKT = max(stock return less market return since purchase date, 0), and LOSS_REL_MKT = min(stock return less market return since purchase date, 0). The stock return is defined as the capital appreciation of the stock. "Price Entering Month / Maximum Price Since Purchase" is defined as the price entering the month divided by the maximum of the end-of-month prices since the purchase date, and thus takes on values between zero and one. The total return of the stock over the year following the month of potential sale is also included in the regression. The performance of the stock both one and eleven months prior to month t and the performance both one and eleven months prior to the purchase date are calculated and assigned to the appropriate market-wide performance-quintile for that time period. The Cumulative Dividend Return Since Purchase is the difference between a stock's total return and a stock's capital appreciation since purchase. HH_PORTFOLIO_RETURN = total household stock portfolio return since purchase date. The Cox proportional hazards model employs a non-parametric estimate of the baseline hazard, $\lambda_0(t)$, (i.e., the probability of selling the stock investment during month t after the buy conditional on no prior sale). Standard errors (shown in parentheses) allow for heteroskedasticity as well as correlation across observations of the same household.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
GAIN	**–0.83** ** **(0.06)**	**–0.61** ** **(0.10)**	**–0.85** ** **(0.11)**	**–0.52** ** **(0.17)**
GAIN*December	–0.72 ** (0.16)	–0.41 (0.23)	–0.20 (0.25)	–0.86 * (0.38)
LOSS	–0.30 ** (0.08)	–0.08 (0.15)	0.03 (0.17)	0.24 (0.26)
LOSS*December	–1.84 ** (0.20)	–2.41 ** (0.28)	–2.20 ** (0.32)	–2.39 ** (0.49)
GAIN_REL_MKT	**0.96** ** **(0.06)**	**0.95** ** **(0.10)**	**1.22** ** **(0.11)**	**0.94** ** **(0.17)**
GAIN_REL_MKT*December	0.76 ** (0.17)	0.41 (0.25)	0.13 (0.27)	0.86 * (0.42)
LOSS_REL_MKT	0.28 ** (0.06)	0.10 (0.09)	0.31 ** (0.11)	–0.52 ** (0.17)
LOSS_REL_MKT*December	–0.11 (0.13)	0.22 (0.20)	–0.07 (0.23)	0.18 (0.37)
Price Entering Month / Max Price Since Purchase	**1.27** ** **(0.06)**	**1.43** ** **(0.08)**	**1.93** ** **(0.09)**	**1.63** ** **(0.13)**
(Price Entering Month / Max Price Since Purchase)*December	–0.25 (0.17)	–0.13 (0.22)	–0.12 (0.25)	–0.34 (0.37)
December	0.37 * (0.16)	0.29 (0.22)	0.27 (0.24)	0.49 (0.37)
Other variables (Panel B)?	No	Yes	Yes	Yes
Household-Specific Baselines?	No	No	No	Yes
Firm-specific Baseline/Controls (Panel C)?	No	No	Baselines	Controls
# Observations	3,449,531	1,658,351	1,658,351	772,830

**, * denote significance at the 1 percent and 5 percent levels, respectively.

Table VI, *Panel B*: Cox Proportional Hazards Model of Stock Sales, Inclusion of Controls for Alternative Hypotheses, Taxable Accounts (continued)

Variable	(2)	(3)	(4)
GAIN Interactions with Categorical Variables			
GAIN*(Return Over Next Year > 0)	–0.07**	0.01	0.01
GAIN*(Previous One-Month Return in top quintile)	–0.09**	–0.01	–0.05
GAIN*(Previous One-Month Return in bottom quintile)	–0.05	0.03	0.03
GAIN*(Previous 11-Month Return in top quintile)	–0.22**	–0.24**	–0.32**
GAIN*(Previous 11-Month Return in bottom quintile)	0.15**	0.41**	0.20
GAIN*(HH portfolio return is positive)	–0.08**	–0.15**	–0.07
LOSS Interactions with Categorical Variables			
LOSS*(Return Over Next Year > 0)	0.07	0.07	0.05
LOSS*(Previous One-Month Return in top quintile)	0.69**	0.36**	0.71**
LOSS*(Previous One-Month Return in bottom quintile)	–0.08	–0.37**	–0.18
LOSS*(Previous 11-Month Return in top quintile)	0.32**	0.02	–0.09
LOSS*(Previous 11-Month Return in bottom quintile)	–0.23**	–0.72**	–0.16
LOSS*(HH portfolio return is positive)	–0.46**	–0.46**	–0.69**
Future Stock Performance			
Return Over Next Year	0.01	–0.08**	0.00
Momentum of Stock Entering Month of Possible Sale			
Previous One-Month Return (top quintile)	0.29**	0.08**	0.10**
Previous One-Month Return (bottom quintile)	0.01	–0.13**	–0.09**
Previous 11-Month Return (top quintile)	0.29**	0.13**	0.14**
Previous 11-Month Return (bottom quintile)	–0.03*	–0.17**	–0.05
Momentum of Stock Entering Month of Original Stock Purchase			
Previous One-Month Return (top quintile)	0.16**	0.06**	0.01
Previous One-Month Return (bottom quintile)	0.08**	–0.05**	0.03
Previous 11-Month Return (top quintile)	0.17**	0.06**	–0.01
Previous 11-Month Return (bottom quintile)	0.06**	–0.02	0.02
Dividends			
Cumulative Dividend Return Since Purchase	–3.61**	–1.74**	–2.82**
Broad Framing – Overall Stock Portfolio Performance			
Household Portfolio Return Since Purchase of Stock	0.12**	0.14**	0.25**
Rebalancing – Share of Stock in Brokerage Account			
Stock's Share of HH Acct. when Purchased	0.94**	0.97**	0.57**
Change in Stock's Share of HH Acct Since Purchase	0.10**	0.07	0.01
Household-Specific Baseline?	No	No	Yes
Firm-specific Baselines/Controls (Panel C)?	No	Baselines	Controls

**, * denote significance at the 1 percent and 5 percent levels, respectively.

Table VI, *Panel C*: Cox Proportional Hazards Model of Stock Sales, Inclusion of Controls for Alternative Hypotheses, Taxable Accounts (continued)

Variable	**(4)**
Local stock (corporate headquarters within 50 miles of household)	–0.08 ** (0.02)
Bottom Quintile Book-to-Market Ratio	–0.04 ** (0.01)
Top Quintile Book-to-Market Ratio	0.00 (0.03)
Bottom Quintile Market Capitalization	–0.19 ** (0.02)
Top Quintile Market Capitalization	–0.13 ** (0.02)
Monthly Volatility	–0.58 ** (0.15)
Monthly Volatility*(Stock Has Accrued GAIN since purchase)	2.46 ** (0.13)
GAIN/LOSS, GAIN/LOSS relative to market, high-water mark, DEC included? (Panel A)	Yes
Other Controls? (Panel B)	Yes
HH-Specific Baseline?	Yes

**, * denote significance at the 1 percent and 5 percent levels, respectively.

Figure 1: Cumulative Probability of Stock Sale. Hazard rates for various assumptions concerning relative performance are calculated using a Cox proportional hazard model. These hazard rates are then accumulated to calculate cumulative probabilities of sale. All models that include relative performance also include the ratio of the current stock price to the high-water mark for the stock since purchase (equal to 1.0 for stock investments assumed to appreciate each month). See text for further details.

Chart A: Contrasting absolute winners and relative losers in taxable accounts. All estimates depicted in this chart that include relative performance are based on the assumption that the relative performance is zero.

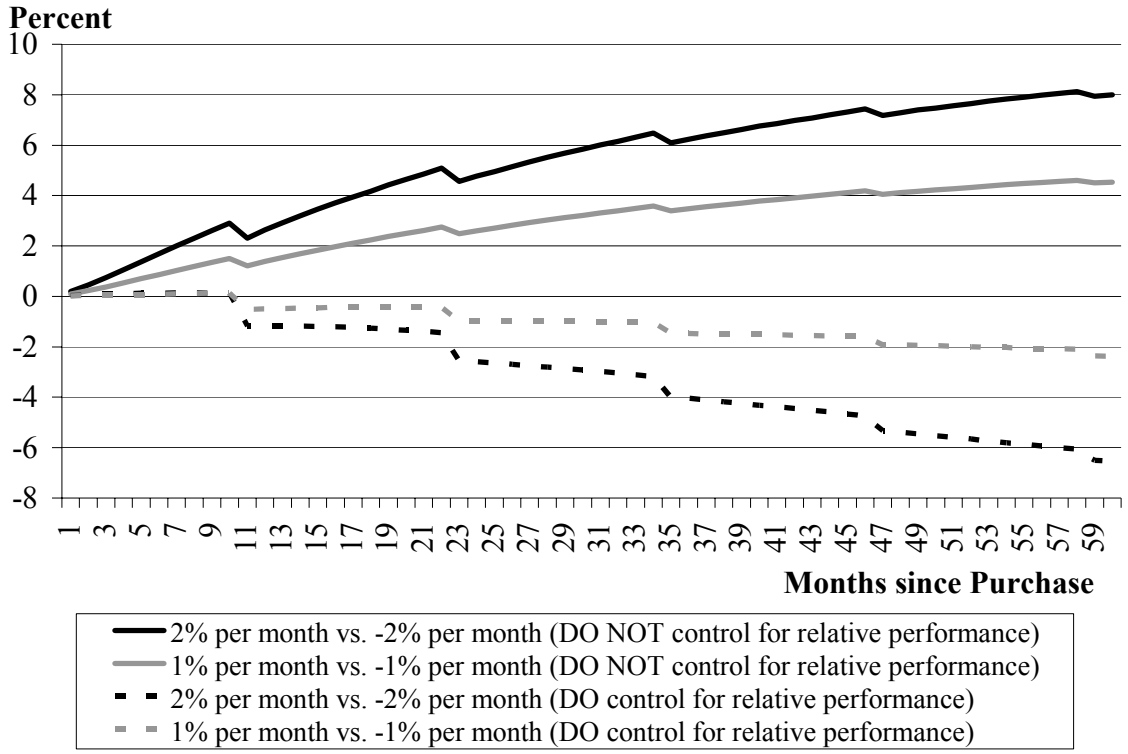

Figure 1: Cumulative Probability of Stock Sale (continued)

Chart B: Contrasting taxable accounts and tax-deferred accounts by capital appreciation. All estimates depicted in this chart are based on the assumption that the relative performance is zero.

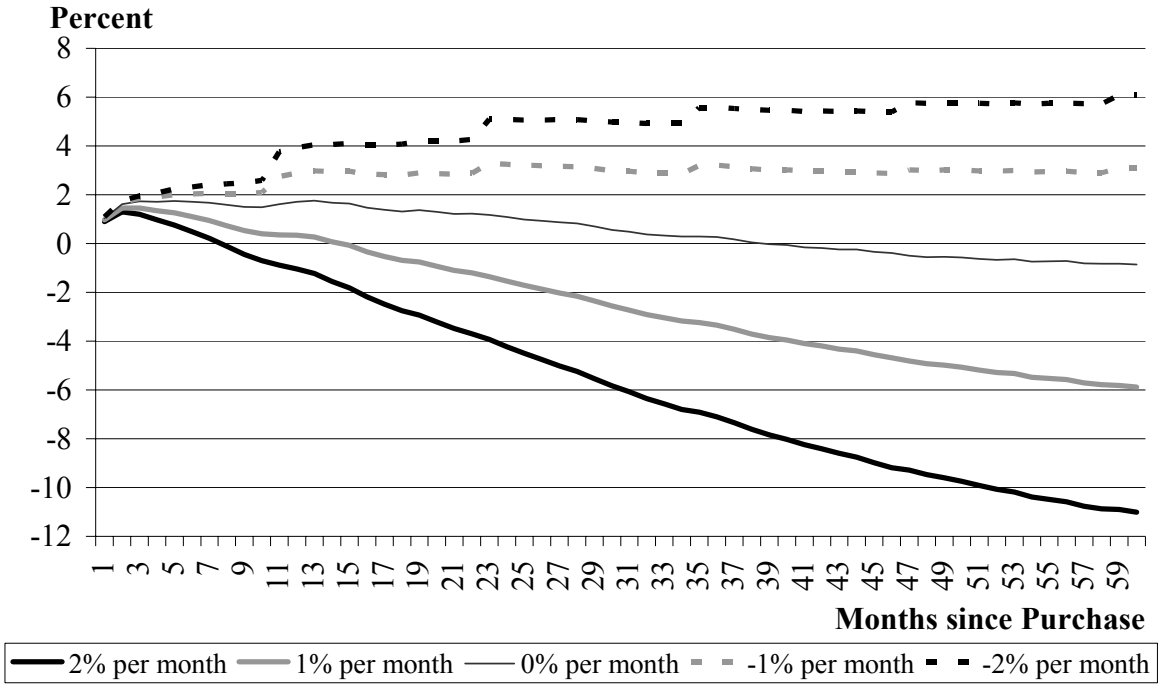

Figure 1: Cumulative Probability of Stock Sale (continued)

Chart C: Contrasting 1% monthly relative return to zero relative return (black line) and -1% monthly relative return to zero relative return (grey line). All investments depicted in this chart come from taxable accounts and have a 1% monthly absolute return.