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What Makes Investors Trade?

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ABSTRACT

A unique data set allows us to monitor the buys, sells, and holds of individuals and institutions in the Finnish stock market on a daily basis. With this data set, we employ Logit regressions to identify the determinants of buying and selling activity over a two-year period. We find evidence that investors are reluctant to realize losses, that they engage in tax-loss selling activity, and that past returns and historical price patterns, such as being at a monthly high or low, affect trading. There also is modest evidence that life-cycle trading plays a role in the pattern of buys and sells.

THE EXTRAORDINARY DEGREE OF TRADING ACTIVITY in financial markets represents one of the great challenges to the field of finance. Many theoretical models in finance, such as those found in Aumann (1976) and Milgrom and Stokey (1982), argue that there should be no trade at all. Empirical research by Odean (1999) also shows that the trades of many investors not only fail to cover transaction costs, but tend to lose money before transaction costs. To address the puzzle of why so much trading occurs, it would be useful to understand what motivates trades and whether such motivations are rooted in behavioral hypotheses, such as an aversion to realizing losses, a misguided belief in contrarianism or momentum that might be evidence of overconfidence (see, e.g., Daniel, Hirshleifer, and Subrahmanyam (1998)), or a love of gambling. Alternatively, it would be equally useful to learn if more rational motivations, such as portfolio rebalancing consistent with mean-variance theory, tax-loss trading, and life-cycle considerations are the fundamental drivers of trade.

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Up until now, the empirical analysis of what makes investors trade has been hindered by limited and incomplete data about the financial markets. Work by Odean (1998), Shapira and Venezia (1998), and Choe, Kho, and Stulz (1999), among others, either focuses on a small segment of the market that may not be representative and/or limits the analysis of trading to single issues, like contrarian behavior or the aversion to losses.

To gain a better understanding of the motivations for trade, it is useful to analyze a data set that describes how all market participants behave in equilibrium to characterize both the similarities and the heterogeneity of investors. The data set analyzed here allows us to do just this. With only negligible and rare exceptions, this data set categorizes in amazing detail the holdings and transactions of the universe of participants in the market for Finnish stocks. We use this data to analyze the motivations for buys, holds, and sales.

It would also be useful to analyze all of the potential trade-motivating factors together to both avoid omitted variable biases and to understand the way these factors interact. For example, lacking sufficient controls, evidence on the disposition effect—the tendency to sell "winners" and hold onto "losers"—could just as easily be interpreted as contrarian behavior with respect to past returns. It is also possible that these effects reinforce one another. Similarly, one cannot distinguish tax-loss selling from seasonally based momentum investing without controls for past returns. One of the contributions of this paper is its ability to analyze numerous behavioral and economic effects together and distinguish their contributions to trading activity. We also analyze a data set that contains unprecedented details on trades and traders. These details enable us to employ all of the customary controls and a "kitchen sink" of additional controls, so that the effects observed are unlikely to be due to alternatives arising from omitted variables about which we lack data.

We use Logit regressions to analyze separately the sell versus hold decision and the sell versus buy decision. We find that the disposition effect and tax-loss selling are two major determinants of the propensity to sell a stock that an investor owns. For all investor types, the tendency to hold onto losers is exacerbated for losses exceeding 30 percent. Stocks with large positive returns in the recent past and with prices at their monthly highs are more likely to be sold. We also find that the disposition effect interacts with past returns to modify the propensity to sell. Finally, regressions using all buys and sells indicate that life-cycle considerations play a modest role in the buy-sell decision, that negative past returns affect the buy-sell decision more than positive past returns, and that having a stock price at a monthly high or low exacerbates an investor's existing contrarian or momentum trading style.

The impact of past returns on the buy versus sell decision is complicated by equilibrium constraints. For example, not all investors can be contrarians if all buys are sells and vice versa. Contrarian behavior is greatest for the household, government, and nonprofit institution investor categories. By contrast, nonfinancial corporations and finance and insurance institutions, domestic groups that generally are more sophisticated than the other three investor types, exhibit much less of this contrarian behavior with respect to recent stock price run-ups. Foreign investors, by contrast, tend to be momentum investors. Heterogeneity of this type has also been found in prior research on other countries, notably by Choe et al. (1999).

The organization of the paper is as follows. Section I describes the data. Section II analyzes the factors that determine when an investor sells and when an investor holds. Section III analyzes buying activity in relation to selling activity. Section IV concludes the paper.

I. A Unique Data Set

This study employs a comprehensive data source: the central register of shareholdings for Finnish stocks in the Finnish Central Securities Depository (FCSD). Most of the details of this data set are reported in Grinblatt and Keloharju (2000a). For our purposes, it is essential to understand that:

- The register is the official (and thus reliable) daily recording, from December 27, 1994, through January 10, 1997, of the shareholdings and trades of virtually *all* Finnish investors—both retail and institutional. These official records are kept in electronic form.
- The data aggregate holdings across brokerage accounts for the same investor, whether the shares are held in street name or not.
- Investor attributes, in substantial detail, are reported with each transaction. Among the more interesting attributes is the investor category. We primarily focus on five categories, based on a classification system that has been determined by the European Union, observed at the top of Table I. A sixth foreign investor category is added to the analysis of buys versus sells in Section III.
- Foreigners are partially exempted from registration as they can opt for registration in a nominee name. This means that we know when an anonymous foreign investor bought or sold a stock (or equivalent ADR), but the stockholdings of virtually all foreign investors cannot be disaggregated by scientific investigation. Thus, the analysis of the sell versus hold decision, which uses panel data on an investor's entire portfolio on dates the investor sells stock, cannot analyze the decisions of foreign investors. However, the analysis of the buy versus sell decision, which is restricted to trades, can study both foreign and domestic investors.
- Because we lack data on holdings and transactions prior to December 27, 1994, we compute each domestic investor's capital gain or loss on a stock only for stocks acquired by open market purchase or equity offering within the sample period. For instance, a sale that takes place on January 30, 1995, with no intervening purchase between December 27, 1994, and January 30, 1995, is one for which we do not know the exact cost basis. Such a sale is eliminated from the analysis. A similar difficulty arises when a stock is acquired within the sample period by means

Table I

Determinants of the Propensity to Sell versus Hold

Table I reports maximum likelihood regression coefficients and t statistics for five Logit regressions, each regression corresponding to an investor category, along with number of observations and pseudo-R^2. The dependent variable is based on a dummy variable that obtains the value of one when an investor sells a stock for which the purchase price is known. Each sell is matched with all stocks in the investor's portfolio that are not sold the same day and for which the purchase price is known. In these "hold" events, the dummy variable obtains the value of zero. All same-day trades in the same stock by the same investor are netted. Panels A and B list regression coefficients and t statistics for market-adjusted returns associated with 11 past return intervals, with positive (Panel A) and negative (Panel B) market-adjusted returns represented separately. Panel C lists regression coefficients and t statistics for two capital loss dummies associated with moderate or extreme capital losses. Panel D lists regression coefficients and t statistics for two interaction variables representing the product of a dummy that takes on the value of one if the sale or hold decision is made in December, and the two capital loss dummies from Panel C. Panels E and F list regression coefficients and t statistics for 22 interaction variables, representing the product of a dummy that takes on the value of one if there is a realized or paper capital loss, and the 22 return regressors described in Panels A and B. Panel G reports on two reference price dummy variables associated with the stock being at a one-month high or low. Panel H reports on variables related to the stock's and market's average squared daily return over the prior 60 trading days. Panel I reports on a set of miscellaneous variables that control for the investor and his portfolio. Unreported are coefficients on a set of dummies for each stock, month, number of stocks in the investor's portfolio, investor age dummies, past market return variables, and products of a capital loss dummy and past market return variables.

	Dependent Variable: Sell vs. Hold Dummy									
	Coefficients					t-values				
Independent Variables	Nonfinancial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households	Nonfinancial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households
Panel A: Max [0, Market-Adjusted Return] in the Given Interval of Trading Days before the Sell vs. Hold Decision										
0	20.81	19.85	17.09	22.81	20.17	29.14	16.76	8.12	9.16	31.69
−1	12.41	11.08	9.11	10.97	10.32	17.80	9.31	3.71	4.55	17.16
−2	8.58	5.65	9.25	8.02	7.35	11.52	4.51	3.66	3.20	11.58
−3	6.42	4.24	11.22	9.55	6.27	8.43	3.33	4.17	3.29	9.82
−4	5.40	4.11	5.92	7.36	5.23	6.80	3.26	2.07	2.53	7.80
[−19,−5]	1.76	1.11	2.39	2.02	2.40	8.42	3.48	4.09	2.77	13.54
[−39,−20]	0.67	0.26	0.19	1.14	1.15	3.77	0.89	0.35	1.58	7.24
[−59,−40]	0.02	0.40	1.61	0.51	0.00	0.11	1.44	3.16	0.81	0.02
[−119,−60]	−0.03	−0.02	0.33	−0.12	0.07	−0.33	−0.11	1.18	−0.37	0.77
[−179,−120]	0.02	0.23	1.18	0.78	0.01	0.24	1.47	4.01	2.52	0.07
[−239,−180]	0.02	−0.08	−0.52	0.18	−0.15	0.20	−0.48	−1.48	0.55	−1.64

Panel B: Min [0, Market-Adjusted Return] in the Given Interval of Trading Days before the Sell vs. Hold Decision										
0	2.23	−1.50	0.54	5.51	3.46	1.79	−0.73	0.12	1.17	3.25
−1	5.43	1.74	9.39	7.44	5.76	4.60	0.91	2.06	1.73	5.64
−2	4.01	0.72	6.93	4.72	5.17	3.40	0.39	1.64	1.18	5.05
−3	3.68	1.18	4.06	0.11	3.53	3.22	0.64	0.99	0.03	3.48
−4	2.33	2.50	8.62	0.61	4.87	2.10	1.35	2.03	0.15	4.98
[−19,−5]	0.11	−0.92	0.45	2.26	1.10	0.29	−1.52	0.33	1.57	3.40
[−39,−20]	−0.70	−1.37	0.66	−1.72	−0.30	−2.41	−2.74	0.58	−1.54	−1.18
[−59,−40]	−0.43	−1.32	1.57	−2.29	0.46	−1.50	−2.68	1.36	−2.05	1.84
[−119,−60]	0.54	0.76	0.79	2.83	0.06	2.91	2.34	1.01	3.39	0.40
[−179,−120]	0.29	0.33	−1.33	0.42	−0.19	1.80	1.20	−2.13	0.65	−1.44
[−239,−180]	0.54	0.35	0.77	1.15	0.47	3.57	1.33	1.37	1.97	3.72
Panel C: Size of Holding Period Realized or Paper Loss										
[−1.00,−0.30]	−1.29	−0.88	−1.21	−1.53	−1.29	−10.54	−3.75	−2.26	−2.04	−13.33
[−0.30,0]	−0.70	−0.70	−0.65	−0.59	−0.82	−11.67	−6.54	−2.32	−2.14	−15.01
Panel D: Interaction Dummies for December and the Size of the Holding Period Realized or Paper Loss										
[−1.00,−0.30]	0.67	0.59	−3.37	−4.08	1.42	2.71	1.55	−0.45	−0.36	7.55
[−0.30,0]	−0.04	0.01	1.11	0.14	0.42	−0.41	0.08	2.91	0.41	5.33
Panel E: Max [0, Holding Period Capital Loss Dummy × Market-Adjusted Return] in the Given Interval of Trading Days before the Sell vs. Hold Decision										
0	0.24	−0.99	5.05	0.17	−6.10	0.17	−0.42	1.14	0.03	−4.94
−1	−5.58	−3.91	−4.42	6.14	−6.84	−3.67	−1.53	−0.70	1.16	−5.12
−2	−3.92	0.40	6.22	−4.27	−4.69	−2.52	0.15	1.11	−0.59	−3.51
−3	−3.81	−1.04	1.63	2.26	−4.17	−2.47	−0.39	0.24	0.36	−3.07
−4	−2.88	−2.73	−2.31	8.22	−0.26	−1.89	−1.07	−0.35	1.33	−0.20
[−19,−5]	−0.56	0.57	−0.69	−6.08	−1.17	−1.36	0.82	−0.39	−2.65	−3.35
[−39,−20]	−0.49	−0.87	−5.34	−4.88	−0.69	−1.40	−1.37	−2.95	−2.65	−2.20
[−59,−40]	0.12	0.48	−4.35	−4.29	0.04	0.33	0.84	−2.85	−2.48	0.14
[−119,−60]	0.23	0.07	0.03	1.14	−0.18	1.46	0.25	0.04	1.95	−1.23
[−179,−120]	0.00	−0.15	−0.56	0.26	0.05	0.02	−0.54	−0.83	0.44	0.37
[−239,−180]	−0.03	0.03	0.94	0.24	0.07	−0.17	0.11	1.29	0.35	0.43

(continued)

Table 1—*Continued*

Independent Variables	Dependent Variable: Sell vs. Hold Dummy									
	Coefficients					*t*-values				
	Nonfinancial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households	Nonfinancial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households
Panel F: Min [0, Holding Period Capital Loss Dummy × Market-Adjusted Return] in the Given Interval of Trading Days before the Sell vs. Hold Decision										
0	−10.07	−8.42	−0.74	−10.50	−9.08	−5.96	−3.05	−0.10	−1.53	−6.13
−1	−5.46	−6.37	−6.01	3.01	−7.84	−3.22	−2.30	−0.83	0.40	−5.35
−2	−1.40	−2.50	−11.66	−3.80	−4.59	−0.80	−0.87	−1.74	−0.54	−3.05
−3	1.57	−5.92	−3.32	8.18	−3.97	0.89	−2.19	−0.48	1.08	−2.60
−4	0.61	−1.42	−2.20	−0.15	−5.48	0.35	−0.50	−0.30	−0.02	−3.70
[−19, −5]	0.45	1.05	−3.15	1.25	−0.38	0.84	1.17	−1.46	0.54	−0.81
[−39, −20]	1.47	1.61	0.92	3.78	0.82	3.31	2.12	0.49	1.95	2.14
[−59, −40]	0.45	1.23	−0.33	4.76	0.63	1.01	1.57	−0.17	2.39	1.58
[−119, −60]	−0.15	−0.56	0.33	−1.97	0.15	−0.56	−1.18	0.28	−1.61	0.65
[−179, −120]	0.49	0.32	2.03	−0.38	0.54	1.82	0.71	1.81	−0.32	2.40
[−239, −180]	0.17	−0.68	1.51	−1.20	−0.08	0.65	−1.46	1.29	−0.96	−0.36

Panel G: Reference Price Variables										
Sell price < min price over days [−19, −1]	0.08	0.02	−0.20	0.27	0.15	1.77	0.27	−1.14	1.61	3.63
Sell price > max price over days [−19, −1]	0.11	0.22	0.17	0.07	0.15	4.34	5.28	2.00	0.81	6.45
Panel H: Volatility Variables										
Average (return)^2 of stock over days [−59,0]	−17.42	78.81	−476.94	110.48	−69.74	−0.53	1.15	−3.14	0.68	−2.70
Average (market return)^2 over days [−59,0]	−706.43	−784.20	−1816.22	277.35	−1186.15	−1.72	−1.20	−1.14	0.17	−3.14
Panel I: Miscellaneous Variables										
Ln (Value of portfolio)	0.0050	−0.0142	−0.0214	0.0412	−0.0034	0.72	−1.42	−0.59	1.21	−0.43
# of days between purchase and sale	−0.00170	−0.00230	0.00180	0.00050	0.00010	−17.00	−7.67	3.60	1.00	1.03
Bank		−0.09					−2.03			
Insurance company		−0.34					−7.05			
Public pension fund			−0.22					−2.48		
Employer or own-account worker					−0.024					−0.49
Employee					0.025					0.78
Male					−0.028					−1.39
N	105,286	46,795	13,991	11,475	122,765					
Pseudo-R^2	0.253	0.157	0.172	0.206	0.362					

other than a purchase on the exchange or an equity offering. This would include, for example, stock acquired via gifts or option exercise. Such acquired inventory also must be liquidated by sales before we can accurately compute the basis. Until that happens, sales of the stock are excluded from the analysis.

When multiple stock purchases occur, we compute the basis for the holding's capital gain or loss as the share volume weighted-average basis (properly adjusted for splits) of the investor's inventory of stock acquired in the sample period. Thus, an investor who purchases 100 shares of Nokia A at 600 FIM on January 6, 1995, and then 200 shares of Nokia A at 900 FIM on February 10, 1995, would (in the absence of further purchases) have a basis of 800 FIM in Nokia A after February 10, 1995. A sale of 150 shares of Nokia A on February 11, 1995, by this same investor is thus assumed to consist of 50 shares purchased previously on January 6 and 100 shares purchased on February 10. Any existing holdings of Nokia A on December 27, 1994, plus holdings acquired since December 27, 1994, for which no purchase price is available need to have been sold before February 11, 1995, to establish this basis correctly. We would exclude the February 11 sale from our analysis if this were not the case.[1]

The data set is obviously large. There are approximately one million sell transactions and one million buy transactions that we initially screen. In addition, for comparison purposes, and consistent with Odean (1998), most of our analysis matches each sell with all stocks in the investor's portfolio that are not sold the same day. Thus, our analysis of stock sales begins with millions of events. Several factors, outlined below and specific to the type of regression undertaken, reduce the size of the sample to that reported in our regressions.

In Section II, which reports the results of regressions that study sell versus hold behavior, we net all same-day trades in the same stock by the same investor (to mitigate the effect of intraday market making and double counting due to trade splitting), and we require that the purchase price used to compute the capital gain or loss for a sale or potential sale be unambiguous. In Section III, which studies buy versus sell behavior, we net intraday buys and intraday sells separately, except for nominee-registered foreign investors (for which the lack of panel data makes netting computations impossible). Finally, there is the requirement that all independent variables be available for all observations within an investor category, but this has little effect on the sample size.

[1] The price associated with the purchase or sale is generally the actual price the investor paid or received. For the first three months of the sample period, the actual purchase and sale prices are not available. In these cases, we use the closing price of the stock on the Helsinki Stock Exchange as the price for determining the basis for the realized capital gain or loss. We also analyze the potential capital gains and losses on some stock positions that are not sold. The closing price for the day is used to determine the hypothetical capital gain or loss that would occur if a stock were to be sold.

II. The Sell Versus Hold Decision

This section analyzes the determinants of a dummy variable representing the binary outcome: sell (coded as a "1") or do not sell (coded as a "0"). Each day that an investor sells stock, we examine all of the other stocks in his portfolio and classify them into one of these two outcomes, based on whether any of his holdings of that stock were sold. We report coefficients and *t* statistics from a Logit regression estimated with maximum likelihood procedures. We have verified that the results we will report shortly are neither Nokia-specific nor affected by serial correlation, and that they are similar to those obtained from the less sensible OLS specification.[2]

A. Description of the Regression

Each of 293,034 binary data points, obtained in the manner discussed above, belongs to an investor in one of the five domestic investor classes. For each domestic investor class, we estimate the relation between the dependent variable (sell versus hold) and 244 regressors, of which 18 are unique to households, 2 are unique to the finance and insurance institutions, and 1 is unique to the government sector. These regressors include a set of variables used as controls for which coefficients are not reported,[3] and a set of reported variables. The latter include (1) 22 variables related to past returns (listed in Table I, Panel A, which analyzes positive past returns over 11 horizons, and Panel B, which analyzes negative past returns over 11 horizons), (2) two dummy variables representing moderate and extreme capital losses (Panel C), (3) two dummy variables representing the interaction of a December dummy and the capital loss dummies (Panel D), (4) the interaction

[2] Our robustness checks include performing identical regressions throwing out various portions of the sample. For example, the results are largely the same if we exclude Nokia A and K shares, the most traded stocks, from the sample. For the highly significant variables we focus on in the paper, the non-Nokia coefficients are generally within 30 percent and frequently are within 10 percent of those reported in Tables I and II. Also, we have performed the same analysis using every other trading day and every fifth trading day to ensure that our test statistics are not biased by first-order serial correlation. Although the test statistic reduction is commensurate with the reduction in sample size, the coefficients are approximately the same, and the test statistics that we focus on in the full regression are all highly significant in the odd-day and even-day regressions.

[3] These include (1) 87 dummy variables for each stock (but one); to control for the tendency of any group to sell or hold any one stock (2) 25 dummy variables for each month analyzed (but one); to control for calendar effects (3) 35 dummy variables for the number of stocks held in the portfolio (one stock through 35 stocks, with greater than 35 being the omitted dummy); to control for cross-sectional differences in trading activeness across investors (4) 15 birth-year dummies; representing 5-year intervals to account for life-cycle effects (5) market returns over the same 11 past return intervals used for market-adjusted returns, (found by Choe et al. (1999) to account for trading behavior); and (6) 11 cross-products between the market return variables and a capital loss dummy to analyze if the disposition effect alters the reaction to past market returns. Using these controls adds a level of comfort to our assertion that the interpretation of the significant coefficients on our reported variables are not due to correlations with omitted variables.

of a dummy for a holding-period capital loss and the 22 past return variables (Panels E and F), (5) two reference price variables to assess if the sales decision is affected by the stock's price being at a one-month high or low (Panel G), (6) a pair of variables related to stock price and stock market volatility (Panel H), and (7) a set of eight miscellaneous variables that control for the investor and his portfolio (Panel I). Variables related to these sets of variables have either been postulated to be related to trading, common sense suggests they should be related to trading, or they have been found in prior empirical research to be related to trading. For example, because we control for the stock traded with stock dummies, the stock volatility variable asks whether an investor tends to sell a stock at a time when its volatility is higher than normal.

Because of the sample sizes involved, it is important that we draw conclusions from judgments about economic significance and that we rely less on standard hurdles for statistical significance. Consistent monotonic patterns and *t*-statistics that are significant by orders of magnitude more than standard significance levels are much more impressive in this regard than the occasional significant *t*-statistic that does not fit into a logical pattern. This is especially true when focusing on the investor categories with large numbers of trades, such as households and nonfinancial corporations. For such investor categories, isolated *t*-statistics of less than three for coefficients that are not part of a pattern are unimpressive, even though such *t*-statistics represent statistical significance at the 1 percent level.

B. Past Returns and the Sell Versus Hold Decision

Panels A and B of Table I report the degree to which the sell decisions of Finnish investors are affected by past returns. They also analyze whether positive past market-adjusted returns matter more than negative past returns and whether some historical intervals are more important than others. The 22 past return variables represent either positive market-adjusted returns (Panel A) or negative market-adjusted returns (Panel B) over 11 nonoverlapping trading-day horizons: the current day (day 0), the four days prior (days −1, −2, −3, and −4), and a series of multiday returns (days −19 to −5; −39 to −20; −59 to −40; −119 to −60; −179 to −120; and −239 to −180, inclusive). We explore the impact of these historical return variables because of evidence on momentum strategies (analyzed, for example, in Jegadeesh and Titman (1993)).[4] These strategies involve buying winning and selling (or shorting) losing stocks whereas contrarian strategies do the opposite. According to Grinblatt, Titman, and Wermers (1995) and Daniel et al. (1997), momentum accounts for a large portion of observed mutual fund performance. Nofsinger and Sias (1999) find that institutional ownership of

[4] In contrast to Choe et al. (1999), market returns over these same intervals were generally not significant and, at the suggestion of the referee, are not reported in the table.

stocks is related to their lagged returns. In addition, Choe et al. (1999) report that individual investors in Korea exhibit short-run contrarian behavior whereas foreign investors exhibit momentum behavior. Odean (1999) finds that investors tend to buy stocks with more extreme performance than those they sell and that they are likely to sell stocks that have performed well in recent weeks.

Panel A indicates that the larger the positive past market-adjusted returns of a stock, particularly in the recent past, the more likely it is that the investor will sell it. Because Logit regression coefficients generate nonlinear propensities to sell—propensities that are functions of the regressor values—expositing an economic interpretation for these largely positive coefficients is complicated. We assess economic significance by noting that each regression coefficient is four times the regressor's marginal impact on the probability of selling a stock for regressor values that make the propensity to sell $\frac{1}{2}$ (a predicted Logit of 0). For example, the 12.41 coefficient for day -1 in the nonfinancial corporation column indicates that a 10 percent market-adjusted return for a stock on the prior day increases the probability of a sale by 0.31 (about $\frac{1}{4}$ of 12.41 times 10 percent) from a point where the predicted propensity to sell is $\frac{1}{2}$. The coefficient from the analogous OLS regression for the linear probability model (not in the table) is 2.11, indicating that a 10 percent market-adjusted return for a stock on the prior day increases the probability of a sale by 0.21. These numbers are impressive, as are the *t*-statistics.

The results are fairly consistent across the investor categories. Returns beyond a month in the past (20 trading days) appear to have little impact on the decision to sell versus hold, whereas positive market-adjusted returns on any day of the last week, or during the last month, are significantly correlated with the decision to sell. Generally, the more recent the positive return, the more likely is the sell decision. Although the results for day 0 are the strongest of all, we do not have intraday panel data that would allow us to separate out the impact of returns on trading activity from the impact of trading activity on returns. However, if there is a simultaneous equations bias, it works to bias the coefficient downwards, and because of the orthogonality of the day 0 return with almost all of the other regressors, has little effect on the other coefficients. (We know this from running our analysis without the day 0 regressors.) Panel B indicates that in the prior week, the more negative are the market-adjusted returns, the lower is the propensity to sell. The significance of the positive *t*-statistics for households and nonfinancial corporations for horizons going back up to one week prior to the sale appears to be weaker than the impact of the positive returns on the propensity to sell. Moreover, there are occasional sign reversals at some of the longer horizons for some of the categories.

This evidence suggests that for Finnish investors, recent large positive market-adjusted returns (up to a month in the past) are an important factor in triggering a sell. Strongly negative market-adjusted returns (up to a week in the past) have a moderate tendency to reduce the probability of a sell.

After controlling for so many other determinants of trading, there is little evidence that past returns over intermediate or long-term horizons affect the propensity to sell.

C. Evidence on the Disposition Effect

Shefrin and Statman (1985) identified what they termed the "disposition effect," a tendency to hold onto losing investments in the hope of a turnaround. This effect is an application of Kahneman and Tversky's (1979) prospect theory. Evidence of the disposition effect with respect to stock trading has been documented for the accounts held at a U.S. discount brokerage house by Odean (1998) and for Israeli traders by Shapira and Venezia (1998).

Odean (1998) shows that investors trading through a U.S. discount brokerage house realize a larger proportion of gains than losses, but does not test whether his results are due to the capital loss or gain per se, or whether investors believe (rightly or wrongly) that contrarian strategies are profitable. Our tests distinguish the disposition effect from the contrarian strategy by controlling for both the stock's pattern of past returns and the size of the holding-period capital loss. Moreover, we have a kitchen sink of control variables in addition to comprehensive data on the trades in a market.

We characterize the functional form of the disposition effect by including dummies for extreme capital losses ($>$30 percent) and for moderate capital losses ($\leq$30 percent), with the omitted dummy being associated with either a capital gain or no price change.[5] Table I, Panel C, reports coefficients for the two capital loss dummy variables along with t-statistics. Although both moderate and extreme losses decrease the propensity to sell, there is a larger effect from the extreme capital losses. With the household category, for example, at a predicted Logit of zero, an extreme capital loss makes a sale 0.32 less likely than a capital gain, whereas a moderate capital loss makes a sale 0.21 less likely. The analogous OLS coefficients, not reported in a table, suggest that an extreme capital loss makes a sale 0.17 less likely and a moderate loss 0.12 less likely. The t-statistics for the households and nonfinancial corporations are also impressive, even with the large sample size, as are the t-statistics associated with the difference between the extreme and moderate capital loss Logit coefficients (-6.02 for the households and -5.66 for the nonfinancial corporations).

[5] This specification is motivated by the more agnostic specification from an earlier draft of this paper. There, to explore nonlinearities in the relationship between the capital gain or loss and the sell decision, we split the size of the holding period gain or loss variable into 76 dummy variables, each dummy representing an interval that lies within a 2 percent return band from -50 percent to $+100$ percent (with the default dummy associated with a capital gain that lies between 0 and 2 percent). The coefficients are relatively constant for the capital gains interval dummies, relatively constant but of opposite sign for the moderate capital loss dummies, and larger (in absolute size) for the more extreme capital loss dummies. At the suggestion of the referee, we present this more parsimonious representation of those results.

Plotting the distributions of holding period realized and paper capital gains and losses (without the controls in the regression) is also insightful. Panel A of Figure 1 shows the distribution of realized gains and losses for all investor categories aggregated together and Panel B shows the paper gains and losses. The left tail of Panel A, the realized capital gain returns, is much thinner than that in Panel B, the paper capital gain returns. The right tail in Panel A is much thicker. Perhaps most striking is what appears to be a discontinuity at zero for Panel A's distribution of realized capital gain returns. To the left of zero in Panel A, the height of the density function immediately drops off. For the paper capital gain returns of Panel B, the distribution to the left of zero appears to be relatively smooth.

Although these plots lack the hundreds of controls found in the regressions, they are consistent with the tendency for large gains to be realized and large losses to be held onto. They also tell a story that is very hard to explain as anything but a disposition effect. For example, in the Harris and Raviv (1993) model, investors have beliefs about a company's future prospects that are not closely tied to stock prices. Hence, as stock prices decline, stock in that company becomes more attractive and vice versa. However, Harris and Raviv's (1993) model is not consistent with the discontinuity observed in Figure 1, Panel A, but rather, with a skewed yet smoother distribution than that observed.[6]

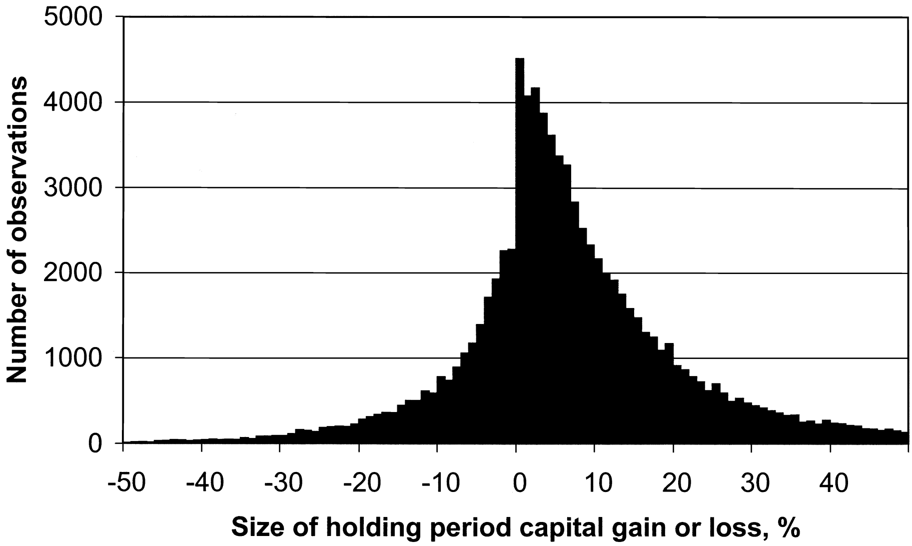
D. Evidence on Tax-Loss Selling

The regression includes interaction variables between the December dummy and capital loss dummies to capture the effect of tax losses on the sell decision, given the evidence that tax losses tend to be realized at the end of the year (see Badrinath and Lewellen (1991) and Odean (1998)).[7]

[6] Unreported work documents that the disposition effect influences the size of a sale: An investor tends to sell a smaller fraction of a stock position if the trade generates a capital loss.

[7] In 1994 and 1995, both capital gains and dividends were taxed at a flat 25 percent rate for all Finnish households and taxable institutions, irrespective of households' ordinary income tax rate or the length of the investment holding period. In 1996 and 1997, the tax rate was 28 percent. Households' ordinary income tax rates are much higher than the capital income rates—as high as about 60 percent. Dividends in Finland are taxed using an imputation system. Thus, dividends are taxed only once at the corporate level; given that the corporate and capital gains/dividend tax rates are the same, there is no further tax at the investor level. Tax exempt investor categories do not get any extra tax credit for dividends. In Finland the tax year ends at the end of December. Grinblatt and Keloharju (2000b) show with the data set analyzed in this paper that the lack of explicit constraints on wash sales leads many investors to realize their losses in late December and repurchase the stocks immediately after the sale. Kukkonen (2000), using tax data from a sample of wealthy Helsinki-based investors, documents that the effective average capital gains tax rate for all capital gains in 1995 was 10 percent, that is, much lower than the 25 percent tax rate. Thus, as in the United States (see, e.g., Poterba (1987) and Auerbach, Burman, and Siegel (1998)), investors successfully reduce their tax bill by realizing capital losses, but these losses are insufficient for completely avoiding taxes.

PANEL A: Realized Holding Period Capital Gains and Losses



PANEL B: Holding Period Capital Gains and Losses

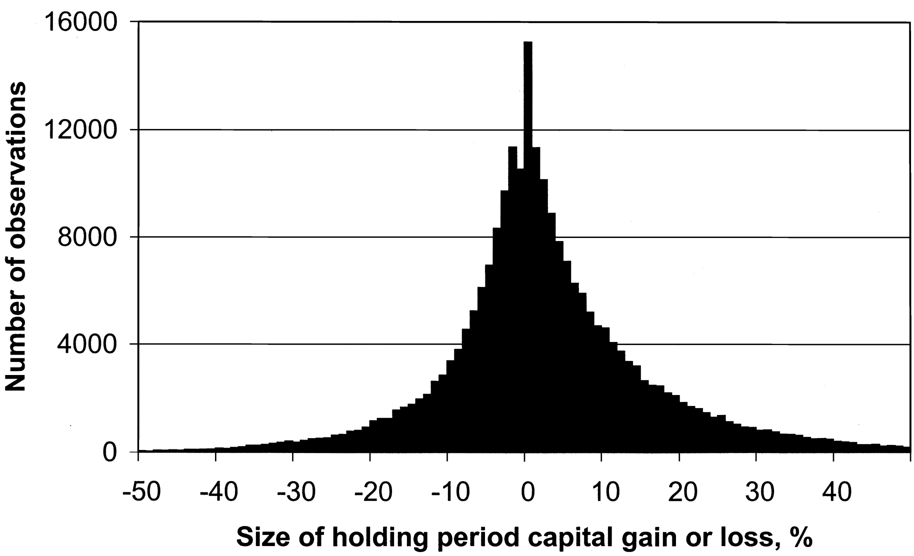


Figure 1. Distribution of the size of holding period realized and paper capital gains or losses. Panel A of Figure 1 graphs the distribution of the size of realized holding period capital gains or losses. The gains and losses are from sell transactions for which the purchase price is known. Each sell is matched with all stocks in the investor's portfolio that are not sold the same day and for which the purchase price is known. The distribution of the holding period capital gains or losses of these hypothetical transactions is graphed in Panel B. Both graphs use all observations from all investor categories for which panel data necessary to perform the computations are available. All same-day trades in the same stock by the same investor are netted.

The disposition effect can be regarded as the opposite of tax-loss selling in that investors are holding onto losing stocks more than they are holding onto winning stocks. Our regressions examine the extent to which the disposition effect is tempered by tax-loss selling at the end of the year and whether the degree of tempering is affected by the magnitude of the capital loss. Panel D of Table I plots the coefficients on two dummies representing the product of the capital loss dummies for a stock (described earlier) and a dummy for December. Households, in particular, seem to temper their tendency to sell winners and hold onto losers. At a predicted Logit of zero, households exhibit a 0.36 larger probability of selling extreme losers than they exhibit during the rest of the year, more than offsetting the disposition effect. In unreported OLS regressions, we similarly find that households are 0.18 more likely to sell extreme losers in December than during the rest of the year, again offsetting the disposition effect seen from January through November. The t-statistic associated with this change in behavior is 7.55, and the analogous statistic for moderate losses, 5.33, is also highly significant. (The t-statistic for the difference between the extreme and moderate loser coefficients for December is 5.54.)

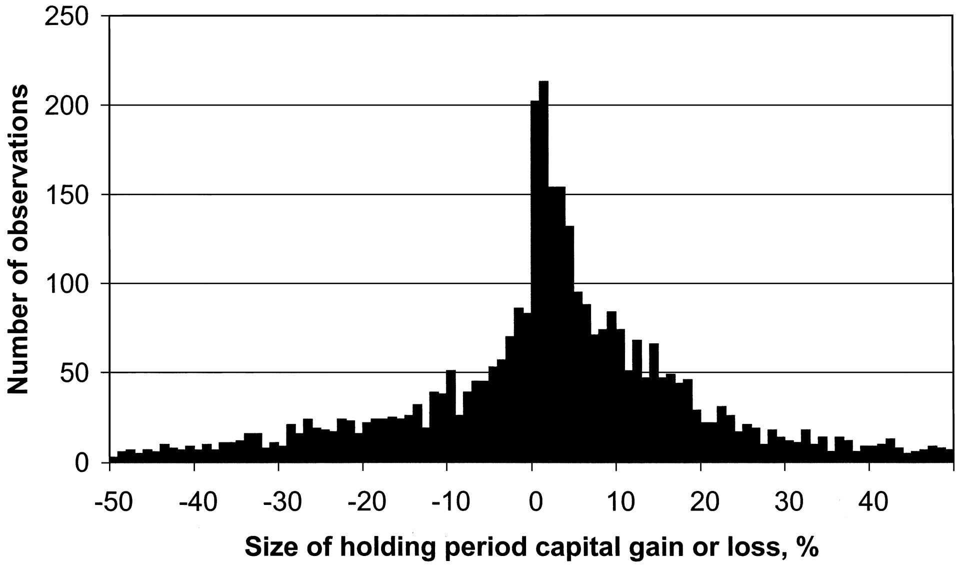
It does not appear as if moderate losses affect the selling behavior of the other taxable investor categories in December. Indeed, the moderate loss coefficient for December is so small that the spreads between the coefficients on the extreme and moderate capital loss coefficients for December exceed that for the disposition effect. Given that there are transaction costs associated with the sale of stock, and diversification reasons for maintaining a wide variety of stocks in one's portfolio, it is not surprising that the large capital losses matter most in December.[8]

The December tax loss selling story is actually more complex than these regressions reveal in that it is mostly the latter half of December that matters. Plotting the distributions of realized capital gains and losses in the first and last two weeks of December (without the controls in the regression) illustrates this point. Panel A of Figure 2 shows the distribution of realized capital gain returns for all investor categories in the last eight trading days of December and Panel B shows the distribution of realized capital gain returns in the first nine trading days of December.[9] However, the left tail of Panel A, the late-month realized capital gain returns, is much thicker than that for the early December returns in Panel B. The right tails seem comparable. Thus, these plots are consistent with the tendency for large losses to be realized "at the last minute."

[8] Although none of the other investor categories in Panel D has a t-statistic above three, all of the other taxable investor categories have positive coefficients on the extreme capital loss December dummy. The requirement of a sell in December and an extremely large loss lowers the power of the test, which may explain the relatively small magnitudes of some of the test statistics.

[9] The distribution from January through November, not shown, is largely indistinguishable from the Figure 2, Panel B, distribution for the first nine trading days in December, except for the increased smoothness in the distribution due to the larger sample size.

PANEL A: Last Eight Trading Days of December



PANEL B: First Nine Trading Days of December

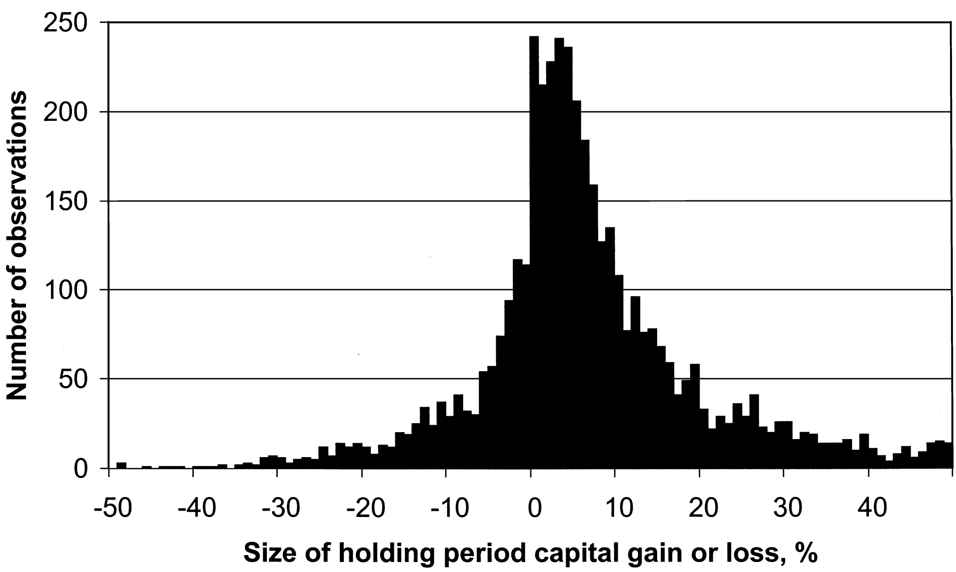


Figure 2. Distribution of the size of holding period capital gains or losses realized at different times of the year. Figure 2 graphs the distribution of the size of holding period capital gains and losses realized at different times of December. The gains and losses are from sell transactions for which the purchase price is known. All graphs use all observations from all investor categories for which panel data necessary to perform the computations are available. All same-day trades in the same stock by the same investor are netted.

E. The Interaction Between Contrarian Behavior and the Disposition Effect

The 22 past return variables in Table I, Panels E and F, are interaction terms to test whether the existence of holding period paper capital losses alters any observed tendency to sell or hold in response to past returns. In Panel E, we look at the reaction to positive past market-adjusted returns for stocks with capital losses; in Panel F, we look at the reaction to stocks with negative past market-adjusted returns for stocks with capital losses. For all but one small investor category, the coefficient on the prior-day market-adjusted return is negative in both panels. To elaborate on this point, recall from Panel A that at a predicted Logit of zero, a 10 percent prior-day market-adjusted return makes a nonfinancial corporation 0.31 more likely to sell a stock. The comparably positioned -5.58 coefficient observed in Panel E indicates that this 0.31 increase in the probability of a sale applies to a stock with a capital gain. For those with a capital loss, the increase in the likelihood of a sale from the 10 percent prior-day return is 0.17 at a predicted Logit of zero. This is 0.14 ($\frac{1}{4}$ of the -5.58 coefficient times 10 percent) less than 0.31.

The coefficient pattern in Panels E and F suggests that the negative relation between the propensity to sell and the prior day's return observed in Panels A and B is moderated by the existence of a paper capital loss for the stock. This is consistent with the disposition effect. If we accept that investors are reluctant to realize a loss, a price run up is less likely to motivate a trade that would realize a loss than a trade that would realize a gain. This pattern continues up to a week in the past for many of the other investor categories, but the effect is largely insignificant.

F. Evidence on Reference Price Effects

Table I, Panel G, indicates that the propensity to sell is positively related to whether a stock has hit its high price within the past month. For households, nonfinancial corporations, and finance and insurance institutions, this relation is highly significant. For households, being at a monthly low is significantly positively related to the propensity to sell.

These reference price variables have been shown to influence investment behavior. Heath, Huddart, and Lang (1999), for example, find that employee stock options tend to be exercised when stocks have attained their yearly high. Our findings and theirs are consistent with Kahneman and Tversky's (1979) prospect theory, which posits that reference points are important for behavior.[10]

[10] In contrast to their results, unreported analysis indicates that prices attaining a 6- or 12-month high or a 6- or 12-month low are relatively unimportant in the decision to sell in comparison with prices attaining a one-month high or low.

G. The Effect of Volatility

Table I, Panel H, also indicates that, with the possible exception of government investors, past return volatility seems to have no effect on the propensity to sell. The well-known result that increases in volatility (evidenced, e.g., by a large price innovation today) are positively related to trading volume (see, e.g., Epps and Epps (1976), Karpoff (1987), and Cornell (1981)), does not necessarily translate into a relation between volatility computed from past returns and current volume. This finding has been upheld here both statistically and economically. For example, a stock that has its annualized volatility increase from 30 percent per year to 40 percent per year has its daily variance increase from approximately 0.00036 to 0.00064. Despite the −69.74 coefficient for households, this translates into a decrease in the household propensity to sell of less than 0.5 percent at a predicted Logit of zero, which is rather unimpressive.

H. Evidence on Miscellaneous Stock and Investor Attributes as Determinants of Sales

In addition to past returns, capital losses, tax-loss selling variables, reference price effects, and volatility, our regressions control for a number of other miscellaneous stock and investor attributes. These miscellaneous attributes include the number of days since a stock was purchased and the logged market value of the portfolio on the day of the sale. In addition, the regressions for two of the institutional categories break the institutions into subcategories, whereas the regression for households controls for whether the investor is male or female, and has two dummies for employment status (nonemployed is the default). Finally, there is also a set of unreported control variables described earlier. The coefficients and *t*-statistics for the reported variables are in Table I, Panel I.

Panel I suggests that the time since purchase of the stock is negatively related to the for-profit institutions' propensities to sell. This probably reflects different turnover rates across institutional investors rather than differences in the way an investor treats old stocks and new stocks.[11] Neither employment status nor portfolio size matter, perhaps because the regression already controls for the number of stocks in the portfolio. The finding that gender is unrelated to the propensity to sell is curious in that it tends to contradict the results in Barber and Odean (2000), who find that men trade more than women do. It is possible that specification differences account for the differences in results. Our regressions control for a number of variables that are correlated with gender (e.g., portfolio size, number of stocks in the portfolio, and stock dummies) for which Barber and Odean do not control.

[11] Including 21 geographic variables—9 variables that characterize the municipality where the investor lives, 11 dummies for the province in which the investor lives, and a dummy for Greater Helsinki residents—has little effect on the remaining regression coefficients.

I. Comparing the Explanatory Power of Capital Loss and Past Return Variables

The capital loss variables (via both the disposition effect and tax-loss selling) are slightly less important determinants of the sell versus hold decision than past returns. For example, excluding the recent return variables and the interaction dummies between recent returns and a capital loss lowers the pseudo-R^2 of households by 0.021, whereas the exclusion of capital loss variables, tax, and the recent return–capital loss interaction dummies generates an R^2 that is 0.017 less than it previously was. The relative magnitudes of the R^2 reduction for the other two major categories—nonfinancial corporations and finance and insurance institutions—are similar, whereas government and nonprofit trading exhibit much more sensitivity to the past return variables.

III. An Analysis of Buying Activity in Relation to Selling Activity

In the absence of short selling (which is greatly inhibited by high transaction costs, the need for margin accounts, and both the difficulty and cost of borrowing shares), the universe of potential stock sales is restricted to those stocks that exist in an investor's portfolio. For this reason, we feel that our analysis of the sell versus hold decision presents a rather thorough picture of the determinants of sales.

The analysis of purchases, by contrast, is complicated by the fact that, at any moment in time, virtually all investments are not purchased. This makes a comparison of purchased with nonpurchased investments a largely useless exercise. Clearly, each investor restricts the universe of stocks under consideration for purchase to a manageable size, as Merton (1987) noted. Although a comparison between purchased stocks and the stocks in each investor's restricted universe of purchasable stocks would be useful, we lack information about what each investor does to restrict his universe.

In this section, we circumvent this problem by comparing purchases with sales. The analysis of the buy-sell decision is based on the same Logit regression framework used to analyze the sell versus hold decision. However, here the dependent variable is derived from a dummy variable that, conditional on a transaction, obtains the value of one if a transaction is a sell and zero if it is a buy.

A. Description of the Regression

The buy versus sell Logit regressions, reported in Table II, analyze 1,465,220 observations, which are subdivided by investor category. The regressions make use of the same regressors as the sell versus hold regressions in Section II, except that we exclude variables related to the disposition effect and tax-loss selling, and exclude days between purchase and sale.[12] This leaves us with 206 regressors, of which 18 are unique to households, two are unique to the

[12] We also report on 11 past market return variables and 15 birth year dummies.

Table II

Determinants of the Propensity to Sell Versus Buy

Table II reports maximum likelihood regression coefficients and t-statistics for six Logit regressions, each regression corresponding to an investor category, along with number of observations and pseudo-R^2. The dependent variable is based on a dummy variable that obtains the value of one when an investor sells a stock and zero when an investor purchases a stock. All intraday purchases and sales of a given stock by a given investor are netted separately. Because of the lack of panel data on stockholdings and transactions, the foreign investor regression does not control for the number of stocks in the investor's portfolio or the value of the portfolio. Moreover, intraday buys and sells are not netted for foreigners, except for a small fraction of observations for which panel data are available. Panels A, B, and C list regression coefficients and t-statistics for 11 past return intervals, with positive (Panel A) and negative (Panel B) market-adjusted returns, as well as past market returns (Panel C) represented separately. Panel D reports on two reference price dummy variables associated with the stock being at a one-month high or low, Panel E reports on variables related to the stock's and market's average squared daily return over the prior 60 trading days, Panel F reports on a set of age dummy variables, and Panel G reports on a set of miscellaneous variables that control for the investor and his portfolio. Unreported are coefficients on a set of dummies for each stock, month, and the number of stocks in the investor's portfolio.

	Dependent Variable: Sell vs. Buy Dummy											
	Coefficients						t-values					
Independent Variables	Non-financial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households	Foreigners	Non-financial Corp.	Fin. & Insurance Inst.	General Government	Nonprofit Inst.	Households	Foreigners
Panel A: Max [0, Market-Adjusted Return] in the Given Interval of Trading Days before the Transaction												
0	2.77	2.88	11.25	7.88	3.52	−2.21	8.16	6.22	8.13	5.68	13.80	−13.80
−1	1.07	1.00	6.27	4.50	−4.32	0.11	3.02	2.10	4.32	3.29	−18.21	0.71
−2	0.68	1.34	5.39	0.99	−1.65	−0.29	1.78	2.63	3.54	0.68	−6.48	−1.66
−3	1.09	1.37	3.92	3.19	0.26	−0.50	2.77	2.65	2.55	2.07	0.97	−2.83
−4	1.64	1.05	4.48	5.79	1.87	−0.69	4.03	2.02	2.85	3.72	6.68	−3.84
[−19, −5]	0.02	0.15	1.49	0.70	1.03	−0.17	0.20	1.15	3.84	1.80	15.39	−4.05
[−39, −20]	0.42	−0.10	0.58	1.46	2.01	−0.17	4.61	−0.87	1.78	4.37	30.28	−4.52
[−59, −40]	0.28	−0.05	0.43	0.77	1.28	−0.10	3.03	−0.44	1.30	2.15	19.89	−2.58
[−119, −60]	−0.18	0.14	0.78	−0.50	−0.10	−0.02	−3.66	2.21	4.41	−2.67	−2.91	−0.95
[−179, −120]	0.15	0.05	0.52	0.45	0.20	−0.09	2.84	0.86	2.90	2.42	5.36	−4.16
[−239, −180]	0.00	−0.10	−0.40	−0.04	0.06	0.15	−0.02	−1.43	−1.94	−0.19	1.50	6.16

Panel B: Min [0, Market-Adjusted Return] in the Given Interval of Trading Days before the Transaction												
0	6.91	5.05	6.91	8.53	8.38	−2.93	14.68	8.15	3.72	4.72	25.01	−15.91
−1	6.21	1.69	4.88	6.15	9.01	−2.71	12.92	2.74	2.55	3.37	27.95	−14.83
−2	3.76	0.47	4.35	2.80	8.96	−1.35	7.62	0.75	2.16	1.48	25.94	−6.89
−3	2.73	−0.30	2.02	4.11	6.08	−1.02	5.48	−0.49	1.02	2.10	17.83	−5.20
−4	2.22	0.57	2.07	1.02	4.99	−1.01	4.54	0.91	1.03	0.54	14.59	−5.01
[−19,−5]	1.26	0.19	0.23	1.42	3.94	−0.71	7.68	0.91	0.37	2.30	34.89	−10.32
[−39,−20]	0.25	−0.07	1.06	−0.79	0.41	−0.16	1.77	−0.39	1.97	−1.45	4.14	−2.72
[−59,−40]	−0.37	0.05	1.12	1.59	1.05	−0.12	−2.57	0.27	2.06	2.94	10.42	−2.01
[−119,−60]	−0.34	−0.19	−0.60	0.64	−0.08	0.06	−3.96	−1.75	−1.81	1.96	−1.40	1.64
[−179,−120]	−0.34	−0.03	0.05	−0.07	−0.33	0.10	−4.18	−0.34	0.17	−0.24	−5.63	2.92
[−239,−180]	−0.10	0.04	0.98	0.08	−0.76	−0.18	−1.14	0.35	3.11	0.24	−12.57	−4.78
Panel C: Market Returns in the Given Interval of Trading Days before the Transaction												
0	−1.23	−1.68	−1.87	3.61	5.48	1.97	−2.48	−2.77	−1.08	2.01	15.04	10.14
−1	2.17	2.04	−1.29	3.30	1.72	0.23	4.46	3.48	−0.75	1.90	4.93	1.18
−2	−0.05	0.64	5.40	3.20	3.64	0.83	−0.10	1.09	3.08	1.86	10.20	4.34
−3	0.07	−0.30	3.61	2.44	3.61	0.38	0.14	−0.51	2.05	1.36	10.01	1.93
−4	−0.88	0.65	0.16	−0.19	1.68	0.69	−1.78	1.11	0.10	−0.11	4.71	3.49
[−19,−5]	0.22	−0.75	−0.34	−0.81	2.46	0.23	0.75	−2.16	−0.34	−0.79	11.37	2.00
[−39,−20]	−0.83	−0.38	−1.88	−2.40	1.60	0.17	−2.92	−1.13	−2.00	−2.43	7.56	1.45
[−59,−40]	−1.17	−1.07	−1.81	−1.26	0.52	0.50	−4.11	−3.20	−1.84	−1.30	2.48	4.40
[−119,−60]	−0.61	−0.88	−1.14	0.03	0.97	0.19	−2.46	−3.04	−1.37	0.04	5.37	1.95
[−179,−120]	−0.39	−0.99	−0.70	0.01	2.72	0.24	−1.49	−3.26	−0.82	0.02	14.54	2.32
[−239,−180]	−0.30	−0.23	1.14	0.89	1.56	0.00	−1.40	−0.88	1.56	1.31	9.66	0.04
Panel D: Reference Price Variables												
Sell price < min price over days [−19,−1]	−0.24	−0.10	−0.46	−0.14	−0.25	0.12	−9.74	−3.41	−5.35	−1.71	−15.15	13.60
Sell price > max price over days [−19,−1]	0.07	0.08	0.39	0.06	0.14	−0.12	4.60	4.18	7.04	1.11	11.84	−17.34
Panel E: Volatility Variables												
Average (return)^2 of stock over days [−59,0]	−34.68	−35.41	−174.07	−225.62	−265.66	25.07	−1.91	−1.42	−2.20	−2.90	−21.27	3.06
Average (market return)^2 over days [−59,0]	−132.92	−7.26	−315.74	886.02	−760.34	46.77	−0.52	−0.02	−0.36	1.00	−4.05	0.46

(continued)

Table II—*Continued*

Independent Variables	Coefficients: Non-financial Corp.	Coefficients: Fin. & Insurance Inst.	Coefficients: General Government	Coefficients: Non-profit Inst.	Coefficients: House-holds	Coefficients: Foreigners	t-values: Non--financial Corp.	t-values: Fin. & Insurance Inst.	t-values: General Government	t-values: Non-profit Inst.	t-values: House-holds	t-values: Foreigners
	Dependent Variable: Sell vs. Buy Dummy											
Panel F: Birth Year Dummies												
[1890,1910]					0.73						15.03	
[1911,1916]					0.22						5.92	
[1916,1920]					0.08						2.68	
[1921,1925]					−0.02						−0.75	
[1926,1930]					−0.04						−1.94	
[1931,1935]					−0.02						−1.37	
[1936,1940]					0.00						0.14	
[1941,1945]					0.01						0.88	
[1951,1955]					0.01						0.47	
[1956,1960]					0.05						3.25	
[1961,1965]					0.07						4.14	
[1966,1970]					0.15						7.66	
[1971,1975]					0.21						8.64	
[1976,1980]					−0.02						−0.79	
[1981,1997]					−0.49						−16.38	
Panel G: Miscellaneous Variables												
Ln(Portfol. value)	−0.08	−0.03	−0.06	−0.09	−0.12		−22.00	−7.73	−4.06	−6.43	−39.60	
Bank		0.07						4.80				
Insurance company		−0.32						−13.33				
Public pension fund			−0.33						−4.96			
Employer or own-account worker					−0.20						−9.32	
Employee					−0.23						−16.79	
Male					−0.30						−32.66	
N	144,046	99,843	14,478	14,169	333,722	858,962						
Pseudo R^2	0.022	0.014	0.100	0.112	0.117	0.007						

finance and insurance institutions, and one is unique to the government sector. The exclusion of the variables, arising from the fact that it is not meaningful to analyze how the disposition effect and tax-loss selling affect buy decisions, enables us to analyze the buys and sells of foreigners (for whom the data needed to compute capital gains are unavailable). This also largely explains the increased sample sizes: There are tens of thousands, and for some investor categories, hundreds of thousands of data points.

Panels A and B of Table II report the coefficients and t-statistics for three sets of 11 historical return variables. These coefficients determine the degree to which an investor category follows a momentum or contrarian strategy in the buy versus sell decision. Panel A reports the coefficients on positive market-adjusted returns for the six regressions. Panel B reports the coefficients on negative market-adjusted returns. Panel C reports the coefficients on past market returns.

B. Past Returns and the Sell versus Buy Decision

Panel A in Table II indicates that, generally, high past returns make it more likely that a domestic investor will sell rather than buy a stock. The opposite is true for foreign investors. This effect lasts for returns up to a week in the past for some of the investor categories and up to three months for households and foreigners. Households have one anomaly in the relation between their buy-sell pattern and past positive returns: For the two days prior to the purchase or sale, households are momentum investors, in contrast to their behavior over more distant horizons.

The anomalous household behavior with respect to the stock's positive market-adjusted return over the two prior days is overshadowed by the consistent behavior exhibited with respect to the negative returns. Panel B in Table II indicates that the negative returns typically have a stronger impact on the buy-sell decision than do positive returns. Negative returns of large magnitude are predictive of buys for the five domestic investor categories and of sells for the foreigners category. For example, the 9.01 household coefficient for day -1 implies that a 10 percent negative market-adjusted return on the day prior to the potential sale or purchase by a household investor increases the probability that a transaction will be a purchase by about 0.23 when the predicted Logit is zero.

The buy-sell effect of negative past returns exists only with respect to the prior day for the finance and insurance institutions, but exists up to three months for the five remaining categories. The t-statistics, which are extremely large, also display this same pattern. The results are fairly consistent across the investor categories. It is not surprising that the foreigner category generally has the opposite behavior from the rest of the market with respect to past returns. There is a loose adding-up constraint in that every buy corresponds to a sell and vice versa. Hence, if all but one of the investors in the market is a contrarian, the remaining investor has to be a momentum investor. However, this constraint is not perfectly expressed in the row sums of the regression because we do not volume weight within or across categories and because the regressions of different subcategories can have different control variables.

With few exceptions, the impact of the market return on the buy-sell decision is weaker than the effect of the market-adjusted return of an individual stock. Except for households, the relevant past market return horizon also tends to be short, at most three days. For households, the relevant horizon is up to one year in the past. There are occasional sign reversals at some of the longer horizons for some of the categories, but given the sample size, the associated *t*-statistics are unimpressive. This evidence suggests that Finnish investors can be viewed as contrarians when it comes to the buy-sell decision, while foreign investors can be viewed as being momentum oriented.[13]

C. Evidence on Reference Price Effects

The reference price variables—being at a monthly high or low—appear to play a more important role in the buy versus sell decision than they do in the sell versus hold decision. Panel D of Table II shows that for domestic investors, being at a monthly low increases the propensity to buy whereas being at a monthly high increases the propensity to sell. The opposite is true for foreign investors. In other words, being at a monthly high or low exacerbates the existing momentum or contrarian tendencies that an investor category exhibits.

D. The Effect of Volatility

Table II, Panel E, indicates that high volatility increases the propensity of households to buy rather than sell a stock. The effect is strong with a *t*-statistic of about -21. Keep in mind that we are controlling for the magnitude and direction of the return, be it positive or negative. Although it is hard to concoct a rational story for this finding, one cannot help but recall the interest in Internet stocks on the U.S. Nasdaq market in 1998 and 1999. Stocks with such unprecedented volatility were largely shunned by experienced institutional investors during this period. Yet, they were the darlings of the inexperienced, sometimes tech-savvy small investor with access to information on the Internet and a desire to get rich quick. Although this analogy may not explain the coefficient observed, it is certainly worthy of further investigation.[14]

[13] In unreported work, we performed an event study that shows that both buys and sells tend to be associated with positive past returns. However, for domestic investors, the positive past returns (up to three months in the past) associated with buys tend to be much smaller than the positive past returns (up to three months) associated with sells. The opposite is true for foreigners.

[14] This is the only finding in the paper that may be due to Nokia, which experienced exceptional volatility swings over portions of the 1995 to 1996 sample period.

E. Evidence on the Life-Cycle Hypothesis

Panel F of Table II investigates the life-cycle hypothesis, developed in Modigliani and Brumberg (1954). The life-cycle hypothesis suggests that rational economic agents should smooth their consumption by appropriately investing and borrowing based on expectations about lifetime income. This has implications for the pattern of investment over the life of an investor: young people of low earning power should borrow to increase consumption; during the peak earning years of middle age they should save; and later in life they should divest to supplement whatever income they have to increase consumption.

Panel F presents age-dummy Logit coefficients from the regression for households along with t statistics. They suggest that relative to those born from 1946 to 1950, the youngest investors (post-1980 birth years) buy more. This is probably due to custodial investing by relatives on behalf of the child. Young adults either divest (what is presumably inherited stock wealth) or, at the very least, invest less than the middle-age adults born from 1946 to 1950. Older investors, however, once past their earning years, start to reduce their savings (sell stocks) and thus consume more than their income.

Investors begin net sales of stocks at an age that is later in life than one might expect from the life-cycle hypothesis. Lindell (1998), for example, notes that 90 percent of Finns retire before the mandatory retirement age of 65. However, only those born before 1920 (at least 75 years old) appear to be net sellers of stock relative to the benchmark age group born between 1946 and 1950. In addition, the marginal propensity to buy is relatively constant for most of the investor's working life, which is surprising in light of the life-cycle hypothesis. However, we have controls for employment status and wealth already in the regression, so it is not surprising that at the margin, the impact of age is rather modest. For example, those born between 1921 and 1965, and thus approximately range from 30 to 75 years old, have propensities to buy (sell) stock that are within three percent of one another.

The modestness of the contribution of life-cycle trading is supported by the R^2 contribution of the birth-year dummies. Taking these dummies out reduces the pseudo-R^2 by a negligible 0.002. By contrast the comparable R^2 reduction for a specification without the past return variables is 0.019.

F. The Impact of Miscellaneous Control Variables

Table II, Panel G, looks at a variety of other control variables. The results here suggest that the size of the portfolio is positively related to the propensity to buy (rather than sell), particularly for household investors. Conditional on a trade, at a predicted Logit of zero, employers and employees are about 0.05 more likely to buy than the nonemployed (typically students and retirees). Moreover, men have about a 0.07 larger propensity to buy stocks than women at a predicted Logit of zero. The unreported OLS coefficients are very similar to these propensities.

The gender effect can be interpreted in light of the results in Section II, which suggest that men and women have similar propensities to sell. The greater propensity for men to buy rather than sell would be consistent with men trading more than women. Thus, our results could be broadly consistent with Barber and Odean (2000) if a direct linkage can be made between the gender coefficient in the sell versus hold regression in Section II and that in the buy-sell regression analyzed here. Obviously, however, it is unlikely that any gender is consistently a net buyer of stocks relative to the other gender. Therefore, we must be cautious about this interpretation.

IV. Summary and Conclusion

This paper presents a comprehensive analysis of the determinants of buy and sell transactions. With a variety of tests, it shows that past returns, reference price effects, the size of the holding period capital gain or loss, tax-loss selling, and, to a small extent, the smoothing of consumption over the life cycle all are determinants of trading.

The regressions for the sell versus hold decisions suggest that the propensity to sell stocks one holds is positively related to recent returns. The effect of the past return on trading activity is much more important for positive past market-adjusted returns than for negative past market-adjusted returns. Investors also tend to be reluctant to realize their losses except in December, when the urge to realize large losses for tax purposes tends to eliminate this effect. We also present evidence that tax-loss selling primarily arises in the last two weeks of the year and that reference prices matter.

Conditional on a trade, sophisticated investor classes place less weight on past returns in deciding whether the trade is to be a buy or sell. By contrast, the less sophisticated investors—households, general government, and nonprofit institutions—are more predisposed to sell than to buy stocks with large past returns. The buy versus sell results are largely consistent with the results of Grinblatt and Keloharju (2000a), in that domestic investors—particularly the less sophisticated investor categories—tend to be contrarians and foreign investors tend to be momentum investors. They are also consistent with the sell versus hold evidence that high past market-adjusted returns generate sells.

Life-cycle considerations also may account for some of the trading. Investors tend to sell (primarily inherited stock) early in life, purchase stock in the prime earning years of middle age, and then sell stocks in old age. However, the results are economically unimpressive.

By looking at all participants in the stock market, we are able to generate a more complete picture of the stylized facts of trading than can be achieved by exploring only a small fraction of the participants in the market. Also, our methodological design incorporates numerous controls to avoid spurious conclusions based on omitted variables. We believe that the main conclusions of this work are fairly robust. For example, when we break the sample into both odd and even months, or into separate calendar years, we find that the results are largely unchanged. However, it remains for future research on other stock markets and other time periods to fully verify this conjecture.

The main conclusion after compiling the stylized facts about trading is that theoreticians are going to be challenged. Although many of the documented facts have separate theoretical models to explain them, researchers will have to come up with better models than those that currently exist to explain these stylized facts in combination with one another.

REFERENCES

Auerbach, Alan, Leonard Burman, and Jonathan Siegel, 1998, Capital gains taxation and tax avoidance: New evidence from panel data, Working paper, National Bureau of Economic Research.

Aumann, Robert, 1976, Agreeing to disagree, *Annals of Statistics* 4, 1236–1239.

Badrinath, S., and Wilbur Lewellen, 1991, Evidence on tax-motivated securities trading behavior, *Journal of Finance* 46, 369–382.

Barber, Brad, and Terrance Odean, 2000, Boys will be boys: Gender, overconfidence, and common stock investment, *Quarterly Journal of Economics*, forthcoming.

Choe, Hyuk, Bong-Chan Kho, and René Stulz, 1999, Do foreign investors destabilize stock markets? The Korean experience in 1997, *Journal of Financial Economics* 54, 227–264.

Cornell, Bradford, 1981, The relationship between volume and price variability in futures markets, *Journal of Futures Markets* 1, 303–316.

Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russell Wermers, 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* 52, 1035–1058.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam, 1998, Investor psychology and security market under- and overreactions, *Journal of Finance* 53, 1839–1886.

Epps, Thomas, and Mary Lee Epps, 1976, The stochastic dependence of security price changes and transaction volumes: Implications for the mixture-of-distributions hypothesis, *Econometrica* 44, 305–321.

Grinblatt, Mark, and Matti Keloharju, 2000a, The investment behavior and performance of various investor-types: A study of Finland's unique data set, *Journal of Financial Economics* 55, 43–67.

Grinblatt, Mark, and Matti Keloharju, 2000b, Tax-loss trading and wash sales, Working paper, University of California, Los Angeles.

Grinblatt, Mark, Sheridan Titman, and Russell Wermers, 1995, Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior, *American Economic Review* 85, 1088–1105.

Harris, Milton, and Arthur Raviv, 1993, Differences of opinion make a horse race, *Review of Financial Studies* 6, 473–506.

Heath, Chip, Steven Huddart, and Mark Lang, 1999, Psychological factors and stock option exercise, *Quarterly Journal of Economics* 114, 601–627.

Jegadeesh, Narasimhan, and Sheridan Titman, 1993, Returns to buying winners and losers, implications for stock market efficiency, *Journal of Finance* 48, 65–92.

Kahneman, Daniel, and Amos Tversky, 1979, Prospect theory: An analysis of decision under risk, *Econometrica* 47, 263–291.

Karpoff, Jonathan, 1987, The relation between price changes and trading volume: A survey, *Journal of Financial and Quantitative Analysis* 22, 109–126.

Kukkonen, Matti, 2000, Capital gains taxation and realization behavior: Evidence from Finnish panel data, Ph.D. dissertation, Helsinki School of Economics and Business Administration.

Lindell, Christina, 1998, Pensions are not the solution to the unemployment problem, *Central Pension Security Institute Reports 1998* 10, Helsinki.

Merton, Robert, 1987, A simple model of capital market equilibrium with incomplete information, *Journal of Finance* 42, 483–510.

Milgrom, Paul, and Nancy Stokey, 1982, Information, trade, and common knowledge, *Journal of Economic Theory* 26, 17–27.

Modigliani, Franco, and Richard Brumberg, 1954, Utility analysis and the consumption function: An interpretation of cross-section data; in K. Kurihara, ed.: *Post Keynesian Economics* (Rutgers University Press, New Brunswick, NJ).

Nofsinger, John, and Richard Sias, 1999, Herding and feedback trading by institutional and individual investors, *Journal of Finance* 54, 2263–2295.

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

Odean, Terrance, 1999, Do investors trade too much? *American Economic Review 89*, 1279–1298.

Poterba, James, 1987, How burdensome are capital gains taxes? Evidence from the United States, *Journal of Public Economics* 33, 157–172.

Shapira, Zur, and Itzhak Venezia, 1998, Patterns of behavior of professionally managed and independent investors, Working paper, New York University.

Shefrin, Hersh, and Meir Statman, 1985, The disposition to sell winners too early and ride losers too long: Theory and evidence, *Journal of Finance* 40, 777–790.