THE JOURNAL OF BEHAVIORAL FINANCE, 10: 9–18, 2009

ISSN: 1542-7560 print / 1542-7579 online
DOI: 10.1080/15427560902719497

Routledge
Taylor & Francis Group

The Hedonic Editing Hypothesis: Evidence from the Finnish Stock Market

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Prospect theory-based hedonic editing hypothesis posits that people integrate or segregate multiple outcomes so as to achieve the highest perceived value. We test the hypothesis in an actual decision-making context by investigating how stock market investors time their sales of stocks when realizing gains and losses. If the principles that guide investors' behavior are those suggested by the hedonic editing hypothesis, we should observe investors integrating losses more frequently than gains and integrating smaller losses with larger gains rather than the other way around. Our results do not conclusively support either of these assumptions but suggest that the relationship between prospect theoretic preferences and investor behavior is not as general as it might seem.

Keywords: Hedonic editing hypothesis, Prospect theory

INTRODUCTION

Suppose an investor has decided to sell two of her stocks, both of which are trading at a price higher than the price at which she originally purchased the stocks. Does the investor realize the two gains at the same time, in other words, integrate them, or does she rather enjoy the gains one by one by segregating them? Would the decision the investor makes be any different were the stocks sold at a loss? Is one large loss more or less unpleasant than two smaller losses; that is, will the investor rather integrate or segregate the losses? These are the kind of questions we seek to answer in this study.

With the aim of providing a detailed account of how people would like to have multiple outcomes framed, Thaler [1985] introduces the notion of hedonic editing.[1] The framework of hedonic editing is derived from Kahneman and Tversky's [1979] prospect theory, and it is based on the assumption that in doing their mental accounting, people tend to frame multiple outcomes in a way that yields the highest perceived value. Because of the nonlinearity and asymmetry of the prospect theory value function, the hedonic editing hypothesis suggests that in some situations integration of outcomes into a single mental account will maximize the perceived value, whereas in other situations the highest value can be achieved by segregating outcomes into separate mental accounts. In particular, perceived value is maximized if a gain is segregated from another gain, and if a loss is integrated with another loss. Highest value is also achieved if a small loss is integrated with a larger gain (a mixed gain), and if a small gain is segregated from a larger loss (a mixed loss).

Despite its intuitive and theoretical appeal, relatively little empirical research has been undertaken to test the hedonic editing hypothesis. More important, the findings of the few studies that have been conducted are mixed. Most of the evidence is based on questionnaire results involving hypothetical scenarios with no or only minor financial consequences to the subjects. Thaler himself [1985] conducts a simple experiment where the subjects are asked to compare pairs of outcomes either segregated or integrated, and to indicate which one they prefer. For example:

> Mr. A was given tickets to lotteries involving the World Series. He won $50 in one lottery and $25 in the other. Mr. B was given a ticket to a single, larger World Series lottery. He won $75. Who was happier?

The results of this experiment support the four principles of hedonic editing described above. In another experiment, Thaler and Johnson [1990] ask their subjects to state their preferences for timing of events. In each case the same two events would occur, either on the same day (for Mr. A) or two weeks apart (for Mr. B). The subjects are then asked to judge

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whether a temporal segregation or integration is preferable. For example:

> The events are:
>
> 1. win $25 in an office lottery.
> 2. win $50 in an office lottery.
>
> Who is happier?

In line with the hedonic editing hypothesis, the majority of the subjects would like to have the two gains separately. In contrast to the hypothesis, they also show preference toward temporal segregation of losses. Linville and Fischer [1991] also investigate the preferences of individuals for temporally segregating or integrating events. In addition to financial outcomes (monetary gains and losses), they also consider academic events (excellent or poor grades on exams or home assignments) as well as social events (positive or negative encounters with people). In all domains, the results are consistent with those of Thaler and Johnson [1990] and thus only partially confirm the hedonic editing hypothesis.

Lim [2006] is, to our knowledge, the only study to date investigating people's preferences for segregating or integrating multiple outcomes outside of an experimental setting. Lim examines how capital gains and losses affect the propensity of a group of U.S. investors to sell multiple stocks on a same day. Using sales records of more than 50,000 accounts at a large discount brokerage house during 1991–1996, and controlling for a variety of alternative explanations, she finds results supporting the hedonic editing hypothesis. In particular, according to Lim, when investors sell their stocks, they tend to integrate their losses on a same day and segregate their gains over different days.

The aim of the current study is to test the hedonic editing hypothesis in a real market setting. With highly detailed data on the shareholdings and market transactions of *all* individual investors in the Finnish stock market, we are able to provide a comprehensive analysis of the preferences of investors for segregating or integrating multiple outcomes. More specifically, when selling their stocks, investors usually have high control over the timing of the sales. Consequently, they can choose to segregate or integrate gains, losses, or some mixture of them in a way that yields the highest perceived value. Whether the principles that guide the decisions of investors are those suggested by Thaler [1985] is investigated in detail in this paper.

We find only weak evidence for the hedonic editing hypothesis: Investors in our sample do not consistently integrate their losses and segregate their gains. In fact, on many occasions, investors integrate their gains at a higher rate than their losses. This observation is even more pronounced after controlling for a wide range of other determinants of investors' selling behavior, including trading month, historical returns on the sold stocks and on the market, selling activity of an investor, overall trading activity in the market, portfolio size, and number of stocks in an investor's portfolio. In general, the evidence regarding the cases of mixed gains and mixed losses is also in contrast to the hedonic editing hypothesis: Investors in our sample prefer to integrate smaller gains with larger losses rather than the other way around.

As pointed out by Lim [2006], behavioral patterns consistent with the hedonic editing hypothesis (if there exist any) may have important implications on the empirical study of asset pricing. Given the weak support we find for the hedonic editing hypothesis, we emphasize the importance of the research question from the theoretical point of view. Besides the integration versus segregation decision of an investor, prospect theory has also been used to explain other investment behavior, most notably the tendency of investors to realize their gains rather than losses. This phenomenon, known as the disposition effect, is observed in a series of papers, including Shefrin and Statman [1985], Odean [1998], and Grinblatt and Keloharju [2001b]. As robust as the disposition effect is, there is little supportive evidence for the prospect theory-based explanation in the form of other observed investment behavior consistent with the theory. In an attempt to fill this gap, Lim [2006] is one of the few studies succeeding in this task. In the current paper, however, we argue that, despite the prominent role of prospect theory in describing decision making under risk, the relationship between prospect theoretic preferences and investor behavior is not as general as it might seem.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical framework of the hedonic editing hypothesis. Section 3 describes the data. Methods used to analyze the data along with the results are provided in Section 4. Discussion in Section 5 concludes the paper.

THEORETICAL FRAMEWORK

Kahneman and Tversky [1979] introduce prospect theory, a descriptive theory of decision under risk, in an attempt to explain certain inconsistencies between observed behavior and expected utility theory. The prospect theory value function has three important properties. First, the function $v(\cdot)$ is defined in terms of gains and losses relative to some natural reference point rather than levels of wealth as in expected utility theory. Second, the value function is S-shaped, concave in the domain of gains and convex in the domain of losses. This implies, for example, that the difference between a gain of $100 and a gain of $200 seems greater than the difference between a gain of $1,100 and a gain of $1,200. The same idea applies to losses as well. Third, the value function is steeper for losses than for gains, a characteristic that has been labeled as loss aversion. For example, a loss of $100 hurts more than a gain of $100 yields pleasure.

The prospect theory value function is defined over single outcomes. Thaler [1985] extends the analysis to incorporate multiple outcomes: How is a joint outcome (x, y) evaluated?[2]

One possibility is that x is segregated from y and the two outcomes are separately evaluated as $v(x) + v(y)$. Another possibility is that x is integrated with y and the outcomes are evaluated together as $v(x + y)$. Whether segregation or integration is preferred depends on which frame, $v(x) + v(y)$ or $v(x + y)$, yields the highest perceived value. This assumption, in combination with those of prospect theory, forms the hedonic editing hypothesis. For the joint outcome (x, y), there are four cases to be considered when applying this hypothesis:

CASE 1: *Multiple gains* $(x > 0, y > 0)$

Because of the concavity of the value function in the domain of gains, higher perceived value can be achieved by evaluating the two gains separately rather than together, that is, $v(x) + v(y) > v(x + y)$. The hedonic editing hypothesis thus calls for segregation of multiple gains.

CASE 2: *Multiple losses* $(x < 0, y < 0)$

The hedonic editing hypothesis predicts that a higher perceived value can be achieved by integrating the two losses rather than by segregating them. Since the value function is convex in the domain of losses, $v(x) + v(y) < v(x + y)$.

CASE 3: *Mixed gain* $(x > 0, y < 0, |x| > |y|)$

Since the value function is steeper for losses than for gains, higher perceived value can be achieved by evaluating the smaller loss as a reduced gain (integration) rather than a separate loss (segregation). That is, $v(x) + v(y) < v(x + y)$.

CASE 4: *Mixed loss* $(x > 0, y < 0, |x| < |y|)$

When the loss is greater in absolute magnitude than the gain, it is generally true that $v(x) + v(y) > v(x + y)$. That is, segregation of the small gain form the larger loss yields higher perceived value. This is, however, not necessarily the case. If the difference between the magnitudes of x and y is very small, it is more likely that integration is preferred.

This analysis can be summarized by four principles:

1. Segregate gains.
2. Integrate losses.
3. Integrate smaller losses with larger gains.
4. Segregate small gains from larger losses (provided that the absolute value of the gain is significantly smaller than the absolute value of the loss).

Thaler and Johnson [1990] further elaborate on this issue by suggesting that temporal vicinity facilitates integration and temporal remoteness facilitates segregation. Accordingly, the hedonic editing hypothesis implies that people will choose to have multiple outcomes together at the same time when integration yields higher perceived value, and apart when segregation is preferred. Following the original assumption of Thaler and Johnson [1990], Lim [2006] takes the time interval within which outcomes are integrated to be one day. In the current study, we take the one-day integration period as a natural starting point and extend the analysis to include integration periods of 2, 3, 4, and 5 days as well.

Based on this theoretical framework, we derive the following hypotheses for empirical testing:

HYPOTHESIS 1: *Investors tend to realize multiple losses rather than multiple gains at the same time.*

HYPOTHESIS 2: *Investors tend to realize mixed gains rather than mixed losses at the same time.*

DATA

The primary data for this study were provided by the Finnish Central Securities Depository (FCSD). With few negligible exceptions, this register covers all the stocks listed in the Helsinki Exchanges (HEX). The typical representativeness problem in this line of research is absent in this dataset, since it reports the shareholdings and daily transactions of all investors in the Finnish stock market. The data consist of information on investor identity,[3] date, stock (e.g., security code, share class), transaction (e.g., trade type, price, volume), and investor attributes such as ownership type and investor class. The time period covered is January 5, 1995, through December 31, 2003.

The FCSD database does not cover indirect ownership records. For example, an investment through a mutual fund has an identification number that belongs to the fund itself and is not traceable to an individual investor. Consequently, investors in our sample may own shares that are not included in the analysis. Although mutual fund investments are currently gaining popularity in Finland, they are far less common among Finnish investors than, for example, among U.S. investors. Moreover, it is highly unlikely that the exclusion of indirect investments will bias our results in any particular direction.

The Finnish Act on the Book-Entry System made shareholding registration obligatory for domestic investors. Foreign investors, on the contrary, may register their shares in a specific book-entry account administered by a nominee registration custodian. In such cases, the identification number of the custodian, and not of the investor, will appear on the records. Because the majority of foreign investors have used this right, we lack adequately detailed data on this investor class.

The focus in this study is thus on the direct stock investments of domestic investors. Of these, we exclude the investments of institutional investors and concentrate on those of individual investors. As this study aims to investigate how investors segregate or integrate multiple outcomes, we require that they have the opportunity to do so. That is, an investor must have at least two stocks in her portfolio to be included in the analysis. Our interest is in selling observations where an investor sells one or more of her stocks at the same time, that

is, within an integration period of 1, 2, 3, 4, or 5 consecutive days. To test the robustness of our results, we also run the analysis requiring a clear-cut nonsale period around the date of observation. More specifically, we consider the impact of restricting the sample to investors who do not execute any other sale within 3, 5, or 10 days before the first and after the last day of the integration period.

In defining whether the stocks are sold at a loss or at a gain, we follow the common practice of using the weighted average purchase price as the reference point.[4] For most cases, the purchase price information is readily available. Investors may, however, sell shares purchased before January 5, 1995, for which we lack the required information. In addition, we are not able to determine the purchase prices for shares subscribed with options or convertible bonds, or for stocks received as gifts, inheritances, and the like.

The FCSD database has imperfect price information for transactions other than ordinary trades. Yet, stocks acquired via, for example, share issues comprise a nonnegligible portion of the portfolios investors hold. Other corporate actions, such as mergers, divisions, exchanges of shares, share series conversions, and stock splits, should also be taken into account when determining the appropriate reference prices for sold stocks. We make an effort to make the database as accurate as possible. We go through all ambiguous observations and, when the information is available, correct the prices. This information is gathered from many different sources, including company press releases, annual reports, stock exchange announcements, and Web pages. Finally, we calculate, for each observation, the percentage of the sold shares that have unknown purchase price. If this percentage exceeds 10%, the observation is excluded from the analysis. Otherwise, the missing values are replaced with closing prices on the day of purchase, which we obtain from the HEX.

Studies similar to ours, examining the trading behavior of all individual investors in a stock market, are uncommon in existing literature.[5] There is a reasonable explanation for this. The FCSD database is extremely large, yet the Finnish stock market is relatively small worldwide. Thus, it would be computationally infeasible to conduct a comprehensive study using market data from, say, the major U.S. exchanges.

EMPIRICAL ANALYSIS

The aim of the current paper is to investigate how individual investors in the Finnish stock market time their sales of stocks when realizing gains, losses, or some mixture of them. For the purposes of this study, two alternatives will be considered: Investors can choose to sell their stocks either separately at different times, or together at the same time, depending on whether segregation or integration yields the highest perceived value. We proceed as follows.

Each time that an investor sells one or more of her stocks within 1, 2, 3, 4, or 5 consecutive days, we classify the observation into one of the following six categories: single sales, where one stock is sold at a loss; single sales, where one stock is sold at a gain; multiple sales, where several stocks are sold at a loss; multiple sales, where several stocks are sold at a gain; multiple sales, where both gains and losses are realized and the net effect is positive; and multiple sales, where both gains and losses are realized and the net effect is negative. In addition to the full sample, we also investigate three subsamples where the investors are required to have a minimum of a 3-, 5-, or 10-day nonsale period around the integration period. In what follows, we analyze pure losses and gains (the first four categories) separately from the mixed cases (the last two categories).

Preliminary Analysis

Pure Gains and Losses

We begin our analysis of the cases involving either pure gains or losses by forming two dichotomous variables: multiple sale, coded as one when multiple stocks are sold at the same time, and zero when only one stock is sold; and loss, indicating whether the stock(s) are realized at a loss (= 1) or at a gain (= 0). These are the two main variables of interest in the current study, and the primary hypothesis we are testing is that losses increase the probability of a multiple sale.

To control for other factors possibly affecting the selling decision of an investor, we include a set of variables that either have been found in previous literature to affect the trading behavior of investors, or intuition suggests that they might be important factors in the current context. These variables include trading month, return on stocks sold, return on the market, investor activity, market activity, portfolio value, and number of stocks in investor's portfolio. Description of the variables is provided in Table 1.

In this subsection, we utilize statistical techniques designed specifically for categorical data. For this reason, we dichotomize all continuous variables (return on the market, investor activity, market activity, portfolio value, and number of stocks) by using the median value as the cut-off point.[6] We first examine whether there exists an association between the propensity of investors to sell multiple stocks at the same time and each of the other variables described above. The usual chi-square tests are used to test for statistical significance. The results of this bivariate analysis reveal that, in general, there is a statistically significant association between the sale variable and each of the other variables. More important, however, the directions of the associations appear to be highly sensitive to the choice of the integration period and the length of the nonsale period around it.

This seems to be particularly the case with the two main variables of interest. As can be seen from Panel A of Table 2, depending on the specification, losses either decrease, have no effect, or increase the propensity of investors to sell multiple stocks at the same time. The odds of a multiple sale

TABLE 1
Variable Definitions.

Variable	Description
Multiple sale	Dummy variable; equals one if multiple stocks are sold and zero otherwise
Loss	Dummy variable; equals one if the stock(s) are realized at a loss and zero otherwise
Trading month	Dummy variable; equals one in December and zero otherwise
Return on stock(s) sold	Dummy variable; equals one if the prior month weighted average return on the stock(s) sold is positive and zero otherwise
Return on the market	Prior month return on the HEX Portfolio Index
Investor activity	Number of days the investor is selling her stocks during the sample period
Market activity	Number of investors trading in the market at the date of observation
Portfolio value	Market value of investor's portfolio in EUR
Number of stocks	Number of stocks in investor's portfolio

Note. This table describes the variables used in the study. The sample covers January 5, 1995, through December 31, 2003.

at a loss varies between 0.909 and 1.561, and is consistent with Hypothesis 1 (i.e., above one) in only 12 out of the 20 specifications. Moreover, a glance at the first specification (integration period of one day and minimum number of nonsale days set to zero), which most closely resembles the setting in Lim's [2006] study, reveals a result completely opposite to that of Lim: Investors do not integrate their losses; they rather realize multiple gains at the same time.

One perfectly rational reason investors sell their stocks is liquidity needs. It might be the case that sometimes liquidity needs overcome the preferences of investors for segregating or integrating multiple outcomes. To test whether these kinds of strong liquidity needs affect our results, we exclude those observations where the entire portfolio is liquidated.[7] From Panel B of Table 2, it appears that the results remain virtually unchanged.

Yet another possible explanation has to do with investor characteristics rather than preferences or rational motives.[8] Variation in these characteristics may cause differences in observed investment behavior. Linnainmaa [2003] reports evidence that individual investors in the Finnish stock market tend to be patient and realize their gains using limit orders rather than market orders. When realizing losses, investors are more hasty and likely to use market orders, which lead to immediate execution. These differences in order strategies may explain some of our results. The tendency of investors to realize their losses by using market orders makes it more likely that when an investor is selling multiple stocks at a loss, these losses are realized at the same time. Conversely, when an investor is selling multiple stocks at a gain using limit orders (that usually are put outside the spread), the gains are not necessarily all realized at the same time.[9]

To test this market microstructure–based explanation, one would ideally want to control for the type of order. Unfortunately, the FCSD database does not contain this information. It is therefore not possible to fully rule out the possibility that investor characteristics (patience) rather than preferences drive our results. We do, however, partially control for this explanation in the specifications requiring the nonsale period around the date of observation. Another indirect test is carried out by including only those observations where the stock(s) being sold have selling prices lower than or equal to the previous day's closing prices. The intuition behind this restriction is that the stocks that meet this criterion, that is, stocks that could have been sold at their selling prices (or higher) a day before, are more likely to be associated with market orders than limit orders.

The effect of excluding the assumed limit orders can be seen from Panel C of Table 2. If the differences in observed order strategies were to explain our results, we would expect the odds ratios in Panel C to be lower than in Panel A. What we in fact see is quite the opposite: Out of the 20 odds ratios, 15 are actually higher in Panel C than in Panel A. Accounting for the differences in order strategies thus brings our results into somewhat closer agreement with the predictions of the hedonic editing hypothesis.

For the other variables (for which the results are not reported here), we did not hypothesize what their effect on the propensity of investors to sell multiple stocks at the same time would be, since we included them mainly to serve as controls in a later phase. However, there is one finding to note. It is well documented in the previous literature that investors tend to realize losses near the end of the year to capture tax-losses.[10] Therefore, tax-loss selling may increase the number of multiple sales executed in December. This is what our results suggest: The odds of a multiple sale are on average 1.4 times higher in December than in other months.

Although we are not particularly interested in the main effects of the control variables, we do want to know whether they interact with the two main variables of interest and, if so, how. We first perform loglinear analysis to test for association among multiple sale, loss, and each of the seven control variables. For the sake of brevity, we do not report the results but conclude that all three-way interaction terms turn out to be statistically significant. Next, we examine the association between the propensity of investors to sell multiple stocks at the same time and losses, after adjusting for the effects of the other variables.

The results of the stratified analysis in Table 3 indicate that the control variables we have included are not just important determinants of investors' selling behavior but also affect the association between multiple sale and losses. In overview, December, negative return on sold stocks, and low previous month market return all increase the odds of a multiple sale at a loss. In particular, the tax-loss selling hypothesis receives further support: The odds of a multiple sale at a loss

TABLE 2
Integration vs. Segregation of Losses and Gains: Univariate Analysis.

Integration period in days	Minimum Number of Nonsale Days Around the Integration Period							
	0		3		5		10	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
				Panel A: Full sample				
1	0.909	[0.899, 0.919]	1.285	[1.264, 1.307]	1.395	[1.369, 1.421]	1.561	[1.527, 1.595]
	$N = 1\,356\,830$		$N = 745\,365$		$N = 617\,390$		$N = 453\,935$	
2	0.951	[0.940, 0.962]	1.105	[1.089, 1.121]	1.201	[1.182, 1.220]	1.354	[1.329, 1.380]
	$N = 1\,090\,335$		$N = 805\,145$		$N = 663\,665$		$N = 485\,776$	
3	0.961	[0.949, 0.972]	1.021	[1.008, 1.034]	1.111	[1.094, 1.127]	1.264	[1.242, 1.286]
	$N = 961\,029$		$N = 840\,880$		$N = 689\,462$		$N = 501\,401$	
4	0.959	[0.947, 0.970]	0.959	[0.947, 0.970]	1.042	[1.027, 1.056]	1.191	[1.171, 1.211]
	$N = 871\,070$		$N = 871\,070$		$N = 710\,718$		$N = 513\,590$	
5	0.956	[0.944, 0.968]	0.956	[0.944, 0.968]	(0.995)	[0.982, 1.009]	1.140	[1.122, 1.158]
	$N = 802\,929$		$N = 802\,929$		$N = 729\,708$		$N = 524\,155$	
				Panel B: Controlling for liquidity needs				
1	0.882	[0.871, 0.892]	1.240	[1.218, 1.263]	1.343	[1.316, 1.370]	1.499	[1.464, 1.536]
	$N = 1\,345\,978$		$N = 737\,409$		$N = 610\,309$		$N = 448\,005$	
2	0.924	[0.913, 0.935]	1.069	[1.053, 1.086]	1.161	[1.142, 1.181]	1.307	[1.280, 1.334]
	$N = 1\,076\,917$		$N = 794\,145$		$N = 653\,962$		$N = 477\,749$	
3	0.933	[0.922, 0.945]	(0.990)	[0.977, 1.004]	1.076	[1.059, 1.093]	1.222	[1.199, 1.245]
	$N = 946\,648$		$N = 827\,839$		$N = 678\,119$		$N = 492\,215$	
4	0.930	[0.918, 0.942]	0.930	[0.918, 0.942]	(1.009)	[0.994, 1.024]	1.150	[1.129, 1.171]
	$N = 856\,369$		$N = 856\,369$		$N = 698\,095$		$N = 503\,495$	
5	0.927	[0.915, 0.939]	0.927	[0.915, 0.939]	0.965	[0.951, 0.978]	1.099	[1.080, 1.118]
	$N = 788\,040$		$N = 788\,040$		$N = 715\,834$		$N = 513\,214$	
				Panel C: Controlling for differences in order strategies				
1	0.725	[0.712, 0.737]	1.231	[1.191, 1.272]	1.282	[1.237, 1.330]	1.322	[1.267, 1.379]
	$N = 528\,227$		$N = 214\,458$		$N = 179\,413$		$N = 113\,384$	
2	1.187	[1.157, 1.217]	1.236	[1.120, 1.274]	1.276	[1.234, 1.319]	1.306	[1.256, 1.359]
	$N = 290\,178$		$N = 220\,668$		$N = 184\,402$		$N = 136\,865$	
3	1.237	[1.205, 1.270]	1.252	[1.216, 1.288]	1.285	[1.244, 1.327]	1.312	[1.263, 1.363]
	$N = 251\,959$		$N = 223\,806$		$N = 186\,732$		$N = 138\,271$	
4	1.255	[1.220, 1.290]	1.255	[1.220, 1.290]	1.281	[1.242, 1.321]	1.307	[1.260, 1.357]
	$N = 226\,295$		$N = 226\,295$		$N = 188\,552$		$N = 139\,326$	
5	1.266	[1.230, 1.303]	1.266	[1.230, 1.303]	1.284	[1.246, 1.323]	1.302	[1.256, 1.350]
	$N = 206\,829$		$N = 206\,829$		$N = 190\,045$		$N = 140\,189$	

Note. This table examines the association between the decision of an investor to sell multiple stocks at the same time and whether all the stocks are realized at a loss or at a gain. The table reports unadjusted odds ratios and 95% confidence intervals for multiple sales by losses versus gains, with the latter being the reference category. Insignificant odds ratios are in parentheses. The sample covers January 5, 1995, through December 31, 2003.

vary between 1.306 and 2.491 in December and between 0.846 and 1.257 in other months. The positive association between the propensity of investors to sell multiple stocks and losses is also more pronounced for less active investors, investors whose portfolio value is low, and investors with a low number of stocks in their portfolios. Our main conclusion from the stratified analysis, however, is based on Mantel-Haenszel statistics. In the majority of the specifications, these statistics indicate that, adjusting for the seven other factors (one at a time), there is a statistically significant association between multiple stock sale and losses.[11] Again, however, the directions of the associations show rather inconsistent patterns.

Mixed Gains and Losses

Methods employed in the analysis of pure gains and losses are not applicable to mixed cases. The reason for this is rather obvious: When realizing mixed gains or losses, investors are, by definition, always selling multiple stocks. What we can do, however, is to test whether investors realize mixed gains rather than mixed losses at the same time. A chi-square test for equal proportions is used to test whether the number of observations is significantly different across mixed gain and mixed loss categories. According to the test statistics in Panel A of Table 4, the difference is statistically significant across all specifications but in the

TABLE 3
Integration vs. Segregation of Losses and Gains: Stratified Analysis.

	Minimum Number of Nonsale Days Around the Integration Period																			
	0					3					5					10				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Control variables	Integration Period in Days																			
January–November	−	−	−	−	−	+	+		−	−	+	+	+	−	−	+	+	+	+	+
December	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
Negative return on stocks sold	+	+	+	+	+	+	[+ −]	+	+	+	+	+	+	+	+	+	+	+	+	+
Positive return on stocks sold	−	−	−	−	−	−		−	−	−	−	−	−	−	−	(−)	−	−	−	−
Low market return	+	+	+	+	+	+	+	+	+	+	+	+	+	+	[+ −]	+	+	+	+	+
High market return	−	−	−	−	−	−	−	−	−	−	−	−	−	−		+	−	−	−	−
Low investor activity	+	+	+	+	+	+	+	[+ −]	+	+	+	+	+	+	+	+	+	+	+	+
High investor activity	−	−	−	−	−	+	−		−	−	+	(+)	−	−	−	+	+	+	+	−
Low market activity	−	−	−	−	−	+	+	+	−	−	+	+	+	+	[+ −]	+	+	+	+	+
High market activity	−	−	−	−	−	+	+	(+)	−	−	+	+	+	(+)		+	+	+	+	+
Low portfolio value	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
High portfoli value	−	−	−	−	−	+	−	−	−	−	+	(+)	−	−	−	+	+	+	(+)	−
Low number of stocks	+	+	+	+	+	+	+	+	+	+	+	+	+	+	[+ −]	+	+	+	+	+
High number of stocks	−	−	−	−	−	+	+	−	−	−	+	+	+	−		+	+	+	+	+

Note. This table presents an analysis of the association between the decision of an investor to sell multiple stocks at the same time and whether all the stocks are realized at a loss or at a gain, while adjusting for the effects of other variables one at a time. These control variables are described in Table 1. The table reports the direction of the association between multiple sales and losses (as compared to gains) as indicated by stratum-specific odds ratios. Insignificant partial associations are denoted by parentheses. Insignificant overall associations, as measured by the Mantel-Haenzel test, are indicated by square brackets. The sample covers January 5, 1995, through December 31, 2003.

opposite direction to what was hypothesized. Contrary to the prediction of the hedonic editing hypothesis, mixed losses are more likely than mixed gains to be realized at the same time.

The preceding analysis does not take into account the size differences between gains and losses.[12] According to the hedonic editing hypothesis, for small gains to be segregated from larger losses, the absolute value of the loss should be significantly larger than the absolute value of the gain. Thus, our second hypothesis is expected to hold only if there is a marked difference between the magnitudes of small gains and larger losses. Of course, there is no objective criterion for a large enough difference. We therefore test differences of various sizes, with the aim of finding the smallest difference with which our results would be consistent with the hedonic editing hypothesis. We find this difference to be rather large, around 100% and 900%, depending on the specification. In other words, for the proportion of mixed gains realized to significantly exceed the proportion of mixed losses realized, we would have to exclude a large number of observations, and keep only those mixed losses, where the losses are at least two to ten times larger than the gains.

Panel B of Table 4 suggests that some of the results in Panel A can be explained by liquidity needs. After excluding the observations where the sell decision appears to be motivated by liquidity reasons, the proportions of realized mixed gains predominantly increase. Nevertheless, the results are line with what was hypothesized on only three occasions out of the 20 specifications.

Logistic Regression Analysis

To gain further insight into the association between multiple sale and pure gains versus pure losses, we perform a series of multivariate logistic regressions. In each model, we regress multiple sale, a binary dependent variable, on all other variables described earlier with the dummy variable for losses being the main explanatory variable of interest. The primary objective of this analysis is to investigate whether losses explain the propensity of investors to sell multiple stocks after controlling for the effects of the other variables all at the same time. To account for the possibility that there are individual differences in the probability of a multiple sale, investor-specific random effects are incorporated into the modeling framework.

TABLE 4
Mixed Gains vs. Mixed Losses.

Integration period in days	Minimum Number of Nonsale Days Around the Integration Period: 0 — Mixed gains (%)	Mixed losses (%)	χ^2−test for equal proportions	3 — Mixed gains (%)	Mixed losses (%)	χ^2−test for equal proportions	5 — Mixed gains (%)	Mixed losses (%)	χ^2−test for equal proportions	10 — Mixed gains (%)	Mixed losses (%)	χ^2-test for equal proportions
						Panel A: Full sample						
1	36.29	63.71	759.680	40.73	59.27	1194.212	42.18	57.82	657.609	43.82	56.18	279.244
	$N = 100\,963$		(.000)	$N = 34\,772$		(.000)	$N = 26\,850$		(.000)	$N = 18\,307$		(.000)
2	40.89	59.11	3166.890	42.96	57.04	1101.361	44.12	55.88	572.236	45.43	54.57	226.252
	$N = 95\,404$		(.000)	$N = 55\,567$		(.000)	$N = 41\,412$		(.000)	$N = 27\,140$		(.000)
3	43.01	56.99	1833.768	43.66	56.34	1183.767	44.64	55.36	612.479	45.72	54.28	245.702
	$N = 93\,812$		(.000)	$N = 73\,709$		(.000)	$N = 53\,002$		(.000)	$N = 33\,524$		(.000)
4	44.18	55.82	1241.046	44.18	55.82	1241.046	45.03	54.97	639.337	45.85	54.15	271.400
	$N = 91\,530$		(.000)	$N = 91\,530$		(.000)	$N = 64\,588$		(.000)	$N = 39\,375$		(.000)
5	45.05	54.95	877.436	45.05	54.95	877.436	45.30	54.70	671.735	45.99	54.01	290.217
	$N = 89\,687$		(.000)	$N = 89\,687$		(.000)	$N = 76\,020$		(.000)	$N = 45\,104$		(.000)
						Panel B: Controlling for liquidity needs						
1	49.93	50.07	0.116	58.61	41.39	620.251	61.29	38.71	799.908	64.08	35.92	812.752
	$N = 68\,327$		(0.734)	$N = 20\,918$		(.000)	$N = 15\,684$		(.000)	$N = 10\,255$		(.000)
2	44.48	55.52	974.823	46.83	53.17	180.334	48.14	51.86	45.458	49.61	50.39	1.257
	$N = 79\,874$		(.000)	$N = 44\,852$		(.000)	$N = 32\,689$		(.000)	$N = 20\,619$		(0.262)
3	47.50	52.50	191.278	48.23	51.77	74.371	49.32	50.68	7.807	50.55	49.45	3.101
	$N = 76\,649$		(.000)	$N = 59\,419$		(.000)	$N = 42\,055$		(.005)	$N = 25\,466$		(.078)
4	43.98	56.02	1196.615	43.98	56.02	1196.615	44.74	55.26	632.975	45.41	54.59	283.229
	$N = 82\,453$		(.000)	$N = 82\,453$		(.000)	$N = 57\,140$		(.000)	$N = 33\,668$		(.000)
5	48.88	51.12	36.873	48.88	51.12	36.873	49.16	50.84	17.611	49.87	50.13	0.255
	$N = 73\,745$		(.000)	$N = 73\,745$		(.000)	$N = 61\,890$		(.000)	$N = 35\,431$		(0.614)

Note. This table examines the difference in the number of realized mixed gains and losses. A mixed gain (loss) is a combination of gains and losses with positive (negative) net proceeds. The *p*-values of the chi-square test are given in parentheses below the test statistics. The sample covers January 5, 1995, through December 31, 2003.

Table 5 presents the odds ratios for the association between multiple sale and losses, computed from the multivariate logistic regression parameter estimates. With only one exception, there is a statistically significant relationship between losses and the propensity of investors to sell multiple stocks at the same time, even after controlling for the effects of trading month, historical returns on the stocks sold and on the market, selling activity of an investor, overall trading activity in the market, portfolio size, and the number of stocks in investor's portfolio. Yet as was the case in the preliminary analysis, the direction of the relationship varies from specification to specification. In general (but not as a rule), shortening the integration period has the effect of increasing the odds of a multiple sale at a loss. Lengthening the nonsale period around the integration period has a similar impact. Overall, however, losses decrease the probability of a multiple sale more often than increase it.

As for the other variables, the odds ratios (not reported) are all statistically significant and consistently either below or above one in all specifications. The only exception to this is the overall trading activity of investors, for which the coefficient estimate is insignificant in two specifications. Thus, out of all the eight determinants of a multiple sale, losses prove to be the most unreliable one in producing consistent and robust results. In sum, although there is some evidence on the contrary, we feel confident to conclude that it is very likely that preferences other than those derived from prospect theory

TABLE 5
Integration vs. Segregation of Losses and Gains: Multivariate Logistic Regression Analysis.

	Minimum Number of Nonsale Days Around the Integration Period							
	0		3		5		10	
Integration period in days	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
1	0.842	[0.831, 0.853]	1.115	[1.094, 1.356]	1.202	[1.177, 1.228]	1.331	[1.298, 1.364]
	$N = 1\,304\,627$		$N = 713\,275$		$N = 590\,353$		$N = 434\,827$	
2	0.857	[0.846, 0.968]	0.974	[0.958, 0.989]	1.051	[1.032, 1.069]	1.166	[1.141, 1.191]
	$N = 1\,047\,662$		$N = 771\,940$		$N = 635\,726$		$N = 466\,023$	
3	0.861	[0.850, 0.873]	0.907	[0.894, 0.921]	0.976	[0.960, 0.992]	1.091	[1.070, 1.113]
	$N = 923\,372$		$N = 807\,251$		$N = 661\,195$		$N = 481\,422$	
4	0.859	[0.847, 0.871]	0.859	[0.847, 0.871]	0.921	[0.907, 0.936]	1.031	[1.012, 1.051]
	$N = 837\,125$		$N = 837\,125$		$N = 682\,193$		$N = 493\,443$	
5	0.856	[0.845, 0.868]	0.856	[0.845, 0.868]	0.886	[0.873, 0.899]	(0.992)	[0.974, 1.010]
	$N = 771\,692$		$N = 771\,692$		$N = 700\,990$		$N = 503\,888$	

Note. This table provides results from multivariate logistic regression analyses examining the association between the decision of an investor to sell multiple stocks at the same time and whether all the stocks are realized at a loss or at a gain, while adjusting for the effects of other variables all at the same time. These control variables are described in Table 1. The table reports adjusted odds ratios and 95% confidence intervals, derived from the logistic regression parameter estimates, for multiple sales by losses versus gains, with the latter being the reference category. Insignificant odds ratios are in parentheses. The sample covers January 5, 1995, through December 31, 2003.

and hedonic editing hypothesis drive the observed selling behavior of investors.

CONCLUSIONS

The study reported here set out to test the prospect theory-based principles of hedonic editing. The current study complements the heretofore limited research on this topic by offering a detailed look at the selling behavior of all individual investors in a real stock market. We find only weak evidence for the hedonic editing hypothesis: Investors in our sample do not consistently integrate their losses and segregate their gains, nor do they show any significant preference for realizing mixed gains rather than mixed losses.

The basic properties of the prospect theory value function have received strong support in a number of recent studies investigating the disposition effect, the tendency of investors to realize their gains rather than losses. Yet supportive evidence in the form of other observed investment behavior consistent with the theory is rather limited. The conclusion we draw from the current analysis is not that one should condemn prospect theory as flawed, but rather that, in analyzing psychological phenomenon within the context of stock markets, one runs the risk of deviating too much from the original theoretical context. Obviously, application of prospect theory to financial settings is not as straightforward a task as it may seem. Therefore, the current study should not be seen as a strict test of prospect theory or hedonic editing hypothesis, but rather as a tentative exploration of whether behavioral patterns predicted by the hypothesis could also be found within the context of markedly different decision-making environment.

ACKNOWLEDGMENTS

The author is indebted to her dissertation advisor Jukka Perttunen for numerous constructive discussions and for his encouragement. Thanks are also due to Matti Keloharju, Hersh Shefrin, and seminar participants at the GSF workshop 2005 for helpful comments and suggestions. Appreciation is also expressed to Finnish Central Securities Depository for provision of the data. This research was financially supported by the OKO Bank Group Research Foundation, the University of Oulu Foundation, the Finnish Foundation for Economic Education, the Finnish Foundation for Share Promotion, the Finnish Konkordia Fund, the Finnish Cultural Foundation, The Finnish Savings Banks Group Research Foundation, the Tauno Tönning Foundation, and the Foundation for the Promotion of Finnish Securities Market. The support is gratefully acknowledged.

NOTES

1. To be precise, the term ‘hedonic editing’ is from Thaler and Johnson [1990].
2. As Thaler [1985] notes, this analysis is generalizable to cases with several outcomes.

3. Individual investors are initially identified by their social security number. For security reasons, each original identification number is replaced with a specific running number.
4. It is possible that investors have other reference points instead of or in addition to the purchase price. For example, Heath, Huddard, and Lang [1999] consider several potential reference points and find that the highest stock price reached over the prior year has the strongest effect on the decision of an investor to exercise stock options. Grinblatt and Keloharju [2001b], in turn, report that monthly highs and lows affect the propensity of investors to sell a stock.
5. A notable exception is the research conducted by Grinblatt and Keloharju [2000], [2001a], [2001b], and [2004], which covers various topics related to the trading behavior of investors.
6. For the most part, results remain qualitatively unchanged if mean value is used instead of median.
7. Another test is conducted (with fairly similar results) by excluding investors who do not execute a purchase within 10 days of the sale date.
8. We thank Matti Keloharju for inviting us to consider this point and for directing us to the relevant reference.
9. On the other hand, one should recognize the possibility that the causality may run from preferences to order strategies. That is, the preferences of investors to integrate losses (segregate gains) may in fact lead them to use market (limit) orders instead of limit (market) orders.
10. See, for example, Dyl [1977] and Grinblatt and Keloharju [2004].
11. According to Table 3, there are six cases where the association between multiple sale and losses appears to be insignificant, after adjusting for the effect of the third variable. It is important to note that the Mantel-Haenszel statistics have low power in detecting associations when, as in the present cases, the pattern of association in one stratum is in the opposite direction of the pattern displayed in the other stratum. Consequently, an insignificant Mantel-Haenszel statistic either indicates that there is no association or suggests that neither pattern of association has enough strength to dominate the other. We believe the latter to be true in this instance, as the stratum-specific odds ratios are statistically significant in all six cases.
12. We thank Hersh Shefrin for pointing this out to us.

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