Rolling Mental Accounts

Cary D. Frydman*

Samuel M. Hartzmark†

David H. Solomon*

This Draft: November 17th, 2015

Abstract: When investors sell one asset and quickly buy another, their trades are consistent with rolling the mental account into the new asset rather than closing it. When trading the new position, investors exhibit a disposition effect based on the amount invested in the original position that is no longer in the portfolio. On days when an investor buys and sells (~31% of observations) there is no disposition effect, consistent with no disutility from realizing a loss. Mutual funds exhibit a larger disposition effect when unable to roll accounts due to outflows. Sales occurring with a purchase have better performance, suggesting that avoiding the emotion of closing a mental account at a loss improves decisions.

*Frydman and Solomon are at the University of Southern California Marshall School of Business. †Hartzmark is at the University of Chicago Booth School of Business. Contact at cfrydman@marshall.usc.edu, samuel.hartzmark@chicagobooth.edu, and dhsolomo@marshall.usc.edu, respectively. We would like to thank Justin Birru, Alex Imas, Kelly Shue, Neil Stewart, Abby Sussman, George Wu and seminar participants at the University of Chicago, HEC Paris, University of Houston, Aalto University and the University of Southern California. All remaining errors are our own.

How do investors evaluate their portfolio decisions over time? In models such as the CAPM (Sharpe (1964)) and portfolio theory (Markowitz (1952)), portfolio evaluation reduces to periodic rebalancing to maintain fixed weights. While this is excellent normative advice given the assumptions of the models, it is sharply at odds with the active trading of many investors (Barber and Odean (2013)).

Perhaps the most successful theories of how investors *actually* rebalance their portfolios rely on mental accounting (Thaler (1980, 1999)). Given the variety of financial decisions people make, it is often difficult or impractical to simultaneously choose optimal actions based on their combined effect on total wealth. Mental accounting describes the heuristics people use to break financial decision-making into smaller, more manageable parts. The first key component is the grouping of financial decisions and outcomes into particular mental accounts. Outcomes within an account are combined and evaluated jointly, whereas outcomes in different accounts are evaluated separately and are not fully fungible, so success in one account does not cancel out failure elsewhere. Second, within each account, individuals keep track of gains and losses relative to a reference point, rather than tracking total wealth. The key questions in applying mental accounting involve understanding how outcomes get grouped together, and what preferences are used to evaluate gains and losses.

In the literature that applies mental accounting to trading decisions, the dominant (if often implicit) assumption about the grouping of outcomes is known as stock-by-stock narrow framing. This assumes that an investor considers each stock in a separate mental account, so that he *narrowly frames* his gains and losses at the stock level.[1] When mental accounting is combined

[1] The narrow framing assumption of evaluating gains or losses at the stock level is discussed in Barberis and Huang (2001), Barberis and Xiong (2012), and Ingersoll and Jin (2013), although framing at the portfolio level has also been examined (Barberis and Huang (2001)).

with certain preferences – such as cognitive dissonance or realization utility (Chang, Solomon, and Westerfield (2015), Barberis and Xiong (2012)) – investors are reluctant to sell assets that have declined in value. In this way, mental accounting is used to explain the disposition effect: the tendency for investors to be more likely to sell assets that are at a gain than assets at a loss (Shefrin and Statman (1985), Odean (1998)).[2] Similar to the narrow framing assumption in mental accounting, most of the literature on the determinants of trading focuses on attributes of individual stocks, not relations between stocks. While there is a large debate on the preferences investors use to evaluate mental accounts (e.g., Barberis and Xiong (2012), Frydman et al. (2014), Chang, Solomon, and Westerfield. (2015), Ingersoll and Jin (2013)), there has been less focus on how investment episodes are constructed. When modeling narrow framing, it is generally assumed that buying a stock opens a mental account and selling the stock closes that account. Each stock is considered a separate investing episode, and the sale completes the episode.

In this paper, we argue that mental accounts are not always closed when an investor sells a stock – in other words, a sale does not always conclude an investing episode. Instead, investors may "roll" an account from one asset to another, by selling the original asset and buying another within a short period of time. We present evidence that when investors reinvest in this manner, their decisions of what to sell, what to buy, and how to trade the new asset are all consistent with the new asset being evaluated within the original mental account. Our evidence suggests that current theories lack a major component of trading behavior – the rolling of mental accounts.

[2] The disposition effect has been documented for individual investors (Odean (1998), Feng and Seasholes (2005), Kaustia (2010a)), mutual fund managers (Frazzini (2006)), futures traders (Locke and Mann (2005)), real estate purchases (Genesove and Mayer (2001)), and prediction markets (Hartzmark and Solomon (2012)). See Kaustia (2010b) for a recent overview. Explanations such as prospect theory (Shefrin and Statman (1985)), realization utility (Barberis and Xiong (2009)) and cognitive dissonance (Hartzmark and Solomon (2012), Chang, Solomon and Westerfield (2015)) can provide a foundation for why closing losing accounts is painful.

When a mental account is rolled, the reference point used to compute gains and losses for a newly purchased asset remains linked to the amount paid for the *original asset.* This implies that if a mental account is rolled, there should be a "rolled disposition" effect – analogous to the disposition effect for a single stock, but where gains and losses are defined relative to the amount paid for the *original asset*. This provides a stark testable prediction of mental accounts, which is not shared by other theories of investor behavior. To test this, we examine assets which are purchased on the same day that another asset was sold ("reinvestment days"), and consider when investors choose to sell the newly purchased asset.

Consistent with the prediction from rolling mental accounts, we find that investors are more likely to sell the new asset if its value exceeds the amount invested in the original asset. This result holds even after controlling for whether the new asset is at a gain or a loss relative to its own cost basis, as under the single stock disposition effect. The interpretation under mental accounting is straightforward: because the new asset's performance is framed as a continuation of the initial investing episode, an investor is more willing to sell the new asset once the combined position on the rolled account reaches a profit.

The concept of rolling mental accounts also makes predictions about which assets are sold on reinvestment days. If the base disposition effect is due to the pain of closing a mental account at a loss, investors should not exhibit the disposition effect on days that they roll an account to another position, as such days do not involve painful account closure. We show that the disposition effect is not present on reinvestment days. On such days, (31% of observations), the difference between the probability of selling a gain and selling a loss is a statistically insignificant -0.08%. The lack of a disposition effect on reinvestment days is consistent with investors not experiencing the disutility of closing a mental account at a loss because they roll

the account into the new asset. The overall disposition effect is driven by the 69% of observations when a sale is not accompanied by a purchase. On such days, investors are 8.1% more likely to sell a gain than a loss (with a t-statistic of 19.72). The lack of a disposition effect on reinvestment days is not due to investor-specific traits, as the same investor displays a smaller disposition effect on reinvestment days relative to other periods.

We demonstrate that such a pattern is unlikely to be driven by investor sophistication, as mutual fund managers exhibit similar behavior. Mutual fund data is limited to quarterly reports rather than precise trades, so to proxy for mental account closure we examine fund flows. A fund experiencing outflows must sell positions without reinvesting into financial assets. We show that mutual funds with inflows (whose managers can roll mental accounts) exhibit a disposition effect that is lower by 2.3% compared with the same fund experiencing outflows (which require the closure of mental accounts).

Next, we test additional predictions about rolled accounts that are motivated by the cognitive psychology literature on the temporal distance between decisions. This literature shows that as the temporal distance between two decisions gets smaller, the two decisions are more likely to be framed jointly (Read et al. (1998)). We therefore predict that the longer the gap between the sale and the associated purchase, the less likely it is that the sale occurred with the purchase in mind. Consistent with this prediction, we find that the disposition effect increases by 0.8% for every trading day that passes between the sale and purchase date.

If reinvestment days are best understood as involving the rolling of mental accounts, then this has implications for which assets get purchased on reinvestment days. Given the rolled disposition effect evidence that investors prefer to sell a new asset at a gain relative to the

amount invested in the original asset, we predict that investors will choose to re-invest in a new asset that they perceive will give them a greater chance of achieving such a gain. Our third main result provides support for this prediction; when an investor rolls a position sold at a loss, he tends to reinvest in a new stock with higher volatility compared to when he sells at a gain. This behavior can be explained if investors derive prospect theory utility over realized gains and losses with diminishing sensitivity (Ingersoll and Jin (2013)). This diminishing sensitivity implies that utility is concave in the gain region and convex in the loss region (Kahneman and Tversky (1979)). Therefore, when an in investor rolls a loss, the reference point does not reset, and he remains in the loss region of the value function. This induces risk seeking, consistent with investors reinvesting in stocks with higher volatility.

While some of these stylized facts can be explained by alternative theories, it is difficult to explain the sum of these results without an appeal to mental accounting. For example, the differences in trading between reinvestment and non-reinvestment days could have a beliefs-based explanation whereby selling on reinvestment days is driven by beliefs about the stock being bought and selling on non-reinvestment days is driven by beliefs about the stock being sold. However, this does not predict the observed difference in volatility of purchased assets on reinvestment days, nor does it explain why the original purchase price is a reference point when trading the new asset. The most parsimonious explanation for these facts is that investors are treating the new asset as a continuation of the old asset in a mental accounting framework.

Finally, we show that investors make significantly better selling decisions on reinvestment days compared to days on which they sell a stock without reinvesting. On reinvestment days, the subsequent returns of the sold asset are lower than the returns on a) assets sold on non-reinvestment days, and b) assets retained in the portfolio on reinvestment days.

While our data does not allow us to isolate the specific psychological mechanism, these results imply that the decision of what to sell varies in quality according to what investors plan to do with the money – sales involving reinvesting in other financial assets are better chosen than sales made for other reasons, such as consumption.

This paper adds to the literature that seeks to understand how investors trade. A number of papers examine stock-level attributes that are associated with greater investor trading, including geographic proximity (Coval and Moskowitz (1999)), being at a gain or a loss as under the disposition effect (Shefrin and Statman (1985)), having extreme returns (Ben-David and Hirshleifer (2012)), being in the news (Barber and Odean (2008), Engelberg and Parsons (2010)), and having lottery-like characteristics (Kumar (2009)). While the assumption of stock-by-stock narrow framing continues to explain a good deal of investor behavior, we show that an extension of narrow framing - treating a new position as the continuation of an old position – is an important determinant of trading behavior. This distinction between realization and closing a mental account appears in the first paper on the disposition effect (Shefrin and Statman (1985)), but has since received little attention.[3]

Our results expand on the recent literature which explores how investors frame trading decisions beyond simple narrow framing. Hartzmark (2015) shows that individuals compare returns across stocks in their portfolio and trade extreme ranked positions thereby demonstrating that they are not viewing each position in their portfolio in isolation. In the current paper, we show how investors compare positions across time when trading.

[3] Shefrin and Statman (1985) posit that "the fundamental reluctance is not so much loss realization as the closure of a mental account at a loss."

This paper also contributes to a growing literature that examines how investors establish and update reference points in a trading context (Barberis, Huang and Santos (2001), Barberis and Huang (2001), Arkes et al. (2008), Pagel (2014), Birru (2015)). Furthermore, Imas (2014) shows that reference points are reset upon realization of a security, and this affects subsequent risk taking. Our empirical results on differential risk-taking after selling a losing stock vs. a winning stock complement his experimental results and provide further evidence that previous investment experiences affect subsequent risk taking (Malmendier and Nagel (2011)).

Finally, our paper contributes to the debate on whether the disposition effect is driven by preferences or beliefs.[4] It is generally difficult to separate the role of beliefs versus preferences in selling decisions, but rolled mental accounts can help break this link. If an investor sells a stock that was previously purchased on a reinvestment day, beliefs influencing the sale pertain to the new stock being sold, but preferences depend both on the new stock *and* the old stock which is no longer held. The existence of a rolled disposition effect provides support for a preference-based theory of the disposition effect, but is not predicted by beliefs-based explanations.

2. Conceptual Framework: Mental Accounting and Resetting Reference Points

It is useful to put forth a basic conceptual framework that can help formalize our definition of rolling a mental account. Consider, for instance, the assumptions used in Barberis and Xiong (2012). In this model, an investor derives prospect theory utility over realized gains and losses. Like in Barberis and Xiong (2012), we consider that when an investor purchases a stock, he opens a mental account in which he tracks the gains or losses accrued on that stock. A

[4] Examples of preference based explanations include prospect theory (e.g. Shefrin and Statman 1985; Odean 1998), Realization Utility (e.g. Barberis and Xiong 2012; Frydman et al. 2014) and cognitive dissonance (e.g. Chang et al. 2015). Examples of belief based explanations include mean reversion (e.g. Odean 1998) and a speculative motive for trade (e.g. Ben-David and Hirshleifer 2012). See Kaustia (2010b) for a recent overview.

second key assumption in the Barberis and Xiong (2012) model is that as long as the proceeds from a realization are not immediately reinvested in the *same* stock, a realization will close the mental account and generate a burst of realization utility.

We instead propose that if the proceeds from a realization are used to reinvest in a different stock on the same day, the mental account used to track the sold stock is not closed. Instead, the mental account remains open, no realization utility is generated, and the reference point of the purchased stock remains at amount initially invested in the *original stock*. We refer to this event in which an investor sells one stock and buys a different stock on the same day as rolling a mental account.[5]

A simple example may help to illustrate the idea. Assume on date 0 that an investor buys $10 of stock in the Alpha Company. On date 1, the value of this investment decreases to $8 and the investor sells his $8 of Alpha and buys $8 of the Beta Company. On date 2 the value of the Beta Company increases to $9. Under the standard assumption that equates a realization with closing a mental account, the investor evaluates the sale of Alpha at date 1 as a realization of a $2 loss and views his investment in Beta at date 2 as a $1 paper gain. If instead the investor rolls his mental account, he does not view the realization of Alpha at date 1 as a closing the mental account. Further, at date 2 he views his investment as standing at a $1 paper loss because the reference point remains at the initial $10 investment in Alpha.

3. Data

The analysis in this paper is mainly based on data on individual investors trading on their own accounts. This is the same dataset used in Barber and Odean (2000) and Strahilevitz, Odean

[5] See Imas (2014) for experimental work on the relationship between realization and resetting the reference point.

and Barber (2011). It includes information on individual investors trading on their own accounts from January 1991 to November 1996. The data is linked to CRSP information on price, returns and other stock characteristics.

The analysis looks at days when investors sell a position in their portfolio (sell days), or days that investors buy a new position or add to an existing position in their portfolio (buy days). The exact time that a trade occurs is not included in the dataset, only the date of trade. Thus if multiple trades of the same security are made within the same day, the value weighted price and net quantity are used. Furthermore, on days that a new position is purchased, the analysis does not include the new position as available to be sold, because it is unclear whether it was held at the time the investor sold the original position. Short positions are not included in the analysis and a position is considered short when it is sold with prior holdings of zero or when it is purchased and the resulting quantities are zero or negative. Following Ben-David and Hirshleifer (2012), all positions with a negative commission are dropped. The initial purchase price of positions purchased before the sample period began is not known. Positions present in the first month of the holdings file for a given account are thus excluded from the analysis.

Returns are calculated as in Hartzmark (2015) from the purchase price to the closing price on the day prior to the sale. If a position is purchased and subsequently more shares of that position are purchased, the purchase price used to calculate the total return on that position is the value weighted purchase price across the multiple purchases.

Mutual fund data is taken from Thompson-Reuters for fund holdings, and this is combined with price and volume information from CRSP. The two files are merged using the WFICN files. Only report dates (not the actual date of trade) are known, so returns are calculated

analogously to the individual investor data, but using the report dates rather than the actual dates of trade. A position is considered a sale if the number of shares decreases (or is not reported) in the subsequent quarter and it is considered a purchase if the number of shares increases or if it appears after being absent in the previous quarter. The analysis examines the sample from January 1990 to June 2010, though data from as early as 1980 is utilized to construct the price history. We apply a number of filters to the Thompson-Reuters data as suggested by Frazzini (2006). Specifically, holdings are set to missing if the number of shares that a fund holds is more than the total number of shares outstanding in the stock, the value of a holding is greater than the fund's total asset value or the value of the fund's reported holdings is more than 100% different from the CRSP value.

Summary statistics for the individual investor data are presented in Table 1. We examine 56,546 accounts that sell at least one position on 352,152 days on which there were slightly more than 2 million positions that they could have sold. The mean portfolio size is 5.7 stocks with many investors holding 3 or fewer stocks. Of the sell days, 82,688 of them were days where another position was purchased.

4. Results

4.1 Reinvestment Days and the Decision to Sell the New Asset

The main hypothesis of this paper is that investors who sell one asset and buy another in quick succession may treat the new asset as a continuation of the old mental account. We examine a number of aspects of trading behavior to see if it is consistent with this notion. First, we investigate whether attributes of a previously sold asset impact the decision to sell the new asset. If the new asset is considered a continuation of the old mental account, then trading in the

new asset will still be influenced by the gains or losses generated from the old asset. Conversely, any theory based on stock-by-stock narrow framing predicts no impact from the position that was previously sold and is no longer held by the investor.[6]

The most straightforward prediction here relates to the disposition effect. If the new asset is placed in the original mental account and if investors are averse to closing a mental account at a loss, then the propensity to sell the new asset will be higher when the mental account is at a gain than at a loss based on the original amount invested in the old asset. This generates a sharp prediction that investors should be more likely to sell the new asset when its price reaches a point at which the investor has made a profit relative to the amount initially invested in the old asset. In other words, investors should exhibit a disposition effect with respect to a reference point of the dollar amount invested in the old asset.

To examine whether investors engage in such behavior, we examine holdings that were purchased as part of a reinvestment day, conditioning on the investor selling only one stock and buying only one stock on that day. In this sample, if the investor rolled a mental account it must be from the single stock sold to the single stock purchased. We examine the propensity of investors to subsequently sell the newly purchased asset.

On each day with a sale, we calculate the gain or loss of the newly purchased position based on the initial value invested in the original position that was sold. We calculate two variables. The first variable, *Gain*, is equal to one if the position has a positive return since it was purchased. This captures the sign of the holding period capital gain, which is the key variable that is traditionally used to measure the disposition effect. The variable that is unique to our

[6] By "stock-by-stock narrow framing" we mean that gains and losses are evaluated at the stock-level, where the reference point is independent of attributes of previously sold positions.

analysis is *Original Gain*, which is equal to one if the position is at a gain relative to the amount that was initially invested in the previously sold position.

For example, assume that an investor initially buys $110 of stock in Apple, which he subsequently sells when its value has fallen to $100. At this point, he simultaneously buys $100 of Microsoft. Observations would be taken for Microsoft on each subsequent day that the investor sold some asset. Now suppose the investor sells an asset on a day that his position in Microsoft is worth $105. On this day *Gain* is equal to one (as the price has increased from $100 to $105), but *Original Gain* is equal to zero, as the $105 price is less than the original purchase amount of $110 of Apple stock.

We examine whether investors exhibit a rolled disposition effect, being more likely to sell when at a gain relative to the amount originally invested in the asset that was sold on the reinvestment day (which is no longer held). In the first column, we regress a dummy variable, *sell*, which is equal to one if a position is sold, on *Original Gain*. The coefficient on *Original Gain* is 0.036 with a t-statistic greater than 5. This coefficient provides a measure of the rolled disposition effect. The coefficient indicates that investors are 3.6% more likely to sell a position that is at a gain relative to the original position, compared to a position at a loss.

Of course, if the new stock is at a gain relative to the investment in the original position, it is more likely to be at a gain relative to the investment in the current position. As such, this result could simply be capturing a noisy measure of the standard disposition effect. The next column adds a dummy that controls for the standard disposition effect, and we find that investors remain 2.4% more likely to sell a position that is at a gain relative to the original amount invested.

In addition to a greater willingness to sell a position at a gain compared to a loss, Ben-David and Hirshleifer (2012) highlight the importance of the *level* of return from purchase, among other variables. The third column adds a number of controls from Ben-David and Hirshleifer (2012) including the return from purchase if the position is at a gain, *Return*Gain*, the return from purchase if the position is at a loss, *Return*Loss*, the square root of the number of holding days, *√Holding Days*, along with the following interactions: *Return*√Holding Days*Gain, Return*√Holding Days*Loss, Variance *Gain, Variance *Loss*. With these added controls, we find that the coefficient increases to 2.9% with a t-statistic of 4.91. These results suggest that the rolled disposition effect is a robust finding - on average, the amount invested in the original position remains an important determinant of trading decisions after a mental account has been rolled into a new position.

To further examine trading decisions of investors based on the return from the original position we examine selling propensities of positions that are at a small gain or a small loss relative to the original position. Figure 1 examines how the propensity to sell a position varies with the level of the return from the original position limiting the sample to observations that are within negative 15% to positive 15% of the original position. The left portion of Figure 1 Panel A graphs the probability of selling a position based on the return from the original position (the continuous analogue to *original gain*). Each bar is a bin containing all observations on a sell day with returns in the indicated 1% range and the height of the bar represents the proportion of positions with a return in that bin that were sold. The maroon bars are positions at a loss relative to the original position and the navy bars are positions at a gain.

In general the maroon bars indicate a lower probability of sale than the navy bars which is consistent with the rolled disposition effect shown in Table 2. The binning of positions at the

1% level is ad hoc, so as an alternative, the right panel utilizes the raw data to estimate two local linear polynomials estimated with the optimal bandwidth. The red line is estimated using only positions at a loss relative to the amount invested in the original position, while the blue line is estimated using only positions at a gain. The two graphs each illustrate a similar pattern of a rolled disposition effect.

These results are clearly correlated with variables based on return from purchase that have been shown to impact the propensity to sell a position. To account for such an effect we regress *sell* on a dummy variable equal to one if a position is at a gain along with *Gain* and the other controls from Ben-David and Hirshleifer (2013) discussed above. In Panel B of Figure 1 we take the residuals from this regression and examine how they respond to the return from the original position. The results are largely unchanged. The maroon bars are generally below the navy bars indicating a rolled disposition effect. The charts are visually similar, the magnitude of the jump in both panel is roughly 5%, and the statistical significance is also about the same magnitude. These results suggest that investors selling decisions are directly impacted by the level of return from their previously held position and that this impact is not explained by simply how the position has performed since the investor purchased it.

4.2. The Disposition Effect and Reinvestment Days

The next hypothesis we examine relates to the choice of which assets investors sell on reinvestment days. In general, investors display a disposition effect, whereby they are more likely to sell assets at a gain than assets at a loss. This behavior is frequently ascribed to avoiding the pain of closing a mental account at a loss. If investors purchase a new stock on a sell day and the original mental account is rolled over, there is no utility generated upon the realization of the

asset. Because this allows investors to realize a loss without generating a negative utility jolt, this predicts that the disposition effect should be reduced on days in which there is a sale and a purchase. Table 3 tests this prediction by examining whether investors exhibit the disposition effect on days that they also buy another position.

Following Odean (1998), we measure the disposition effect using the difference in the proportion of gains realized (PGR) and the proportion of losses realized (PLR). PGR and PLR are defined as follows:

$$PGR = \frac{\#\ of\ Gains\ Sold}{\#\ of\ Gains\ Sold + \#\ of\ Gains\ Not\ Sold}$$

$$PLR = \frac{\#\ of\ Losses\ Sold}{\#\ of\ Losses\ Sold + \#\ of\ Losses\ Not\ Sold}$$

where *# of Gains Sold* is the total number of positions realized at a gain and *# of Gains Not Sold* is the total number of gains that could have been sold, but were not (on days that some position in the portfolio is sold). Similarly, *# of Losses Sold* is the total number of positions realized at a loss and *# of Losses Not Sold* is the total number of losses that could have been sold, but were not (on days that some position in the portfolio is sold). Table 3 presents measures of the disposition effect using a stock's purchase price as a reference point. Examining the *All* column of Panel A, PGR for all investors is 22.8% and PLR is 17.5%. Thus the disposition effect for these investors is 5.4%, which is significant with a *t*-statistic of 11.80 (*t*-statistics are clustered by firm and date). There are a number of investors that hold very few stocks and exhibit a very strong disposition effect. Panel B examines only investors that hold at least 5 stocks and shows they exhibit a smaller disposition effect of 2.4%, while Panel C examines investors that hold fewer than 5 stocks and shows they exhibit a disposition effect of 13.3%.

The second column examines the disposition effect when an investor sells a position in his portfolio and does not buy another position on the same day (non-reinvestment days, 69% of observations) while the third column examines the 31% of observations where an investor sells a position in his portfolio and buys another position on the same day (reinvestment days). On non-reinvestment days, investors exhibit a larger disposition effect. The magnitude of the disposition effect on non-reinvestment days is 8.1% across all investors, 3.8% for investors holding at least five stocks, and 17.1% for investors holding less than five stocks.

On reinvestment days, investors do not exhibit a disposition effect. Examining all investors, the difference between PGR and PLR on reinvestment days is -0.8% with a t-statistic of -1.42. Examining investors that hold five or more stocks, we find the disposition effect is -0.3% with a t-statistic of -0.52. Investors that hold fewer than five stocks exhibit an insignificant disposition effect of -0.8% with a t-statistic of -1.58. As a whole, these results are consistent with the hypothesis that investors are less likely to close a mental account and derive a jolt of utility on days when they purchase another position.

While the magnitude of the disposition effect (that is, the difference between PGR and PLR) is easy to compare across reinvestment and non-reinvestment days Table 3, comparing PGR or PLR across reinvestment and non-reinvestment days is more involved. The main complication is that there may be differences in overall selling propensity between the types of investors who reinvest assets and those who do not. Such differences, whatever their origin, will influence the individual PGR and PLR values, but will be canceled out in the PGR-PLR measure. The key idea we wish to test is that if an investor rolls a mental account, he does not experience utility from closing out a position at a gain or loss. Thus when rolling a mental account we predict investors will be equally likely to sell a position at a gain or loss, and that the

likelihood is simply equal to the base rate of selling a position. To test this, we must first estimate a base selling rate for each account, and examine which set of days and positions (reinvestment vs non-reinvestment, gain vs loss) display a greater deviation from this baseline propensity. We therefore repeat the analysis from columns 2 and 3, but include fixed effects for each account as well as portfolio size. More concretely, we run a single regression of a sale dummy on account fixed effects and portfolio size fixed effects, examining all days with a sale (both reinvestment and non-reinvestment). Then we take the average of the residuals for four categories – reinvestment day for assets at a gain, reinvestment day for assets at a loss, non-reinvestment for assets at a gain, and non-reinvestment for assets at a loss. Figure 2 provides the results where each bar represents the difference in selling propensity from the baseline of the account, controlling for portfolio size, rather than the straight proportion realized as before. As these are residuals and must sum to zero, they reveal which categories drive the overall difference, but they do not speak to the level.

The left side of the chart shows that on days with no reinvestment, investors are more likely to sell positions at a gain and less likely to sell positions at a loss, as compared with their baseline probability of selling assets. The right side of the figure shows that on reinvestment days, there is no disposition effect, evidenced by the fact that the deviations from baseline selling propensity are the same for gains and losses. More importantly, the level of deviations for both categories is statistically indistinguishable from zero. This indicates that on reinvestment days, the selling propensity for gains and losses both equal the unconditional average selling rate for that investor. This fits the intuition that there is no particular utility burst at such times – gain and loss realization propensities are the same as in the overall case. Rather, deviations from the baseline occur on non-reinvestment days, consistent with the idea that closing a mental account

generates a burst of utility which affects trading decisions. We return to a more detailed examination of the impact of investor heterogeneity in section 4.5.

In the previous discussion, we proxy for an investor rolling a mental account by the presence of a purchase on the same day as a sale. The notion, consistent with the discussion in section 2, is that on a reinvestment day the previous pool of money is transferred into the new asset. While outside the basic framework of section 2, this intuition suggests that the measure can be refined further by considering the relative size of the amount sold and the amount purchased. In particular, days with both a purchase and a sale can be broken into cases where a) the entire sale amount is reinvested, b) more than the sale amount is invested (e.g. the investor sold a position, added extra cash and bought a larger total position in the new stock), and c) less than the sale amount is reinvested (e.g. the investor sold a position, reinvested some component and kept some in cash).

The most straightforward prediction applies to cases where the amount reinvested is approximately equal to the amount sold, and thus the pool of money remains the same. However, when more money is added to the account, the entirety of the money from the old stock is still in the investment account, which makes it more likely that the returns in the new asset are considered part of the same investing episode. In the third case there is some transfer to a different account, which may make it more likely that the investor is treating the episode as finished. As a result, cases with only partial reinvestment should have more of a disposition effect than those with full reinvestment.

Table 4 tests this hypothesis and finds evidence in support of it. Investors who sell a position and reinvest the entire proceeds of the sale back into their account on the same day do

not exhibit a disposition effect, but actually exhibit a negative disposition effect. When the sum of what is purchased is greater than 105% of the sum of what is sold, we find a negative disposition effect of -4.4% with a *t*-statistic of -7.32. When investors reinvest roughly the same amount of the proceeds back into their account (plus or minus 5% of the sale amount), we find a negative disposition effect of -3.5% with a *t*-statistic of -4.75. In contrast, when investors reinvest less than the amount sold they exhibit a positive disposition effect of 1.3% with a *t*-statistic of 2.03.

To this point the paper has only examined purchases that occur on the same day as a sale. The key intuition we are trying to capture is that investors treat the new asset as a continuation of the same investing episode from the old stock. It is possible that investors may still connect a purchase and a sale as being part of the investment episode in a rolled account even though they do not occur simultaneously. For instance, an investor might be waiting for the funds to clear on the sold asset, waiting for a particular price point on the new asset, or waiting for a previously submitted limit order to execute. In such instances, near-in-time purchases and sales may still be part of the same rolled mental account. It seems likely that the closer in time two trades are observed, the more likely it is that investors are treating the two transactions as involving the same mental account (Read et al. (1998)).

Table 5 examines how the disposition effect varies as the length of time between a sale and a purchase increases. We consider observations where a sale and a purchase occurred within one month (20 trading days) of each other. The table has regressions of *sell*, a dummy variable equal to one if a position is sold, on a gain dummy as before, as well an interaction term between a gain dummy and the time until the nearest buy. In a second version of the regression, we

interact the gain variable with dummy variables for purchases that are 1, 2, 3 and 4 weeks away from the sale (with the omitted category being purchases that occur on the same day as the sale).

We find that as the length of time between the sale and the purchase increases (making it less likely that the two trades are part of a rolled mental account) the disposition effect gets larger. In column 1, each additional day between the sale and the purchase increases the propensity to sell gains relative to losses by 0.7%. When the disposition effect is broken out week by week, there is a monotonic increase in disposition effect as the time until purchase increases. When a purchase is made within a week of the sale (but not on the exact sale day), investors are 7.4% more likely to sell winners than losers. By contrast, when a purchase is made four weeks from a sale, investors are 10.0% more likely to sell winners than losers. This is consistent with the idea that purchases within a week are more likely to be part of a rolled mental account, whereas purchases further away are less likely to be part of the same investing episode and thus in a different mental account.[7]

4.3 Reinvestment Days and the Decision of What to Purchase

The previous section provides evidence in favor of rolling mental accounts by looking at the choice of what investors sell on reinvestment days. In this section, we examine the decision of which assets investors buy on reinvestment days. In particular, if the two stocks are considered to be in the same mental account, then attributes from the old stock may influence the subsequent purchase decision.

One major attribute that may affect purchase choices is the level of gains and losses on the old investment. In particular, mental accounting posits that investors consider gains and

[7] In untabulated results, when observations are split according to whether the sale occurred before or after the associated purchase, the results are similar for both subsets.

losses relative to reference points, as in models such as prospect theory (Kahneman and Tversky (1979)). Under a prospect theory value function with diminishing sensitivity, investors' utility is concave in the region of gains, but convex in the loss region. As a result, an investor who is at a gain will be risk-averse while an investor who is at a loss will exhibit risk-seeking behavior. Furthermore, if the realization does not close the mental account, then the new stock will have a reference point equal to the value initially invested in the old stock.

This generates the prediction that if the realization involves rolling a mental account, then investors will want to take on more (less) volatility in the new stock if the old stock is sold at a loss (gain). If the two transactions are not linked through a mental account, it is not clear why volatility levels should be different. Standard portfolio theory predicts that investors should care about covariances rather than variances, and it makes no obvious predictions about the relation between realized gains and losses on the old investment and volatility in the new investment.

Table 6 examines this question and finds that investors tend to purchase more volatile stocks when the old asset is sold at a loss. We examine days where only one position is sold and at least one other position is purchased, and consider as a dependent variable the volatility (over the previous year) of stocks that are purchased.[8] This is regressed on a dummy variable equal to one if the stock sold that day is at a loss. Panel A examines the variance measured as percentiles of all stocks on the day of the sale, and Panel B examines the raw measure of variance winsorized at the 1st and 99th percentile. The constant represents the average variance measure for positions purchased on days when the total amount sold was sold at a gain and the dummy variable shows the difference from this amount on days when positions are sold at a loss.

[8] We require at least 50 trading days over the previous year to calculate the volatility. If the position lacks the requisite number of data points we do not include it in the analysis.

Examining the first column of Table 6 Panel A, we see that on reinvestment days when a stock is sold at a loss, investors buy positions that are more than one percentile higher in the distribution of variance. This could simply be indicative of certain days being more volatile than others, or investors having systematically different preferences for volatility over the sample period, so column 2 adds in a date fixed effect. The effect is larger after its inclusion, suggesting that such an explanation does not account for the effect. In the third column we add investor fixed effects to examine whether the measure is simply capturing systematic differences in volatility preferences. We find a positive coefficient of 0.659 with a *t*-statistic of 2.46. In Panel B we examine the winsorized level of the variance rather than our percentile measure and find a similar pattern suggesting our results are not driven by specific scaling choices. Thus we find that investors invest in more volatile positions when they close out other positions at a loss. This is consistent with investing in riskier assets to increase the chances of converting a mental account at a loss into one at a gain.

4.4 Reinvestment Days and the Subsequent Performance of Trades

The disposition effect is now widely considered a trading mistake due to poor ex-post performance and suboptimal tax implications (Odean (1998)). If the disposition effect is driven by the disutility from closing a mental account at a loss, then rolling a mental account (which avoids such account closure) may result in better trading decisions. In this section, we examine the returns of positions after they are sold and find that decisions made on reinvestment days are more profitable (measured by ex-post returns) than those made on non-reinvestment days.

Table 7 examines the subsequent returns of all positions sold, both on reinvestment days and non-reinvestment days. Returns following the sale are measured over the subsequent quarter

(65 trading days), year (255 trading days) and two years (505 trading days), both as the return in excess of the CRSP value weighted market return and characteristic adjusted returns similar to Daniel, Grinblatt, Titman and Wermers (1997). We sort stocks into quintiles based on their book to market, size and return from *t*-20 to *t*-250 and match each stock to the portfolio that matches the three quintiles. We then subtract the portfolio return from the stock return to give the characteristic adjusted return.

For each measure and time period, three regressions are run on the returns of positions in the period after they are sold. The first regression is of the return on a dummy variable for whether a position is purchased on the same day (i.e. the asset was sold on a reinvestment day) and on a constant. Thus the constant gives the return on the position that is sold on a non-reinvestment day. Note that a positive point estimate is indicative of a poor sell decision (subsequent returns are high) while a negative point estimate is indicative of a good sell decision (subsequent returns are low). Using any of the return measures and any of the holding periods, we find that, on average, a stock sold on a reinvestment day subsequently earns a lower return compared to that of stocks sold on non-reinvestment days. Over the next quarter this excess return differential is -0.70% (with a *t*-statistic of -5.93), over the next year it is -2.34% (with a *t*-statistic of -8.48) and over the next two years it is -4.74% (with a *t*-statistic of -10.27). Examining the characteristic adjusted numbers yields similar results of -0.61% per quarter, -2.05% per year and -4.28% over two years, and is significant at the 1% level in all cases.

In general, selling a position at a gain has been found to be a poor decision based on ex-post returns (Odean (1998)) and our previous results show that investors exhibit a higher propensity to sells gains on days that they do not buy another position. Thus the improved trading decisions in the first regression might simply capture this reduction in the disposition

effect and associated subsequent returns. To test this, the second regression includes a dummy variable for when a position is at a gain. For each return measure and for each time period the coefficient on this dummy variable is positive, indicating that selling a position at a gain typically leads to foregone positive returns in the future. However, the coefficient on *Reinvestment Day* decreases only slightly in most specifications. Column three allows for a differential effect of disposition-related selling on reinvestment days, and finds little difference in most specifications. The robustness of the coefficient on *Reinvestment Day* suggests that only a small portion of the effect is due to the fact that there is a decreased propensity to sell gains on reinvestment days.

Another alternative explanation for our result is that some investors have skill, and skilled investors exhibit both a lower disposition effects and the ability to generate higher returns. To the extent that such skill is correlated with the decision to reinvest assets, this could account for the robust negative coefficient found on *Reinvestment Day* in the previous regression. Table 8 attempts to control for this by re-running the same regressions with individual fixed effects to account for a persistent component of skill in selling decisions. In general the results look similar to the regression without the individual fixed effects. Some coefficients decrease slightly, suggesting that investors with more skill are more likely to buy and sell on the same day, but this alone does not account for the entire effect.

The analyses above compare the subsequent returns of stocks sold on reinvestment days with the subsequent returns of stocks sold without reinvestment. This is designed to test the effect of reinvestment on the return of the sold stock. Another relevant comparison group is the set of stocks that could have been sold on the day that a sale occurred, but were not sold. If an investor sells a position that does poorly over the next year, but the other positions in his

portfolio do worse, the decision to sell may not be viewed in as favorable a light. We examine this relative subsequent performance of sold stocks (relative to stocks retained in the portfolio) for both reinvestment days and non-reinvestment days. Table 9 regresses returns on all positions that could have been sold on a sell day on *Sell*Reinvestment Day*, a dummy variable equal to one if a position is sold on a day that another position is purchased and *Sell*No Reinvestment Day*, which is equal to one if a position is sold on a day that no other position is purchased. To control for the average performance of holdings that could have been sold on a given day, fixed effects for the interaction of account and date are included. Thus the variation examined is relative to the return of all positions in the portfolio that were not sold on that sell date. Again, we see a strong pattern of significant negative coefficients on *Sell*Reinvestment Day*. This suggests that on reinvestment days investors make better choices about which positions to sell, as measured by ex-post performance.

4.5 Alternative Explanations

While the reduction of the disposition effect could be explained by theories other than rolling mental accounts, when combined with the finding of the rolled disposition effect it becomes very difficult to present a unified theory of the findings without some sort of continued mental account. For example, one possible explanation of the disposition effect reduction involves beliefs about the future returns of assets. To see this, note that on non-reinvestment days, if beliefs are driving the trading behavior then they must relate to the asset being sold (since this is the only trade taking place). But on reinvestment days, investors may trade because they have beliefs about the stock being sold *or* beliefs about the newly purchased asset. If the motivation for the combined trade is beliefs about the asset being purchased, then the choice of which asset to sell may be different to other days because investors do not have strong views on

the stock being sold. This does not immediately predict a reduced disposition effect (since the different beliefs must relate to the gain or loss status of each stock), but it would explain why selling behavior might be generally different on such days.

If the analysis of reinvestment days were limited to studying the level of the disposition effect, it would be difficult to directly rule out this kind of beliefs-based explanation. However, the subsequent results suggest that such a theory would leave much unexplained about trading behavior around reinvestment episodes, and thus does not seem to be a parsimonious explanation of our results. For instance, beliefs at the time of reinvestment do not obviously explain why investors in reinvested assets should have a rolled disposition effect, selling the new asset based on profits relative to the old investment amount. Beliefs about the asset being purchased also do not seem to generate our result that the newly purchased stock's volatility is predicted by whether the old asset was sold at a gain or at a loss.

Indeed, these two results are also difficult to explain with other standard theories such as portfolio rebalancing. This is especially true for the finding of a rolled disposition effect. In this case, the stock which is influencing the sale decision is no longer even held in the portfolio. Standard rebalancing also does not predict discontinuities in sale tendencies around particular reference points that have only psychological (and not economic) significance.

It is worth noting that the proposed alternatives are very much piecemeal across the different results, and none explains anything like the totality of our findings. By contrast, the theory of rolled mental accounts provides a parsimonious explanation of all of these findings.

4.6 Robustness

4.6.1 Mutual Funds, Rolling Mental Accounts and the Disposition Effect

The paper to this point has examined solely individual investors trading on their own accounts. Ideally it would be possible to analyze other investors and time periods to see the extent to which they exhibit similar behavior. Unfortunately we do not have data that allows for such an examination. Instead we examine the quarterly reporting of mutual funds. These funds do not report trade by trade activity, making it difficult to assign a particular sale and purchase to the same mental account. Nonetheless, we can test a proxy for the ability to roll over mental accounts and examine its effect on the disposition effect as in section 4.2.

In particular, we can calculate whether a fund has recently experienced inflows or outflows. A fund that has experienced outflows will be forced to sell positions and send that money to investors. This will reduce the ability of the fund to sell an asset and roll the proceeds into a new asset, because more of the sales have to be used to pay for the redemptions. If funds consider each stock separately, outflows will constrain the ability of funds to roll mental accounts, whereas inflows provide funds with the flexibility to roll mental accounts. As a consequence, we predict that funds experiencing outflows will display a larger disposition effect among their holdings than funds experiencing inflows.

The results in Table 10 provide supporting evidence for this hypothesis. In column 1 the following regression is run:

$$sell_{ijt} = \alpha + \beta_1 Gain_{ijt} * (Pos\ Flow_{it}) + \beta_2 Gain_{ijt} + \beta_3 (Pos\ Flow_{it})$$

where *i* indicates a mutual fund, *j* indicates a stock and *t* indicates a report date. *Gain* is a dummy variable equal to one if a position is at a gain. Flow is calculated using the following formula:

$$flow_{it} = \frac{TNA_{it} - TNA_{it-1} * (1 + Return_{it})}{TNA_{it-1}}$$

where return is the fund return from *t-1* to *t* and TNA is the total net assets of the fund. We examine the annual flow from sixteen months to four months before the announcement.[9] The dummy *Pos Flow* is equal to one if $flow_{it}$ is positive. Thus the coefficient on β_2 measures the disposition effect for funds that experienced outflows while the coefficient on β_1 measures the difference in disposition effect between funds with inflows and those with outflows.

Examining column 1 we see that funds that have experienced outflows – and are thus forced to send money to investors – display a disposition effect of 1.9% (with a *t*-statistic of 2.10) while funds that have experienced inflows display a disposition effect that is 4% less (t-statistic of -4.59), so they display a reverse disposition effect of -2.1%. Mutual funds have been shown to sell based on other characteristics of their holdings (see Hartzmark (2015) and An (2015)), so column 2 includes the controls from Hartzmark (2015). These controls are *Gain*Ret* which controls for the impact of return magnitude in the positive domain, *Loss*Ret* which controls for the impact in the negative domain, *Gain*Variance* which controls for the impact of a positions variance in the past year if that position is at a gain and *Loss*Variance* which does the same for positions at a loss, *Gain*Ret*√HoldingPeriod* and *Loss*Ret*√HoldingPeriod* control

[9] The decision to examine only up to four months before the announcement is to use only publicly available information and avoid a look-ahead bias (as we are looking at changes from the previous quarter's report). Similar results are obtained looking at monthly flows, annual flows, or examining flows up to the month before the announcement rather than utilizing the four month lag.

for interactions of past return and holding period in for gains and losses respectively. Including these controls in Column 2 yields a similar pattern.

It could be that some mutual funds have a tendency to exhibit the disposition effect and that this relationship is responsible for fund flows. To test whether a fund characteristic is responsible for this pattern, column 3 adds a fund fixed effect. With this addition, funds experiencing outflows exhibit a statistically significant disposition effect of 0.9% (*t*-statistic of 2.42), while funds experiencing inflows exhibit an effect 2.6% below that (with a *t*-statistic of -5.30). Finally, it could be that certain periods of time are more likely to be associated with inflows or outflows. The fourth column tests for this by adding a report date fixed effect and yields a similar gap in disposition effect between inflows and outflows, though the disposition effect for fund with outflows is only marginally significant.

Thus mutual funds exhibit a stronger disposition effect when they have experienced outflows rather than inflows. In such a scenario they are forced to sell positions and not reinvest the proceeds back into the portfolio. This suggests that even sophisticated market participants utilize mental accounting when making their decisions.

4.6.2 Investor Heterogeneity

To this point the analysis has aggregated investors together. This could mask systematic differences in investors that are correlated with the variables of interest. For example, the apparent relationship between reinvestment days and the disposition effect may simply be capturing fixed differences in the types of investors likely to engage in reinvestment, not the reinvestment days themselves. Relatedly, Kumar and Lim (2008) show that investors who trade

more frequently exhibit less of a disposition effect. If these investors who cluster their trades are also more likely to buy positions on the same day, this could account for our results.

To test for this, Table 11 examines the disposition effect on reinvestment days for a subset of investors who both reinvest and sell without reinvesting at some point. The sample is limited to investors who have at least five sell days where another position is purchased and five sell days where no other position is purchased. Thus for investor *i* we calculate:

$$\Delta Disp.Effect = \left(PGR_i^{No\ Buy} - PLR_i^{No\ Buy}\right) - \left(PGR_i^{Buy} - PLR_i^{Buy}\right)$$

We find that investors display a disposition effect 7.7% higher on days when another position is not purchased compared to days on which they reinvest. The effect is not restricted to investors with a small number or large number of stocks in their portfolio. Investors holding four or fewer stocks exhibit a disposition effect 10.8% larger on days they do not purchase another position, while those with five or more stocks exhibit a disposition effect 4.8% larger.

5. Conclusion

In this paper, we examine how investors apply mental accounting rules to their stock trades. In particular, we examine the assumption generally made in the mental accounting literature that investors open a mental account when a stock is purchased and they close it when the stock is sold. Contrary to this assumption, we present evidence that when investors sell an asset and buy a different asset in quick succession, the original mental account may instead remain open. Across a range of investment behaviors, investors act as if they treat the new asset as a continuation of the same pool of money that was invested in the old stock.

In terms of which assets are sold, reinvestment days differ from days without reinvestment. On days without reinvestment (when mental accounts are closed), investors are reluctant to sell losing assets, but on reinvestment days (when accounts are rolled), there is no tendency to sell winners more than losers. This lack of a disposition effect is consistent with investors not experiencing the disutility of closing a mental account at a loss, since the position is rolled into the new asset.

On reinvestment days, investors also make trading decisions consistent with them continuing to track the gain or loss status of the previously sold stock. When the old asset is sold at a loss, investors who simultaneously purchase are more likely to buy more volatile stocks, whereas selling at a gain and simultaneously purchasing is associated with buying less volatile stocks. This is consistent with predictions from prospect theoretic preferences that investors in the loss region will be more risk-seeking. Additionally, when trading the new asset, investors appear to keep track of the purchase price on the original asset. They are more likely to sell the new stock when its total value exceeds the amount invested initially in the old asset, which we term the rolled disposition effect. This is consistent with them treating the old investment amount as a reference point.

Overall, our results support the importance of mental accounting as an explanation for many aspects of investor behavior, but they also explore a heretofore ignored component of how mental accounts work in practice. The idea of a rolled mental account can be thought of as an extension of the idea in Barberis and Xiong (2012) that traders consider stocks in terms of investing episodes. We show that selling an asset and buying another one in quick succession is a way of extending the original investing episode and maintaining the initial mental account.

Rolling a mental account has parallels with the idea discussed in Chang, Solomon and Westerfield (2015) of how investors sometimes react to the cognitive dissonance of losses by blaming an intermediary. Here, we explore another means by which investors can avoid admitting to mistakes – namely by transferring assets across mental accounts so that the question of whether the investing episode was a mistake is now considered across the combination of two stocks, rather than one.

In this sense, rolling a mental account allows an investor to make return-improving trades while avoiding the pain of closing mental accounts at a loss. While rolling mental accounts may be a second-best solution relative to standard portfolio theory, it offers a considerable improvement over the third-best disposition effect that many individuals display. The question of how to encourage investors to so behave is one highly worthy of further study.

References

An, Li, 2015, "The V-shaped disposition effect", *Working Paper,* Tsinghua University.

Arkes, Hal R., David Hirshleifer, Danling Jiang, and Sonya Lim, 2008, "Reference Point Adaptation: Tests in the Domain of Security Trading", *Organizational Behavior and Human Decision Processes* 105, 67-81.

Baker, Malcolm, Stefan Nagel and Jeffrey Wurgler, 2007, "The Effect of Dividends on Consumption", *Brookings Papers on Economic Activity,* Economic Studies Program, The Brookings Institution, 38, 231-292.

Barber, Brad M. and Terrance Odean, 2000, "Trading is hazardous to your wealth: The common stock investment performance of individual investors", *Journal of Finance* 116, 261-292.

Barber, Brad M. and Terrence Odean, 2001, "Boys Will be Boys: Gender, Overconfidence and Common Stock Investment", *Quarterly Journal of Economics,* 116, 261-292.

Barber, Brad M. and Terrence Odean, 2008, "All that Glitters: The Effect of Attention on the Buying Behavior of Individual and Institutional Investors", *Review of Financial Studies*, 21 (2), 785-818

Barberis, Nicholas and Ming Huang, 2001, "Mental Accounting, Loss Aversion, and Individual Stock Returns", *Journal of Finance* 56, 1247-1292.

Barberis, Nicholas, Ming Huang and Tano Santos, 2001, "Prospect Theory and Asset Prices", *Quarterly Journal of Economics*, 116, 1-53.

Barberis, Nicholas and Wei Xiong, 2009, "What drives the disposition effect? An Analysis of a Long-Standing Preference-Based Explanation", *Journal of Finance,* 64, 751-784.

Barberis, Nicholas and Wei Xiong, 2012, "Realization utility", *Journal of Financial Economics,* 104, 251-271.

Ben-David, Itzhak and David Hirshleifer, 2012, "Are investors really reluctant to realize their losses? Trading responses to past returns and the disposition effect", *Review of Financial Studies* 25, 2485-2532.

Birru, Justin, 2015, "Confusion of Confusions: A Test of the Disposition Effect and Momentum", *Review of Financial Studies* 28, 1849-1873.

Chang, Tom Y., David H. Solomon and Mark M. Westerfield, 2015, "Looking for Someone to Blame: Delegation, Cognitive Dissonance and the Disposition Effect", *Journal of Finance*, Forthcoming.

Engelberg, Joseph E. and Christopher A. Parsons, 2011, "The Causal Impact of Media in Financial Markets", *Journal of Finance* 66, 67-97.

Feng, Lei and Mark S. Seasholes, "Do Investor Sophistication and Trading Experience Eliminate Behavioral Biases in Financial Markets?", *Review of Finance* 9, 305-351.

Frazzini, Andrea, 2006, "The Disposition Effect and Under-Reaction to News", *Journal of Finance*, 61, 2017-2046.

Frydman, Cary, Nicholas Barberis, Colin Camerer, Peter Bossaerts, and Antonio Rangel, 2014, "Using neural data to test a theory of investor behavior: An application to realization utility", *Journal of Finance* 69, 907-946.

Garleanu, Nicolae, and Lasse H. Pedersen, 2013, "Dynamic Trading with Predictable Returns and Transaction Costs", *Journal of Finance* 68, 2309-2340.

Genesove, David and Christopher Mayer, 2001, "Loss aversion and seller behavior: Evidence from the housing market", *Quarterly Journal of Economics* 116, 1233-1260.

Goetzmann, William, and Alok Kumar, 2008, "Equity Portfolio Diversification", *Review of Finance* 12, 433-463.

Gross, Leroy, 1982, "The Art of Selling Intangibles: How to Make your Millions by Investing Other People's Money", New York Institute of Finance, New York.

Harris, Lawrence, Samuel M. Hartzmark and David H. Solomon, 2015, "Juicing the Dividend Yield: Mutual Funds and the Demand for Dividends", *Journal of Financial Economics* 116, 433-451.

Hartzmark, Samuel M., 2015, "The Worst, the Best, Ignoring All the Rest: The Rank Effect and Trading Behavior", *Review of Financial Studies,* Forthcoming.

Hartzmark, Samuel M. and David H. Solomon, 2012, "Efficiency and the disposition effect in NFL prediction markets", *Quarterly Journal of Finance* 2, 1250013.

Heath, Chip and Jack B. Soll, 1996, "Mental Budgeting and Consumer Decisions", *Journal of Consumer Research* 23, 40-52.

Imas, Alex, 2014, "The Realization Effect: Risk-Taking After Realized Versus Paper Losses", *Working Paper*, Carnegie Mellon University.

Ingersoll, Jonathan. E. and Lawrence J. Jin, 2013, "Realization utility with reference-dependent preferences", *Review of Financial Studies* 26, 723-767.

Kahneman, Daniel, and Amos Tversky, 1979, "Prospect Theory: An Analysis of Decision under Risk", *Econometrica* 47, 263-291.

Kaustia, Markku, 2010a, "Prospect Theory and the Disposition Effect", *Journal of Financial and Quantitative Analysis* 45, 791-812.

Kaustia, Markku, 2010b, Disposition effect, in *Behavioral Finance*, Robert W. Kolb Series in Finance (John Wiley Sons, Inc., Hoboken, NJ).

Koszegi, Botond and Matthew Rabin, 2006, "A Model of Reference-Dependent Preferences", *Quarterly Journal of Economics* 121, 1133-1166.

Kumar, Alok, and Sonya Lim, 2008, "How Do Decision Frames Influence the Stock Investment Choices of Individual Investors?", *Management Science* 54, 1052-1064.

Kumar, Alok, 2009, "Who Gambles in the Stock Market?", *Journal of Finance* 64, 1889-1933.

Locke, Peter R., and Steven C. Mann, 2005, "Professional trader discipline and trade disposition", *Journal of Financial Economics* 76, 401–444.

Markowitz, Harry, 1952, "Portfolio Selection", *Journal of Finance* 7, 77-91.

Malmendier, Ulrike, and Stefan Nagel, 2011, "Depression Babies: Do Macroeconomic Experiences Affect Risk Taking?", *Quarterly Journal of Economics* 126, 373-416.

Odean, Terrance, 1998, "Are Investors Reluctant to Realize Their Losses?", *Journal of Finance*, 53, 1775-1798.

Pagel, Michaela, 2014, "Expectations-Based Reference-Dependent Life-Cycle Consumption", *Working Paper*, Columbia University.

Read, Daniel and George Loewenstein, 1995, "Diversification bias: Explaining the discrepancy in variety seeking between combined and separated choices", *Journal of Experimental Psychology: Applied* 1, 34-39.

Read, Daniel and George Loewenstein, and Matthew Rabin, 1998, "Choice bracketing", *Journal of Risk and Uncertainty* 19, 171-197.

Sharpe, William F., 1964, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk", *Journal of Finance* 19, 425-442.

Shefrin, Hersh and Meir Statman, 1985, "The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence", *Journal of Finance*, 41(4), 951-974.

Shefrin, Hersh and Richard H. Thaler, 1988, "The Behavioral Life-Cycle Hypothesis", *Economic Inquiry* 26, 609-643.

Strahilevitz, Michal A., Terrance Odean, and Brad M. Barber, 2011, "Once burned, twice shy: How naive learning, counterfactuals, and regret affect the repurchase of stocks previously sold", *Journal of Marketing Research* 48, 102-120.

Thaler, Richard H., 1980, "Towards a positive theory of consumer choice", *Journal of Economic Behavior and Organizations* 1, 39-60.

Thaler, Richard H., 1985, "Mental accounting and consumer choice", *Marketing Science* 4, 199-214.

Thaler, Richard H., 1990, "Anomalies: Saving, Fungibility, and Mental Accounts", *Journal of Economic Perspectives* 4, 193-205.

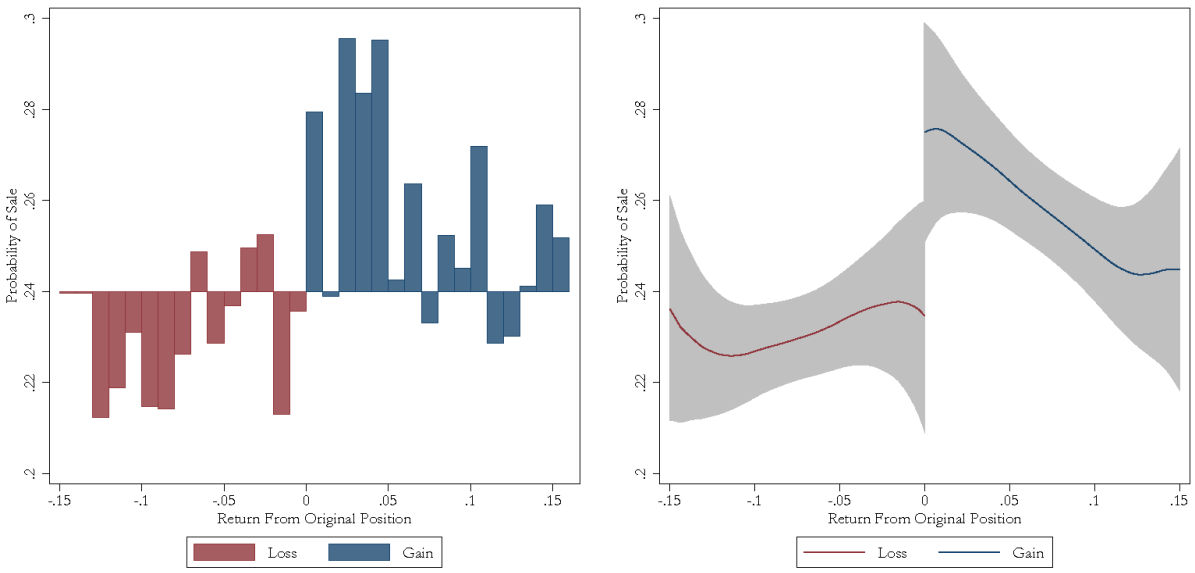
Thaler, Richard H., 1999, "Mental Accounting Matters", *Journal of Behavioral Decision Making* 12, 183-206.

Thaler, Richard H. and Hersh M. Shefrin, 1981, "An Economic Theory of Self-Control", *Journal of Political Economy* 89, 392-406.

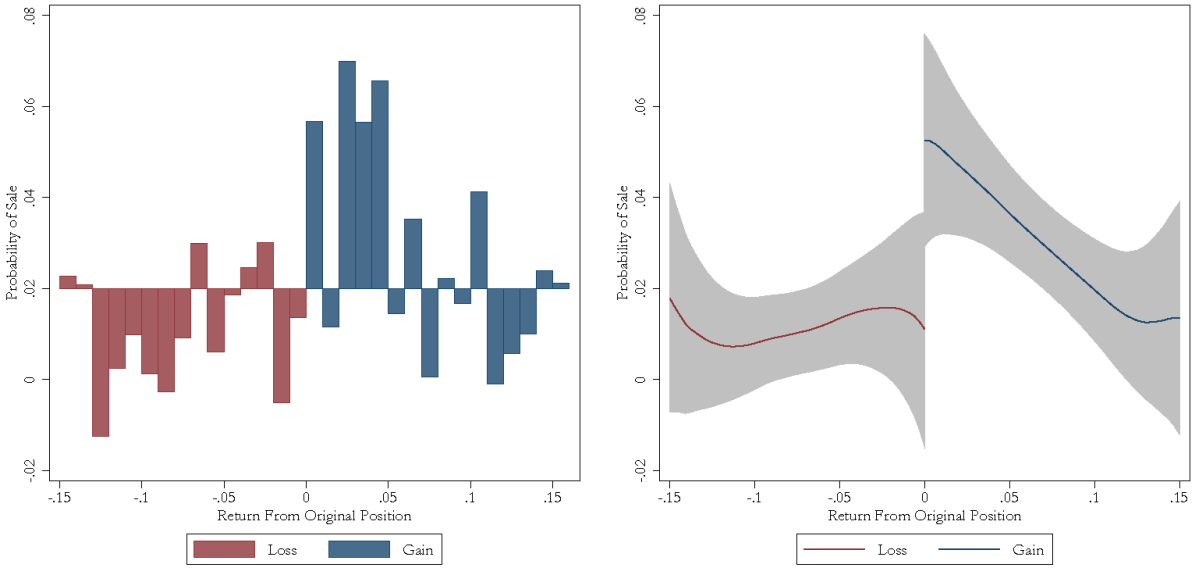
Weber, Martin and Colin Camerer, 1998, "The disposition effect in securities trading: An experimental analysis", *Journal of Economic Behavior & Organization* 33, 167-184.

Figure 1 – Probability of Sale by Return from Original Position

Panel A: Without Controls

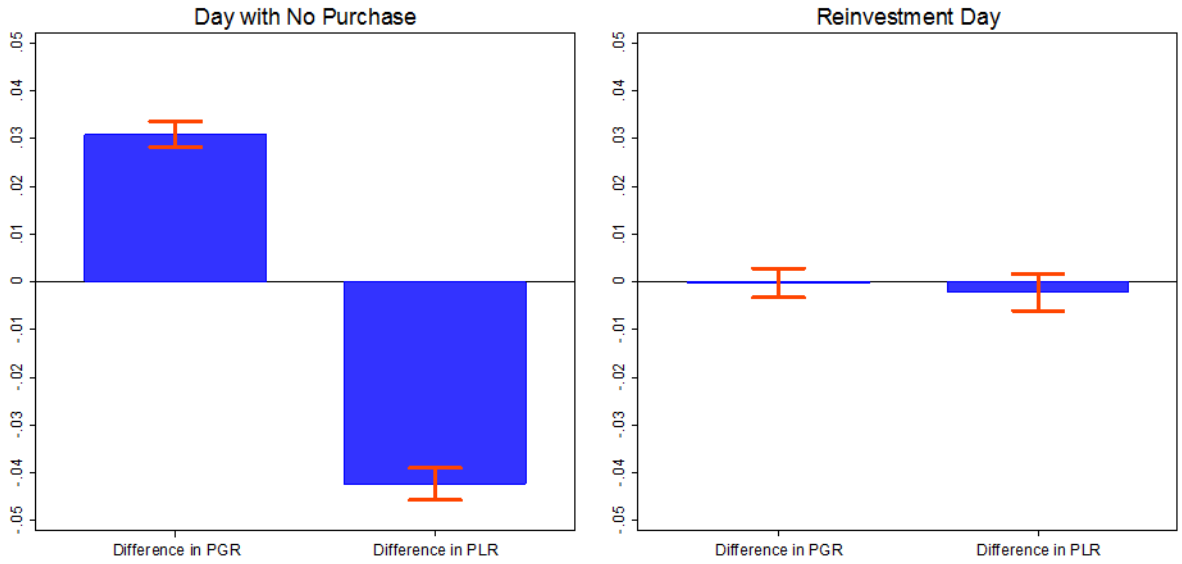


Panel B: Residual after controlling for Current Position's Gain/Loss, Returns, Holding Period and Volatility



This figure presents the probability of sale based on the return from the previously held position. The sample is limited to positions that were previously purchased on a day where exactly one other position was sold. The return is calculated relative to the value originally invested in the previously sold position. The left graph shows the raw probability of sale for bins of 1% return. The right graph shows a local linear plot conducted separately on positions at a loss or a gain relative to the original position with the 95% confidence interval. Panel A does not include controls. In Panel B a sell dummy is regressed on *Gain*, *Return*Gain*, *Return* Loss*, *Return*√Holding Days*Gain, Return*√Holding Days*Loss, Variance *Gain, Variance *Loss,* and *√Holding Days*, and the residual from this regression is used for the analysis. Individual investor data covers January 1991 to November 1996.

Figure 2 - Deviations from Investor-Specific Baseline Selling Propensity, Split by Gains versus Losses and Reinvestment versus Non-Reinvestment Days



This figure presents deviations from the baseline selling propensity for each investor (controlling for portfolio size), according to whether or not it is a reinvestment day and whether or not the stock in question is at a gain or a loss. A dummy equal to 1 if a position is sold is regressed on fixed effects for each account and number of stocks in a portfolio. The average of this residual is graphed as the bar for each of the four samples above. The red lines represent the 95% confidence interval where standard errors are clustered by acount and date. Only days where a stock is sold are included in the sample. Stocks are not included on the day the position is opened. Individual investor data covers January 1991 to November 1996.

Table 1 – Summary Statistics

	Obs	Mean	SD	Minimum	25th Pctile	Median	75th Pctile	Maximum
# Observations	2,015,204							
# Accounts	56,546							
# Sell days	352,152							
# Sell Days with Buy	82,688							
Proportion Sold	352,152	0.442	0.335	0.002	0.167	0.333	0.500	1.000
Number of Stocks Held	352,152	5.675	9.339	1	2	3	7	478

This table presents summary statistics on investors from January 1991 to November 1996. Only days where a stock is sold are included. Stocks are not included on the day their position is opened.

Table 2 – Disposition Effect based on Gain from Previous Position

Original Gain	0.036 ***	0.024 ***	0.029 ***
	(5.49)	(3.68)	(4.91)
Gain		0.050 ***	0.061 ***
		(7.05)	(7.02)
Constant	0.206 ***	0.187 ***	0.236 ***
	(30.69)	(27.47)	(26.08)
Obs	97,738	97,738	97,038
R2	0.002	0.005	0.023
Additional Controls			X

This table presents linear regressions of a dummy variable equal to one if a position is sold on controls. The sample is limited to positions that were previously purchased on a day where exactly one other position was sold. *Original Gain* is a dummy variable equal to one if the value of the current position is greater than the value originally invested in the previously sold position. *Gain* is a dummy variable equal to one if a position is at a gain from its purchase price. Additional controls are *Return* Gain, Return* Loss, Return*√Holding Days*Gain, Return*√Holding Days*Loss, Variance *Gain, Variance *Loss,* and *√Holding Days.* Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 3 – The Disposition Effect on Days with and without a Purchase

	Panel A: All Observations		
	All	**No Buy**	**Any Buy**
PGR	0.228	0.258	0.162
PLR	0.175	0.177	0.170
Difference	0.054 ***	0.081 ***	-0.008
	(11.80)	(19.72)	(-1.42)
Observations	2,015,204	1,397,032	618,172

	Panel B: 5 or more stocks		
	All	**No Buy**	**Any Buy**
PGR	0.129	0.141	0.105
PLR	0.105	0.103	0.107
Difference	0.024 ***	0.038 ***	-0.003
	(6.96)	(12.16)	(-0.52)
Observations	1,534,209	1,017,184	517,025

	Panel C: 4 or Fewer stocks		
	All	**No Buy**	**Any Buy**
PGR	0.539	0.557	0.466
PLR	0.406	0.386	0.474
Difference	0.133 ***	0.171 ***	-0.008
	(36.09)	(42.71)	(-1.58)
Observations	480,995	379,848	101,147

This table presents measures of the disposition effect by whether or not other positions are purchase. PGR is the #Gains Sold/(#Gains Sold+#Gains Not Sold) and PLR is the #Losses Sold/(# Losses Sold+# Losses Not Sold). Difference is PGR-PLR with a *t*-statistic (clustered by date and account) for the test that this difference is 0 underneath. All includes all observations, No Buy includes sell days where no position is purchase and Any Buy includes only sell days where another position is purchased. "Buy Stocks" examines days where another CRSP merged position is purchased while "Any Buy" includes days where any position is purchased. The Number of stocks in the various panels is the total number of stocks the investor could sell. Only days where a stock is sold are included in the sample. Stocks are not included on the day the position is opened. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 4 – Disposition Effect by Amount Purchased Relative to Amount Sold

Panel A: All Observations

	All Buy	$Buy>$Sell	$Buy≈$Sell	$Buy<$Sell
PGR	0.161	0.125	0.203	0.183
PLR	0.170	0.169	0.237	0.170
Difference	-0.009	-0.044 ***	-0.035 ***	0.013 **
	(-1.55)	(-7.32)	(-4.75)	(2.03)
Observations	614,208	235,404	69,949	378,971

Panel B: 5 or more stocks

	All Buy	$Buy>$Sell	$Buy≈$Sell	$Buy<$Sell
PGR	0.104	0.079	0.107	0.120
PLR	0.107	0.105	0.132	0.108
Difference	-0.003	-0.026 ***	-0.025 ***	0.012 **
	(-0.60)	(-5.40)	(-4.23)	(2.29)
Observations	514,265	199,648	52,001	314,758

Panel C: 4 or Fewer stocks

	All Buy	$Buy>$Sell	$Buy≈$Sell	$Buy<$Sell
PGR	0.465	0.406	0.489	0.496
PLR	0.475	0.487	0.527	0.467
Difference	-0.010 *	-0.081 ***	-0.038 ***	0.028 ***
	(-1.93)	(-11.65)	(-3.99)	(4.89)
Observations	99,943	35,756	17,948	64,213

This table presents measures of the disposition effect by whether or not other positions are purchase. PGR is the #Gains Sold/(#Gains Sold+#Gains Not Sold) and PLR is the #Losses Sold/(# Losses Sold+# Losses Not Sold). Difference is PGR-PLR with a *t*-statistic (clustered by date and account) for the test that this difference is 0 underneath. All Buy includes all observations when another position is purchased. $Buy>$Sell includes days where the total amount purchased is greater than the total amount sold by at least 1%, $Buy≈$Sell include all days where the amount purchased is within 1% of the amount sold and $Buy<$Sell where the amount purchased is less than 99% of the amount sold. Only days where a stock is sold are included in the sample. Stocks are not included on the day the position is opened. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 5 – Disposition Effect by Days from Most Recent Purchase

Gain*(Time to Buy)	0.007	***	Gain*(1 Week to Buy)	0.074	***
	(10.64)			(15.58)	
Gain	0.020	***	Gain*(2 Week to Buy)	0.086	***
	(3.76)			(14.95)	
Loss*Time to Buy	0.001	*	Gain*(3 Week to Buy)	0.095	***
	(1.77)			(14.21)	
Constant	0.152	***	Gain*(4 Week to Buy)	0.100	***
	(24.53)			(14.16)	
Observations	1,621,563		Gain	-0.008	
R2	0.007			(-1.42)	
			Constant	0.170	***
				(21.17)	
			Week Dummies	X	
			Observations	1,621,563	
			R2	0.009	

This table presents linear regressions of a dummy variable equal to one if a position is sold on *Gain*, a dummy variable equal to one if a position is at a gain, and variables indicating the number of days between a sell day and the most recent buy date. The first column includes a linear variable *Time to Buy* which is the number of days between a sell day and the nearest buy date. The second column includes dummy variables for each week (5 trading days) to the nearest buy date where buy and sell on the same day is the omitted category. The main effects of the four week dummies not interacted with *Gain* are included in the regression, but not reported. We consider only observations where a buy and sell day occur within one month of each other (where *Time to Buy* is between 0 and 20 trading days). Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively

.

Table 6 –Variance of Assets Bought on Reinvestment Days

	Panel A: Variance in Percentiles		
Previous Stock Sold at Loss	1.210 ***	1.732 ***	0.659 **
	(4.88)	(6.72)	(2.46)
Constant	44.181 ***	43.963 ***	
	(122.09)	(153.27)	
Observations	69,005	69,005	69,005
R2	0.001	0.078	0.557
Date FE		X	X
Account FE			X

	Panel B: Winsorised Variance (x100,000)		
Previous Stock Sold at Loss	5.626 ***	8.699 ***	4.414 **
	(4.15)	(5.99)	(2.42)
Constant	112.986 ***	111.699 ***	
	(72.77)	(96.12)	
Observations	69,005	69,005	69,005
R2	0.000	0.054	0.479
Date FE		X	X
Account FE			X

This table examines the variance of assets purchased on reinvestment days as a function of whether the stock being sold was at a gain or a loss. The sample consists of all purchased positions on days that something else is sold. The main dependent variables are the variance of the stock that was purchased calculated over the previous year, either as a percentile of the distribution (Panel A) or in raw values, winsorized at the 1% level (Panel B). The independent variable is a dummy variable equal to one if the assets sold that day were sold at an overall loss, so the omitted category are purchased positions on days when the assets being sold were at a gain. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 7 – Returns of Sold Positions after the Sale

	Panel A: One Quarter (65 trading Days) Post Sale					
	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-0.698 ***	-0.640 ***	-0.492 ***	-0.609 ***	-0.571 ***	-0.443 ***
	(-5.93)	(-5.43)	(-2.79)	(-5.50)	(-5.15)	(-2.61)
Gain		0.547 ***	0.613 ***		0.344 **	0.401 ***
		(3.83)	(3.93)		(2.57)	(2.75)
Gain*Reinvestment Day			-0.248			-0.212
			(-1.24)			(-1.06)
Constant	0.180	-0.188	-0.233	-0.310 ***	-0.545 ***	-0.584 ***
	(1.20)	(-1.01)	(-1.22)	(-2.77)	(-3.65)	(-3.78)
Obs	403,319	403,319	403,319	343,194	343,194	343,194
R2	0.000	0.000	0.000	0.000	0.000	0.000
	Panel B: One Year (255 trading Days) Post Sale					
	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-2.335 ***	-1.949 ***	-1.310 ***	-2.053 ***	-1.826 ***	-1.413 ***
	(-8.48)	(-7.10)	(-3.22)	(-7.25)	(-6.46)	(-3.36)
Gain		3.638 ***	3.924 ***		2.084 ***	2.267 ***
		(11.67)	(11.53)		(6.78)	(6.76)
Gain*Reinvestment Day			-1.073 **			-0.683
			(-2.30)			(-1.38)
Constant	0.485 *	-1.965 ***	-2.158 ***	-0.906 ***	-2.335 ***	-2.460 ***
	(1.78)	(-5.58)	(-5.91)	(-3.99)	(-7.55)	(-7.57)
Obs	403,319	403,319	403,319	336,669	336,669	336,669
R2	0.000	0.001	0.001	0.000	0.001	0.001
	Panel C: Two Years (505 trading Days) Post Sale					
	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-4.738 ***	-3.962 ***	-2.565 ***	-4.278 ***	-3.847 ***	-2.941 ***
	(-10.27)	(-8.56)	(-3.66)	(-9.20)	(-8.22)	(-4.26)
Gain		7.314 ***	7.940 ***		3.944 ***	4.345 ***
		(12.64)	(12.10)		(7.65)	(7.34)
Gain*Reinvestment Day			-2.346 ***			-1.494 *
			(-2.90)			(-1.80)
Constant	-2.869 ***	-7.794 ***	-8.215 ***	-4.858 ***	-7.566 ***	-7.841 ***
	(-5.38)	(-10.49)	(-10.55)	(-11.83)	(-13.63)	(-13.10)
Obs	403,319	403,319	403,319	334,120	334,120	334,120
R2	0.000	0.002	0.002	0.000	0.001	0.001

This table presents linear regressions of returns on a number of dummy variables. *Reinvestment Day* is equal to one if another position is purchased on the day of the sale and *Gain* is a dummy variable equal to one if a position is at a gain. Returns are measured from the trading day after the sell day (*t*) to *t*+65 in Panel A, *t*+255 in Panel B and *t*+505 in Panel C. Excess returns are returns after the sell date with the CRSP value weighted return index subtracted. Characteristic adjusted returns are the returns with the portfolio matched on quintile of size, book to market and momentum subtracted. Only positions that are sold are included. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 8 – Returns of Sold Positions after the Sale Controlling for Investor Effects

Panel A: One Quarter (65 trading Days) Post Sale

	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-0.643 ***	-0.626 ***	-0.604 ***	-0.891 ***	-0.894 ***	-0.907 ***
	(-4.71)	(-4.56)	(-3.02)	(-5.53)	(-5.53)	(-3.78)
Gain		0.254 *	0.264		-0.047	-0.053
		(1.65)	(1.57)		(-0.27)	(-0.28)
Gain*Reinvestment Day			-0.037			0.021
			(-0.16)			(0.08)
Constant	0.167	-0.002	-0.009	-0.374 ***	-0.342 **	-0.338 **
	(1.25)	(-0.01)	(-0.05)	(-3.52)	(-2.16)	(-2.02)
Obs	403,319	403,319	403,319	342,426	342,426	342,426
R2	0.150	0.150	0.150	0.167	0.167	0.167
Account FE	X	X	X	X	X	X

Panel B: One Year (255 trading Days) Post Sale

	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-1.180 ***	-1.024 ***	-0.561	-1.253 ***	-1.209 ***	-0.938 *
	(-3.98)	(-3.45)	(-1.26)	(-3.82)	(-3.69)	(-1.86)
Gain		2.303 ***	2.525 ***		0.640 *	0.768 **
		(7.25)	(7.12)		(1.89)	(2.03)
Gain*Reinvestment Day			-0.777			-0.448
			(-1.49)			(-0.77)
Constant	0.201	-1.328 ***	-1.477 ***	-1.101 ***	-1.534 ***	-1.622 ***
	(0.98)	(-4.54)	(-4.76)	(-6.47)	(-5.44)	(-5.31)
Obs	403,319	403,319	403,319	336,669	336,669	336,669
R2	0.164	0.164	0.164	0.179	0.179	0.179
Account FE	X	X	X	X	X	X

Panel C: Two Years (505 trading Days) Post Sale

	Excess Returns			Characteristic Adjusted Returns		
Reinvestment Day	-1.828 ***	-1.513 ***	-0.759	-1.789 ***	-1.751 ***	-1.480 *
	(-3.90)	(-3.22)	(-1.04)	(-3.43)	(-3.35)	(-1.87)
Gain		4.654 ***	5.015 ***		0.557	0.686
		(8.37)	(7.92)		(1.01)	(1.07)
Gain*Reinvestment Day			-1.266			-0.447
			(-1.46)			(-0.47)
Constant	-3.584 ***	-6.674 ***	-6.917 ***	-5.466 ***	-5.843 ***	-5.931 ***
	(-10.22)	(-11.79)	(-11.43)	(-19.84)	(-12.57)	(-11.41)
Obs	403,319	403,319	403,319	334,120	334,120	334,120
R2	0.184	0.184	0.184	0.199	0.199	0.199
Account FE	X	X	X	X	X	X

This table presents linear regressions of returns on a number of dummy variables. *Reinvestment Day* is equal to one if another position is purchased on the day of the sale and *Gain* is a dummy variable equal to one if a position is at a gain. Returns are measured from the trading day after the sell day (*t*) to *t*+65 in Panel A, *t*+255 in Panel B and *t*+505 in Panel C. Excess returns are returns after the sell date with the CRSP value weighted return index subtracted. Characteristic adjusted returns are the returns with the portfolio matched on quintile of size, book to market and momentum subtracted. Only positions that are sold are included. All regressions include an account fixed effect. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 9 – Returns of Sold Positions Compared to Positions Retained in the Portfolio

	One Quarter (65 trading Days) Post Sale		One Year (255 trading Days) Post Sale		Two Years (505 trading Days) Post Sale	
	Excess Returns	Characteristic Adjusted Returns	Excess Returns	Characteristic Adjusted Returns	Excess Returns	Characteristic Adjusted Returns
Sell* Reinvestment Day	-0.294 **	-0.201	-1.174 ***	-0.901 **	-1.964 ***	-1.516 **
	(-2.20)	(-1.34)	(-3.56)	(-2.36)	(-3.49)	(-2.41)
Sell*No Reinvestment Day	0.026	0.057	-0.012	-0.062	-0.279	-0.528
	(0.26)	(0.55)	(-0.05)	(-0.24)	(-0.74)	(-1.25)
Constant	-0.109 ***	-0.479 ***	-0.787 ***	-1.698 ***	-6.005 ***	-6.706 ***
	(-12.29)	(-49.59)	(-36.91)	(-67.05)	(-159.34)	(-154.69)
FE: Account x Date	X	X	X	X	X	X
Obs	1,899,281	1,595,464	1,899,282	1,571,773	1,899,282	1,561,483
R2	0.254	0.243	0.230	0.240	0.245	0.256

This table presents linear regressions of returns on a number on *Sell*Reinvestment Day* which equals to one if a position is sold on a day that another position is purchased and *Sell*No Reinvestment day* which is equal to one if a position is sold on a day that another position is not purchased. The omitted category is thus stocks that were not sold on the day that a sale occurred. Returns are measured from the trading day after the sell day (*t*) to *t*+65 in the first two columns, *t*+255 in columns 3 and 4 and *t*+505 in columns 5 and 6. Excess returns are the return with the CRSP value weighted return index subtracted. Characteristic adjusted returns are the returns with the portfolio matched on quintile of size, book to market and momentum subtracted. All positions that could have been sold on sell days are included in the regression. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.

Table 10 – Mutual Fund Selling by Flow Amount

Gain*(Pos Flow)	-0.040 ***	-0.030 ***	-0.026 ***	-0.021 ***
	(-4.59)	(-4.45)	(-5.30)	(-4.97)
Gain	0.019 **	0.015 ***	0.009 **	0.006 *
	(2.10)	(2.90)	(2.42)	(1.70)
Pos Flow	-0.096	-0.108 ***	-0.047 ***	-0.049 ***
	(-7.90)	(-10.99)	(-7.38)	(-7.88)
Constant	0.457	0.505 ***	0.351 ***	
	(32.82)	(59.16)	(67.66)	
Observations	15,081,746	15,081,713	15,081,713	15,081,713
R2	0.014	0.022	0.139	0.143
Other Controls		X	X	X
Fund FE			X	X
Date FE				X

This table presents coefficients from linear regressions of a dummy variable, *Pos*, equal to 1 if a stock is sold on a dummy variable equal to one if the position is at a gain and *Pos Flow* which is equal to one if the fund experienced positive flows from month *m*-16 to *m*-4 where month *m* is the report month. Flow is calculated as $Flow_t = [TNA_t - TNA_{t-1} \times (1+Return_t)] / TNA_{t-1.}$ Additional controls are *Gain, Return* Gain, Return* Loss, Return*√Holding Days*Gain, Return*√Holding Days*Loss, Variance *Gain, Variance *Loss,* and *√Holding Days*. Mutual fund data are from January 1990 to June 2010 where dates examined are report dates. A fund must hold at least 20 CRSP merged securities to be included in the analysis. The top number is the coefficient, and the lower number in parenthesis is the *t*-statistic. Standard errors are clustered by date and fund.

Table 11 – Within-Investor Difference in Disposition Effect between Reinvestment Days and Non-Reinvestment Days

	(Disposition Effect with No Purchase)$_i$ - (Disposition Effect with Purchase)$_i$
All Observations	0.077 ***
	(18.77)
4 or Fewer Stocks	0.108 ***
	(12.79)
5 or More Stocks	0.048 ***
	(12.53)

This table presents measures of the disposition effect calculated for each investor separately for when they sell positions on days where they purchase another position and by days they do not buy another position. Only investors with at least five of each type of days are included. The mean difference is shown with a *t*-statistic (clustered by date and account) for the test that this difference between the two disposition effect measures is 0 underneath. The Number of stocks in the various panels is the total number of stocks the investor could sell. Only days where a stock is sold are included in the sample. Stocks are not included on the day the position is opened. Individual investor data covers January 1991 to November 1996. The top value is the coefficient, the bottom value in parentheses is the *t*-statistic, and standard errors are clustered by acount and date. *, **, and *** indicate statistical significance at the 10%, 5%, and 1%, level respectively.