The Portfolio-Driven Disposition Effect

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We report the probability of selling a stock (including partial sales) based on the stock's performance (gain versus loss) from the date the investor purchased the stock and the performance of the rest of the investor's portfolio (excluding the stock under consideration). We report the unconditional probabilities (left) and conditioning on a sale taking place (right). The unconditional results have 102,821,438 observations (57% stock gains, 43% stock losses; 64% portfolio gains, 36% portfolio losses). The conditional results have 1,403,572 observations (56% stock gains, 44% stock losses; 64% portfolio gains, 36% portfolio losses). We define gains as strictly greater than zero while losses include zeros.
The Disposition Effect

The “disposition effect”: Investors are more likely to sell a stock if it is at a gain than if it is at a loss (Shefrin and Statman, 1985)

One of the most robust phenomena in trading behavior:

- US retail stock investors (Odean, 1998)
- foreign retail investors (Grinblatt and Keloharju, 2001)
- institutional investors (Shapira and Venezia, 2001)
- homeowners (Genesove and Mayer, 2001)
- corporate executives (Heath, Huddart, and Lang, 1999)
- laboratory experiments (Frydman, Hartzmark, and Solomon, 2018)
Our Basic Question

Is the disposition effect affected by the performance of the investor’s portfolio?

- Researchers have hypothesized that investors derive utility over “paper gains/losses” (e.g., Barberis and Huang, 2001) and “realized gains/losses” (e.g., Barberis and Xiong, 2009; 2012)

- If investors derive utility over both sources of gains, then the disposition effect will likely be related to the performance of the investor’s portfolio
  - If an investor’s portfolio is down, she will have low utility due to her paper losses
  - She might therefore be eager to get a burst of realization utility by realizing a gain
Data

We use the large discount brokerage data analyzed by Barber and Odean (2000)

- ~78,000 households and ~158,000 accounts between 1991 and 1996

Unit of observation: (account, stock, date) triple

- Restrict attention to:
  - common stocks that can be merged to CRSP
  - (account, date) pairs such that the account has at least two common stocks on the given date

- Primary dataset sample size: ~103 million obs
- “Sale conditioned dataset”:
  - restrict attention to (account, days) such that the account sold stock on the given date
  - sample size: ~1.4 million observations
Figure 1: Probability of Selling a Stock Based on its Return and the Return of the Rest of the Portfolio

We report the probability of selling a stock (including partial sales) based on the stock's performance (gain versus loss) from the date the investor purchased the stock and the performance of the rest of the investor's portfolio (excluding the stock under consideration). We report the unconditional probabilities (left) and conditioning on a sale taking place (right). The unconditional results have 102,821,438 observations (57% stock gains, 43% stock losses; 64% portfolio gains, 36% portfolio losses). The conditional results have 1,403,572 observations (56% stock gains, 44% stock losses; 64% portfolio gains, 36% portfolio losses). We define gains as strictly greater than zero while losses include zeros.
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Analyzing the Disposition Effect

Standard methodology (e.g., Odean 1998)

- Compute the percentage of gains realized ($PGR$) and the percentage of losses ($PLR$) realized

- A “disposition effect” is said to exist if $PGR > PLR$

As previous researchers have noted, this is equivalent to estimating the regression:

$$Sale_{i,j,t} = \beta_0 + \beta_1 Gain_{i,j,t} + \epsilon_{i,j,t},$$

where $Sale$ and $Gain$ are dummies for the stock being sold and the stock being at a gain, respectively.

Straightforward to verify that $\beta_1 = PGR - PLR$
Advantage of regression methodology: researchers can control for a host of factors

Our baseline regression specification:

\[ Sale_{i,j,t} = \beta_0 + \beta_1 Gain_{i,j,t} + \beta_2 PortfolioGain_{i,j,t} \]
\[ + \beta_3 Gain_{i,j,t} \times PortfolioGain_{i,j,t} + \varepsilon_{i,j,t}, \]

where \( PortfolioGain_{i,j,t} \) denotes a dummy for the rest of the investor’s portfolio being at a gain.
Analyzing the Disposition Effect (cont.)

Coefficient of interest:

$$\beta_3 = \left\{ \Pr(\text{Sell stock} \mid \text{stock at gain, portfolio at gain}) \right. \right. $$

$$- \Pr(\text{Sell stock} \mid \text{stock at loss, portfolio at gain}) \right\}$$

$$- \left\{ \Pr(\text{Sell stock} \mid \text{stock at gain, portfolio at loss}) \right. \right. $$

$$- \Pr(\text{Sell stock} \mid \text{stock at loss, portfolio at loss}) \right\}$$

$$= \{ \text{Disp Effect} \mid \text{portfolio } \uparrow \} - \{ \text{Disp Effect} \mid \text{portfolio } \downarrow \}$$
### Regression Results (Unconditional Dataset)

<table>
<thead>
<tr>
<th></th>
<th>Sale</th>
<th>Sale</th>
</tr>
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<tbody>
<tr>
<td><strong>Gain</strong></td>
<td>0.00226***</td>
<td>0.00365***</td>
</tr>
<tr>
<td></td>
<td>(17.31)</td>
<td>(23.52)</td>
</tr>
<tr>
<td><strong>PortfolioGain</strong></td>
<td>0.00022***</td>
<td>0.00173***</td>
</tr>
<tr>
<td></td>
<td>(4.13)</td>
<td>(19.13)</td>
</tr>
<tr>
<td><strong>Gain × PortfolioGain</strong></td>
<td>-0.00220***</td>
<td>-0.00281***</td>
</tr>
<tr>
<td></td>
<td>(22.94)</td>
<td>(22.68)</td>
</tr>
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<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Observations</th>
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<tr>
<td></td>
<td>102,821,233</td>
<td>102,821,233</td>
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<thead>
<tr>
<th></th>
<th>(R^2)</th>
<th>(R^2)</th>
</tr>
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<tbody>
<tr>
<td><strong>Date FE</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Account FE</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Stock FE</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
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Standard errors are clustered across three dimensions (date, account, and stock) following the procedure of Cameron, Gelbach, and Miller (2011)
### Regression Results (Sale-Conditioned Dataset)

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<thead>
<tr>
<th></th>
<th>Sale</th>
<th>Sale</th>
</tr>
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<tbody>
<tr>
<td><strong>Gain</strong></td>
<td>0.166***</td>
<td>0.162***</td>
</tr>
<tr>
<td></td>
<td>(29.38)</td>
<td>(34.40)</td>
</tr>
<tr>
<td><strong>PortfolioGain</strong></td>
<td>0.015***</td>
<td>0.067***</td>
</tr>
<tr>
<td></td>
<td>(2.76)</td>
<td>(21.73)</td>
</tr>
<tr>
<td><strong>Gain × PortfolioGain</strong></td>
<td>-0.154***</td>
<td>-0.134***</td>
</tr>
<tr>
<td></td>
<td>(26.23)</td>
<td>(29.92)</td>
</tr>
</tbody>
</table>

| Observations         | 1,397,274  | 1,397,274  |
| R²                   | 0.021      | 0.173      |
| Date FE              | No         | Yes        |
| Account FE           | No         | Yes        |
| Stock FE             | No         | Yes        |

Standard errors are clustered across three dimensions (date, account, and stock) following the procedure of Cameron, Gelbach, and Miller (2011)
Possible Explanations

Some possible explanations for the portfolio-driven disposition effect

1. Attention/salience effects
2. Portfolio rebalancing
3. Unobserved investor skill
4. Utility over both paper gains/losses and realized gains/losses
Attention/Salience Effects?

Hartzmark (2015) shows that investors often sell their best and worst performing stocks (the “rank effect”)

- If an investor has one stock that is a winner and the rest are losers:
  - Her portfolio is performing poorly,
  - The portfolio-disposition effect and the rank effect both predict her to sell the winner

To address this possibility, we partition the sample:

- “Extreme” stocks (best or worst stock in investor’s portfolio)
- non-extreme stocks (all the others)

Coefficient of our interaction term ($Gain \times PortfolioGain$) is very similar in both samples
Portfolio Rebalancing?

Suppose an investor’s portfolio is doing poorly, and she has some winners and some losers:

- The winners likely comprise a large proportion of her holdings
  - the losers must have significantly depreciated in value
- If she wants to rebalance her portfolio:
  - partially liquidate her winners
  - use proceeds to invest in other stocks
  - portfolio-driven disposition effect

Does the portfolio disposition effect disappear when we restrict attention to complete liquidations?
Figure 2: Probability of a Complete Liquidation Based on its Return and the Return of the Rest of the Portfolio

We report the same graphs as in Figure 1 except that here we analyze only full sales, or complete liquidations, instead of including partial sales. These graphs show the probability of a complete liquidation based on the stock’s performance (gain versus loss) from the date the investor purchased the stock and the performance of the rest of the investor’s portfolio (excluding the stock under consideration). We report the unconditional probabilities (left) and conditioning on a sale taking place (right). The unconditional results have 102,821,438 observations (57% stock gains, 43% stock losses; 64% portfolio gains, 36% portfolio losses). The conditional results have 1,403,572 observations (56% stock gains, 44% stock losses; 64% portfolio gains, 36% portfolio losses). We define gains as strictly greater than zero while losses include zeros.
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Multivariate regressions also cast doubt on the portfolio rebalancing explanation:

- Portfolio-driven disposition effect is very strong when sample is restricted to complete liquidations

Another test of portfolio rebalancing:

- When an investor liquidates a stock at a gain and her portfolio is at a loss, is she likely to reinvest the proceeds or keep it as cash?
  - Portfolio rebalancing $\implies$ reinvest
  - Empirically, investors are disproportionately unlikely to reinvest the proceeds in this scenario
Unobserved Skill?

Grinblatt, Keloharju, and Linnainmaa (2012) show that Finnish investors with high IQ have superior stock-picking ability and exhibit less of a disposition effect.

Perhaps:

- Skilled investors’ portfolios are generally at a gain
- Skilled investors don’t exhibit a disposition effect

We test this possibility in two ways:

1. Examine how our results vary among levels of investor sophistication
2. Examine scenarios where *PortfolioGain* is more likely the result of luck than skill
   
   If portfolio-driven disposition effect is driven by unobserved skill, we should find a stronger disposition effect when an investor’s portfolio is doing well due to luck.
Unobserved Skill? (Investor Sophistication)

We follow Dhar and Zhu (2006) in using employment and income as proxies for sophistication

- Employment: professional ("professional/technical" or "administrative/managerial") versus non-professional ("white collar/clerical," "blue collar/craftsman," or "service/sale")
- Income: high ($\geq 100,000) versus low ($\leq 40,000)

Portfolio-driven disposition effect is present among all types of investors
Unobserved Skill? \((PortfolioGain\text{Driven by Luck})\)

For each stock in an investor’s portfolio, decompose the performance based on its DGTW performance (Daniel, Grinblatt, Titman, and Wermers, 1997)

- One component is based on the stock’s characteristics (size, book-to-market, and momentum)
- Other component is its performance relative to its matched portfolio

Motivation: while retail investors might be able to pick stocks that will perform well compared to their matched portfolios, it is unlikely they can time the Fama-French HML, SMB, and MOM factors

We find that the disposition effect is equally strong whether an investor’s portfolio performs well due to “skill” (stocks’ performance relative to matched portfolios) or “luck” (performance driven by HML, SMB, and MOM factors)
Utility over Paper Gains/Losses and Realized Gains/Losses?

In the standard model, investors’ utility is based on their consumption

- Changes in portfolio value affect expected utility through the expected change in future consumption

Prospect theory: investors derive utility of gains/losses relative to a benchmark (e.g., purchase price)

- This idea has been applied to both paper (i.e., unrealized) gains/losses as well as realized gains/losses
Utility over Paper Gains/Losses and Realized Gains/Losses? (cont.)

If investors derive utility from both paper and realized gains/losses:

- when portfolio is performing poorly, utility is low due to paper losses
  - investor is psychologically fragile
  - investor might seek a burst of realization utility by selling a winner
- when portfolio is performing well, utility is high due to paper gains
  - investor is psychologically strong
  - investor is willing to sell a losing position and take the disutility from realizing a loss
Utility over Paper Gains/Losses and Realized Gains/Losses? (cont.)

Investors act as though they do not “close” their mental accounts when they liquidate a stock and reinvest the proceeds into a new stock (Frydman, Hartzmark, and Solomon, 2018)

- They “roll” their initial investment amount as the benchmark value for their new stock

Consider the following four possible scenarios:

- stock is up, rest of portfolio is up,
- stock is up, rest of portfolio is down,
- stock is down, rest of portfolio is up,
- stock is down, rest of portfolio is down.

**Prediction:** The likelihood of reinvesting proceeds from a sale should be *smallest* when the liquidated stock is up and the rest of the portfolio is down.
Utility over Paper Gains/Losses and Realized Gains/Losses? (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Reinvest</th>
<th>Reinvest</th>
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<tbody>
<tr>
<td>LossGain</td>
<td>0.104***</td>
<td>0.056***</td>
</tr>
<tr>
<td></td>
<td>(14.73)</td>
<td>(13.08)</td>
</tr>
<tr>
<td>LossLoss</td>
<td>0.070***</td>
<td>0.025***</td>
</tr>
<tr>
<td></td>
<td>(12.55)</td>
<td>(6.25)</td>
</tr>
<tr>
<td>GainGain</td>
<td>0.028***</td>
<td>0.016***</td>
</tr>
<tr>
<td></td>
<td>(5.19)</td>
<td>(4.83)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.344***</td>
<td></td>
</tr>
</tbody>
</table>

Observations: 189,623  189,623

R²: 0.006  0.32

Date FE: No  Yes
Account FE: No  Yes
Stock FE: No  Yes

Standard errors are clustered across three dimensions (date, account, and stock)
Explanation most consistent with the data: investors derive utility from both paper gains/losses and realized gains/losses
An and Wang (2018), in an independent and contemporaneous paper, also document the moderating effect of portfolio performance on the disposition effect.

They show the result holds in both the Odean dataset and among Chinese investors.

They provide evidence that the phenomenon is driven by hedonic mental accounting.

We are in the process of combining and unifying our papers.

- An, Engelberg, Henriksson, Wang, and Williams (2019) should be available on SSRN in the near future.