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Drivers of the Disposition Effect

A Study Testing for Motivating Forces of Investors' Propensity to Realize Gains over Losses

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ABSTRACT

In this thesis, 2,864,940 trade transactions of 125,555 US retail investors from 1991-1996 are analyzed to investigate if variations in the disposition effect, the tendency of investors to sell winning investments too soon and hold losing investments too long, can be explained by investor sentiment and implied market volatility. First, we run a regression analysis between the disposition effect and market sentiment, where results show no significant correlation. This indicates that investors' readiness to realize winners over losers is not driven by aggregated beliefs of market direction. Secondly, we run a regression between the disposition and implied market volatility. Here, results show an economic significant positive correlation. This suggests that investors are more disposed to realize winners than losers during times of high expected market uncertainty. Finally, we test if this correlation is driven by certain stock characteristics. Results indicate that the market capitalization and idiosyncratic volatility of stocks are valued factors in investors' readiness to realize winners over losers in times of high anticipated market volatility.

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Table of Contents

I. Introduction

Through history, standard financial economic models, where fully rational investors will force the markets to equal fundamental values of future cash flows, has had great difficulty in describing patterns in stock price movements. Various researchers have therefore concluded that investors must not be fully rational but affected by behavioral biases. One of the most studied of these irrationalities is the disposition effect, the tendency of investors to hold on to losing investments too long and realize winning ones too soon. A phenomenon observed on a wide level that goes against the momentum theory, which according to Jegadeesh and Titman (1993) suggests that winners will continue to perform well and losers will continue to perform poorly in the short term. The question is why investors continue to persistently realize winners more readily than losers even though it has been demonstrated by Odean (1998) among others, to be a suboptimal behavior? This paper's objective is to investigate this question further and identify what major factors are the driving forces of the disposition effect, as well as suggest explanations for the behavioral motivation behind them.

To test these driving forces behind the disposition effect we use trading account data from 1991 to 1996, supplied from a major brokerage house in the United States, to calculate disposition effect values on a monthly basis. We observe a propensity to realize winners rather than losers similar to the initial findings of Odean (1998). In addition we also find a reverse effect in December where the proportion of losses surpasses the proportion of gains realized. This has also been shown earlier by Shefrin and Statman (1985) and explained as tax motivated selling since an investor who sells a stock at a loss can write off the price loss against other price gains, thus reducing total capital tax. As the disposition effect findings from our data set show similar results as previously mentioned studies, these monthly disposition values can be considered as good estimators for further analysis and investigation of the potential drivers of the disposition effect.

Market Sentiment and Self-Justification

The first driver we research is market sentiment, which can be described as investors' aggregated beliefs on market direction. To test this we run regressions between our disposition effect values and Baker and Wurgler's (2006, 2007) sentiment index, as it is the most established index of its kind. The main motivation for using market sentiment as an explanatory variable for the disposition effect is the behavioral theory of self-justification.

Self-justification is described by Festinger (1957) as a psychological theory of cognitive dissonance, which says that a discrepancy between ones actions and attitudes creates discomfort, and that changing an attitude involves psychological costs. Selling a stock at a loss may be unpleasant for an investor as he is indirectly admitting a bad investment decision. Investors are sometimes overconfident and so certain of their belief that a particular stock will perform well, that they refuse to admit their fault by selling the stock when it turns out to perform poorly. If the disposition effect is caused by self-justification and overconfidence it should be in line with investors' beliefs on future market movements, hence market sentiment.

Our regression results show no significant correlation between the disposition effect and market sentiment. To make sure that our findings are solid we conduct a similar correlation test adjusting for lagging effects. This test also shows no significant correlation between the disposition effect and market sentiment. Based on these results, we propose that investors' tendencies to realize winners over losers are not driven by aggregated beliefs of market direction.

Implied Market Volatility and Mean Reversion

The second driving force we investigate is implied market volatility, which can be described as investors' expectations on market uncertainty. To test if this is a driver for the disposition effect we run regressions between our disposition effect values and implied market volatility on a monthly basis. The Chicago Board of Options Exchange monthly VIX values are used as a measure for implied market volatility. The rationale for this analysis is the connection between implied market volatility and the theory of mean reversion, where investors believing in mean reverting returns expect stock prices to move to their historical average (Hillebrand, 2003). This implies that high performing stocks will eventually decline to their moving average while subsequent underperforming ones will rise to theirs. High market volatility increases the probability that winners and losers will mean revert. In this case the optimal strategy for an investor expecting future market uncertainty will be to sell winners and hold on to losers, suggesting an increase in the disposition effect.

Regression results show a significant positive correlation between the disposition effect and VIX. This suggests that investors are indeed more disposed to realizing winners and hold on to losers in times of expected high market uncertainty, strengthening the rationale of mean reversion.

Stock Characteristics

To further investigate if this increased propensity to realize winners over losers in times of high implied market volatility, a stock characteristics analysis is conducted. The motivation is to investigate if any specific kind of realized stock is overrepresented. To conduct this analysis interaction variables are formed by multiplying the VIX values with various stock characteristics on a monthly basis. The following characteristics are tested; assets, liabilities, equity, earnings yield[1], dividend yield, market capitalization, book-to-market ratio and idiosyncratic volatility[2]. These variables cover the risk, size as well as current and expected profitability of a specific stock.

Regression results show that the market capitalization and idiosyncratic volatility interaction terms are of statistical significance. However, only the latter is considered to be of economic significance.

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[1] Earnings yield is defined as earnings per share divided by the current market price per share.
[2] Idiosyncratic volatility, in this study, is defined as the monthly standard deviation of stock prices.

II. Related literature

Disposition Effect

The tendency of selling winning investments too soon and holding losing investments too long, has its origin in the prospect theory of Kahneman and Tversky (1979) and was labeled the disposition effect by Shefrin and Statman (1985). Shefrin and Statman appealed to the results from an earlier study by Schlarbaum et al. (1978), who analyzed the realized returns from round-trip trades for a sample of investors by calculating the returns for stocks bought and subsequently sold. Judging by the realized returns, Schlarbaum et al. (1978) found that the investors in their sample beat the market by 5 percent per year and that 60 percent of the trades resulted in profits. Based on their evidence, Schlarbaum et al. (1978) concluded that the investors in their data set possessed reputable stock picking skills. Shefrin and Statman (1985) questioned this conclusion. They proposed that the stated stock picking skills among investors was an illusion, and explained that the realized returns came disproportionally from stock picks that turned out to be good ones, while the poor stock picks were kept unrealized. Remarkably, Schlarbaum et al. (1978) raised the possibility that their investors' outstanding performance could be due to a disposition in realizing winners while keeping losers, however, they dismissed this hypothesis and preferred the superior stock picking skills explanation.

More recent literature including Odean (1998), Odean (1999), Barber and Odean (2000), Grinblatt and Keloharju (2000) and Barber et al. (2009) have shown that there indeed is a disposition effect, and that individual investors do not have great stock picking skills, but significantly underperform. The most reputable and used method for measuring the disposition effect was developed by Odean (1998).

Odean (1998) interprets the disposition effect as the differences between what he calls PGR (Proportion of gains realized) and PLR (Proportion of losses realized). Significant differences between PGR and PLR indicate that, on average, investors favor to realize either gains or losses. The disposition towards winners, commonly known and referred to as the disposition effect, is verified when PGR is higher than PLR. For his data sample, Odean (1998) finds strong evidence in favor of the disposition effect. Odean (1998) obtained, on average, a PGR of 14.8 percent and a PLR of 9.8 percent, implying that investors are more than 50 percent more likely to realize gains than losses. For December, Odean (1998) on average found the opposite relationship between PGR and PLR, 9.8 percent versus 12.8 percent, suggesting that investors realize more losers than winners in this month.

Dyl (1977), Lakonishok and Smidt (1986) and Badrinath and Lewellen (1991) have also reported evidence that investors realize more losses near the year-end. Shefrin and Statman (1985) propose that the reason why investors are more readily to sell losers in December, even though they are reluctant to sell at a loss, is because they value the tax benefit of doing so. The end of the year is the deadline for filing the individual tax return, and hence the last chance for writing off losses against gains reducing total capital tax. Odean (1998) concludes that the investors' disposition to realize winners over losers is suboptimal as it leads to lower returns, especially for taxable accounts. He also clarifies that this investor behavior does not appear to be motivated by unwillingness to incur the higher trading costs of low priced stocks or by a desire to rebalance portfolio holdings.

Market Sentiment

As aforementioned, the standard financial economic models have turned out to have difficulties in predicting market movement. Therefore, many researchers have tried to develop alternative theories, focusing on investor sentiment, to better explain and predict past and future events. DeLong et al. (1990) suggested that investors are subject to sentiment and defined sentiment as a belief about future cash flows not consistent with the facts available. Shleifer and Vishny (1997) put forward that betting against sentimental investors is costly and risky. Consequently, rational investors are not as eager to force market prices to equilibrium as the standard financial economic models and mean reversion predicts, Poterba and Summers (1988) suggest. Nowadays, the discussion is not about whether investor sentiment affects stock prices, but rather to what degree and how one can measure it. Baker and Wurgler (2006, 2007) developed what today is the most used and reputable investor sentiment index, based on the six proxies; trading volume, dividend premium, closed-end fund discount, IPO volume, IPO first-day return and equity shares in new issues.

III. Data

The transaction data used for calculating the disposition effect is provided by a US discount brokerage house, consisting of 125,555 active accounts between January 1991 and November 1996. This data has been made available to several schools where our source is the Yale School of Management. It consists of two data sets, total security holdings per account and trading records per account. The total number of transactions is 2,864,940 where 1,228,749 are sell transactions. Security holdings are on monthly basis and verified by account identifier, CUSIP and the brokerage house's internal number for the security. Trading records are on daily basis and consist of trading date, account identifier, security CUSIP, buy/sell-indicator, quantity traded, commission paid, and nominal amount. To match the two data sets, trading records are compressed to monthly observations where multiple buys or sells in the same account and month, are aggregated.

Market sentiment data used in Baker and Wurgler (2006, 2007) is retrieved from Professor Wurgler's profile on the NYU Stern School of Business website[3]. It consists of two monthly sentiment indices. We chose the index labeled SENT^, as it is the most updated version based on components of six sentiment proxies[4] estimated from 1962 to 2005, where each of the proxies have been orthogonalized[5] with respect to a set of macroeconomic conditions. In this study, we use sentiment data from February 1991 to November 1996[6] as that is the period our transaction data covers.

Daily VIX values are provided by the Chicago Board of Options Exchange. These values are used to calculate monthly averages.

Stock characteristics data[7] is downloaded from Wharton Research Data Services (WRDS) where assets, liabilities, equity, earnings yield, dividend yield, market capitalization and book-to-market ratio values are provided by Compustat. Idiosyncratic volatility is calculated by using the standard deviation on daily stock prices on a monthly basis. The source for daily stock prices is the Center for Research in Security Prices (CRSP). The motivation for choosing these characteristics is that they cover all the following factors; size, current and future profitability as well as risk. In particular, stocks of low capitalization, unprofitable

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[3] Available at <http://people.stern.nyu.edu/jwurgler/>.
[4] The six proxies are; trading volume, dividend premium, closed-end fund discount, IPO volume, IPO first-day return and equity shares in new issues.
[5] Orthogonality implies that an independent variable that affects a specific dependent variable is considered to be uncorrelated in statistical analysis.
[6] See "Table B.I" in Appendix B for monthly market sentiment data from February 1991 to November 1996.
[7] See "Table B.III" in Appendix B for monthly stock characteristics data from February 1991 to November 1996.

stocks, volatile stocks, stocks of growth companies or stocks of firms in financial distress are likely to be disproportionately sensitive to broad waves in investor beliefs according to Baker and Wurgler (2007).

IV. Methodology

The aim of this paper is to study possible drivers of the disposition effect by testing on two expectation measures, market sentiment and implied market volatility. This section will explain how our study is applied. First, we describe how the disposition effect is obtained. Secondly, we present how regression analyses were conducted for market sentiment and implied market volatility. Finally, we give details on how the stock characteristic analysis was executed.

Obtaining the Disposition Effect

The disposition effect is calculated by applying the methodology used in Odean (1998) with some minor exceptions[8]. We choose to base our methodology on this paper as it is the most renowned in the literature of the disposition effect with a high amount of academic citations. To examine investors' readiness to realize winners one should not solely look at the numbers of gains realized but rather the realized proportion of gains compared to losses. For instance, even if an investor is indifferent between selling winners or losers, an upward-moving market would automatically lead to a higher quantity of realized gains than losses as there are more gains in the portfolio. To be able to test an investor's willingness to realize gains and losses we have to compare the rate at which he does so to his opportunities at the time.

For each investor and date in the data set, sell trades are observed. The sell prices of these transactions are then compared to the latest purchase price the specific investor paid for that particular security. If the sell price is above the latest purchase price the transaction is counted as a realized gain. If the sell price is below the latest purchase price it is instead counted as a realized loss. In 26,499 sell trades the latest purchase price was equal to the selling price. These transactions are neither counted as a realized gain nor a realized loss. It is of essence to note that not all sales have accounted purchase prices. For example, a specific security may have been purchased before January 1991, the start date of our data set. This took place in 372,113 cases and these observations were dropped. Many of these unaccounted for sell trades occurred in January 1991, hence underestimating both the quantity of gains and losses realized for that month.

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[8] The exceptions are: (1) Usage of last purchase price as benchmark for categorizing realization as a gain or loss instead of average purchase price. The motivation being that this method is more user friendly and Odean (1998) states that it gives the same results as the latter. (2) Commissions are not accounted for when categorizing winners and losers. This has also been stated in Odean (1998) not to bias the results.

To acknowledge the opportunities of realization each investor had at a specific date, a partial portfolio including securities with known purchase prices is constructed on a monthly basis. Although the constructed portfolio does not mimic the real one completely, Odean, (1998) argues it is not likely that the selection process will bias these incomplete portfolios to securities which investors have unusual inclinations for realizing gains or losses. If the value of a specific security at a particular month is above the latest purchase price the security is counted as a paper gain, an unrealized gain, for that month. If a security at the time has a lower price than what it was latest bought for, it is counted as a paper loss. Like with the realized positions, if the purchase price is equal to the price of the last trading day for the month that particular security is counted as neither a gain nor a loss. For each investor and month a comparison is done between the number of realized gains and realized losses, and paper gains and paper losses. It is important to note that as the constructed portfolio data is by monthly basis the realization data needs to be adjusted to fit it. Therefore a realization of a particular security is only counted once per investor and month. For example, if an investor has realized the same stock twice during the same month the second realization is not counted.

The comparison between realized gains and losses, and paper gains and losses is done by calculating the Proportion of Gains Realized (PGR) and Proportion of Losses Realized (PLR) in the same way as in Odean (1998).

$$PGR = \frac{\text{No. of Realized Gains}}{\text{No. of Realized Gains} + \text{No. of Paper Gains}}$$

$$PLR = \frac{\text{No. of Realized Losses}}{\text{No. of Realized Losses} + \text{No. of Paper Losses}}$$

"Odean (1998) describes the concept of PGR and PLR as follows: Suppose, for example, that an investor has five stocks in his portfolio, A, B, C, D, and E. A and B are worth more than he paid for them; C, D, and E are worth less. Another investor has three stocks F, G, and H in her portfolio. F and G are worth more than she paid for them; H is worth less. On a particular day the first investor sells shares of A and of C. The next day the other investor sells shares of F. The sales of A and F are counted as realized gains. The sale of C is a realized loss. Since B and G could have been sold for a profit but weren't, they are counted as paper gains. D, E, and G are paper losses. So for these two investors over these two days, two

realized gains, one realized loss, two paper gains, and three paper losses are counted. Realized gains, paper gains, realized losses, and paper losses are summed for each account and across accounts. In the example PGR = ½ and PLR = ¼. A large difference in the proportion of gains realized (PGR) and the proportion of losses realized (PLR) indicated that investors are more willing to realize either gains or losses."

In our study, PGR and PLR ratios are calculated for 341,877 sell trades from our data and collapsed by month to achieve 71 monthly averages. The disposition effect is, as aforementioned, calculated as the difference between PGR and PLR and also presented on a monthly basis. After conducting winsorization[9] at one percent tails in STATA, the January 1991 disposition effect observation was revealed to be an extreme outlier. It is considered biased as a large proportion of the sell trades have non-documented purchase prices, hence making it impossible to classify sells as gains or losses. Based on this reasoning the January 1991 observation is dropped, hence leaving us with 70 monthly observations[10].

Regressing on Market Sentiment and Implied Market Volatility

Regression analysis is first run between monthly disposition effect values, which are proven to be normally distributed[11], and monthly market sentiment values. Secondly, a similar regression is run between the disposition effect and market sentiment values adjusted for one month lagging effects. The motivation is that investors may act on earlier sentiment beliefs. For instance, a decision to realize a higher proportion of winning stocks in June 1992 may be based on investor sentiment from May 1992. The months stretch from February 1991 to November 1996, adding up to 70 months in total. One month is lost when adjusting for lagging effects summing up 69 months for the second regression. Thereafter, a regression is run between the disposition effect and VIX values on a monthly basis. A one month lagging effect test is also performed for the VIX variable. Finally, a multiple regression is performed including both market sentiment and VIX as explanatory variables. All regressions are OLS regressions and have been controlled for heteroscedasticity by using the robust command in STATA.

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[9] Winsorization is the transformation of statistical data by limiting extreme values to reduce the effect of outliers.
[10] See "Table B.II" in Appendix B for monthly averages of PGR, PLR and corresponding disposition effect.
[11] See "Table A.I" in Appendix A.

There are two hypotheses to be tested. The first is if there is a significant correlation between the monthly disposition effect values and market sentiment where the sentiment index developed by Baker and Wurgler (2006, 2007) has been used as estimator.

Hypothesis I

$$H_0 = Corr(Disposition\ Effect, Market\ Sentiment)\ = 0$$

$$H_1 = Corr(Disposition\ Effect, Market\ Sentiment)\ \neq 0$$

The second hypothesis tests if there is a significant correlation between the disposition effect and implied market volatility on a monthly basis, where monthly VIX values are used as estimates for the latter.

Hypothesis II

$$H_0 = Corr(Disposition\ Effect, Implied\ Market\ Volatility)\ = 0$$

$$H_1 = Corr(Disposition\ Effect, Implied\ Market\ Volatility)\ \neq 0$$

Regressing on Interaction Terms

The aforementioned stock characteristics data downloaded from Compustat and CRSP is merged with the transaction data by CUSIP identifier. This process results in the dropping of some observations, as stock characteristic data is not available for all sell transactions. The dropped observations are not considered to be securities which investors have unusual inclinations for realizing gains or losses in times of expected high volatility. Subsequently, 184,514 observations remain, an amount considered more than sufficient not to bias our analysis. New PGR and PLR ratios, and their implied disposition effect values, are calculated based on the remaining transactions. Like the first ratios, these values have been tested and proven to be normally distributed[12]. This data is later collapsed to show PGR, PLR and average stock characteristic values per month[13]. Like earlier, disposition effect values are presented as the difference between PGR and PLR. The interaction term is generated by

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[12] See "Table A.II" in Appendix A.
[13] Some accounting related stock characteristics are only presented in quarterly reports. As estimates, these values have been applied for the subsequent two months until new accounting data is available in the next quarter.

multiplying each stock characteristic with the VIX value for that specific month. The disposition effect is then regressed using various multiple regressions where the explanatory variables are VIX and a different interaction term for each regression. Similar regressions are also run for all stock characteristic interaction terms after being winsorized at one percent tails. All regressions are OLS regressions and controlled for heteroscedasticity.

V. Results

Disposition Effect Results

Table I
PGR, PLR and Disposition Effect

This table presents the Proportion of Gains Realized (PGR), Proportion of Losses Realized (PLR) between the years 1991-1996, and the corresponding disposition effect which is calculated as PGR subtracted by PLR. The values are constructed by aggregating individual investor PGR and PLR per month and then presenting the mean value and standard deviation of these monthly observations. The first column shows the obtained values for the whole year and the second and third columns show corresponding values for January-November and December, respectively.

	Entire Year	Jan. - Nov.	December
PGR			
Number of obs.	70	65	5
Mean	0.311	0.318	0.222
Standard deviation	0.060	0.057	0.020
PLR			
Number of obs.	70	65	5
Mean	0.222	0.219	0.259
Standard deviation	0.042	0.041	0.026
Disposition Effect			
Number of obs.	70	65	5
Mean	0.090	0.099	-0.037
Standard deviation	0.083	0.077	0.040

For the entire year, we find that PGR is larger than PLR, 0.311 versus 0.222. This results in a disposition effect of 0.090. For the period January to December, a slightly higher PGR, 0.318, and lower PLR, 0.219 is obtained. For December, we observe a much smaller PGR, 0.222 and a larger PLR, 0.259. This results in a negative disposition effect of (-0.037), a phenomena explained by Shefrin and Statman (1985) as tax motivated selling, where investors realize their losers at the year-end for tax saving purposes.

The results above are all in line with the initial findings in Odean (1998) and although they already have been scientifically validated through several follow up studies it indicates that our monthly disposition values are valid estimates for further analysis.

Market Sentiment as Driver of the Disposition Effect

Table II
Regression: Disposition Effect w.r.t. Market Sentiment Index

This table reports regression results from a linear regression between monthly disposition effect values and Baker and Wurgler's market sentiment index on a monthly basis. Robust standard errors are used to correct for heteroscedasticity.

Explanatory Power

Number of obs.	70
F (1, 68)	0.040
Prob. > F	0.084
R²	0.000
Root MSE	0.084

Linear Regression

Disposition Effect	Coefficient	Std. Err.	t-statistic	P > |t|
Sentiment Index	-0.006	0.030	-0.200	0.842
Constant	0.089	0.011	7.810	0.000

$$Disposition\ Effect_i = \beta_0 + \beta_1 * Market\ Sentiment_i + \varepsilon_i$$

The first explanatory variable we test is market sentiment. Regression results show no significant correlation between the disposition effect and the market sentiment index with a high p-value of 0.842. To make sure that investors do not act on earlier sentiment beliefs an additional regression is run adjusting for lagging effects by one month.

Table III
Regression: Disposition Effect w.r.t. 1-Month Lagging Market Sentiment Index

This table reports regression results for an almost identically executed regression as in Table II with the exception that market sentiment values are moved backwards a month to control for potential lagging effects. The motivation is that investors may act on earlier sentiment beliefs. For instance, a decision to realize a higher proportion of winning stocks in June 1992 may be based on investor sentiment from May 1992. Robust standard errors are used to correct for heteroscedasticity.

Explanatory Power

Number of obs.	69
F (1, 68)	0.630
Prob. > F	0.429
R²	0.005
Root MSE	0.084

Linear Regression

Disposition Effect	Coefficient	Std. Err.	t-statistic	P > |t|
Sentiment Index	-0.028	0.035	-0.800	0.429
Constant	0.085	0.011	7.780	0.000

$$Disposition\ Effect_i = \beta_0 + \beta_1 * Lag\ Adjusted\ Market\ Sentiment_i + \varepsilon_i$$

Like in the initial regression, the lag adjusted test does not show any significant correlation between the disposition effect and market sentiment. Table III reports a p-value of 0.429, which is lower than the value in the first regression but still far from significant.

Based on these two tests we accept the first null hypothesis that there is no significant correlation between the disposition effect and market sentiment.

Implied Market Volatility as Driver of the Disposition Effect

Table IV
Regression: Disposition Effect w.r.t. VIX Index

This table reports regression results from a linear regression between disposition effect values and VIX values on a monthly basis. Robust standard errors are used to correct for heteroscedasticity. *, and ** indicates that the t-statistic is statistically significant at the 5% and 1% levels, respectively.

Explanatory Power

Number of obs.	70
F (1, 68)	8.970**
Prob. > F	0.004
R²	0.117
Root MSE	0.079

Linear Regression

Disposition Effect	Coefficient	Std. Err.	t-statistic	P > |t|
VIX Index	0.012	0.004	2.990**	0.004
Constant	-0.092	0.057	-1.610	0.112

$$Disposition\ Effect_i = \beta_0 + \beta_1 * VIX_i + \varepsilon_i$$

The second explanatory variable we test is VIX. Regression results from Table IV demonstrate positive correlation between the disposition effect and VIX with a t-statistic of 2.99 implying a p-value of 0.004, which is considered highly statistically significant. The coefficient value of 0.012 is considered of economic significance as both variables are presented in absolute values. This correlation can easily be observed in Figure I below. In addition, we run a one month adjusted lagging regression for the VIX, similar to the market sentiment analysis. Results from this test[14] imply that there is no lagging effect between the disposition effect and VIX.

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[14] See "Table A.III" in Appendix A.

Figure I
Disposition Effect and VIX Index From 1991-1996

This figure demonstrates two graphs showing fluctuations in the disposition effect, obtained between February 1991 and November 1996, and fluctuations the VIX index over the same period. To be visually telling, some adjustments are done to clarify the confirmed correlation between the disposition effect and implied market volatility. The adjustments performed include: (1) dividing VIX values by 100, and (2) scaling down the vertical VIX axis scope between 0.07 and 0.19. From looking at the disposition effect graph, we can easily see how investors generally realize more losers (positive values) except for in December, where we find negative values for all years but 1992, implying that investors realize more winners in this month.
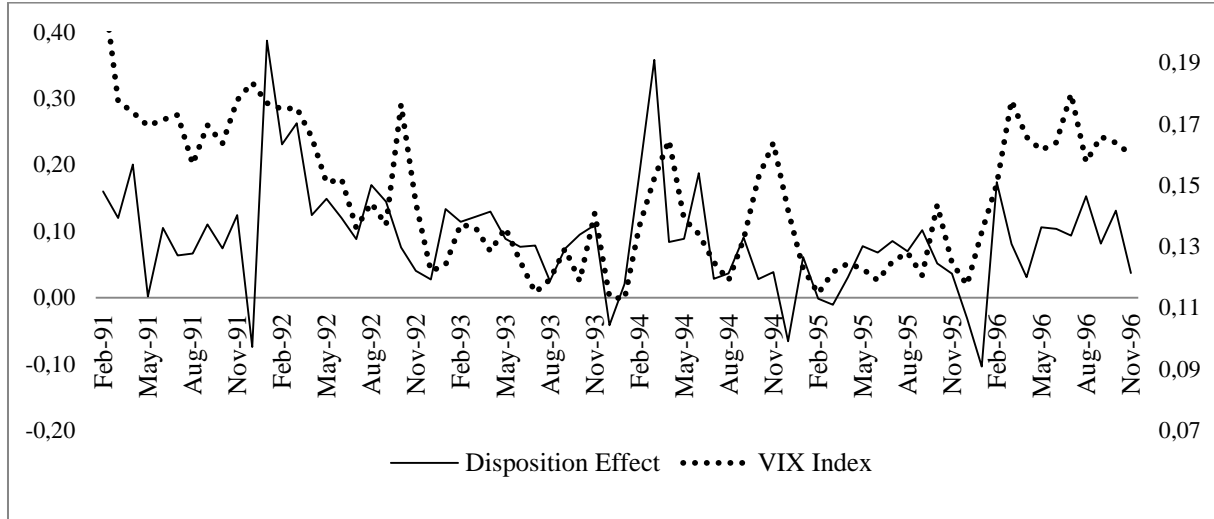
Table V
Multiple Regression: Disposition Effect w.r.t. Market Sentiment Index and VIX Index

This table report descriptive statistics and the main results from a multiple linear regression between disposition effect values, market sentiment index[15] values, and VIX values on a monthly basis. This regression is conducted to ensure that the significant correlation findings between the disposition effect and VIX are robust, hence controlling for market sentiment. Robust standard errors are used to correct for heteroscedasticity. *, and ** indicates that the t-statistic is statistically significant at the 5% and 1% levels, respectively.

Explanatory Power				
Number of obs.	70			
F (2, 67)	4.420*			
Prob. > F	0.016			
R²	0.117			
Root MSE	0.079			

Linear Regression				
Disposition Effect	Coefficient	Std. Err.	t-statistic	P > | t |
Sentiment Index	-2.11E-04	0.027	-0.010	0.948
VIX Index	0.012	0.004	2.970**	0.004
Constant	-0.092	0.058	-1.590	0.116

$$Disposition\ Effect_i = \beta_0 + \beta_1 * Market\ Sentiment_i + \beta_2 * VIX_i + \varepsilon_i$$

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[15] Baker and Wurgler's (2006, 2007) market sentiment index not adjusted for lagging effects.

To verify that our findings are robust we run a multiple regression controlling for market sentiment. Results are reported in Table V where we observe that the regression between the disposition effect and VIX still has an economic and statistical significance with a coefficient of 0.012 and a p-value of 0.004. The sentiment coefficient is still not significant with a reported p-value of 0.948. Overall, the regression is jointly significant with an F-statistic of 4.42.

Based on the values in Table IV and Table V we reject the second null hypothesis and accept that there is a significant economic correlation between the disposition effect and implied market volatility.

Stock Characteristics' Contribution to Implied Market Volatility as Driver of the Disposition Effect

Table VI
Regression: Disposition Effect w.r.t. VIX and Interaction Terms

This table reports regression results from 8 multiple linear regressions between the disposition effect, VIX and interaction terms[16] between VIX and 8 different stock characteristics. All variables are measured on a monthly basis. The different stock characteristics are; assets, liabilities, equity, earnings yield, trading volume, dividend yield, market capitalization, book-to-market ratio and idiosyncratic volatility. Robust standard errors are used to correct for heteroscedasticity. *, and ** indicates that the t-statistic is statistically significant at the 5% and 1% levels, respectively.

Multiple Linear Regressions						
Disposition Effect	Coefficient	Std. Err.	t-statistic	$P > \lvert t \rvert$	Explanatory Power	
VIX	0.004	0.004	1.020	0.309	Num. of obs.	70
VIX*Assets	3.86E-07	2.89E-07	1.330	0.187	F(2 , 67)	1.520
Constant	0.005	0.065	0.080	0.937	Prob. > F	0.227
					R²	0.051
					Root MSE	0.082
VIX	0.004	0.004	0.930	0.357	Num. of obs.	70
VIX*Liabilities	5.94E-07	3.45E-07	1.720	0.090	F(2 , 67)	1.880
Constant	0.005	0.064	0.070	0.941	Prob. > F	0.160
					R²	0.061
					Root MSE	0.082
VIX	0.010	0.005	1.950	0.055	Num. of obs.	70
VIX*Equity	-1.63E-06	1.49E-06	-1.090	0.280	F(2 , 67)	1.920
Constant	0.023	0.066	0.350	0.730	Prob. > F	0.155
					R²	0.048
					Root MSE	0.083
VIX	0.007	0.005	1.390	0.169	Num. of obs.	70
VIX*Earnings Yield	0.077	0.132	0.580	0.565	F(2 , 67)	1.990
Constant	0.010	0.062	0.160	0.875	Prob. > F	0.145
					R²	0.041
					Root MSE	0.083
VIX	0.005	0.004	1.170	0.245	Num. of obs.	70
VIX*Dividend Yield	0.903	0.600	1.510	0.137	F(2 , 67)	1.950
Constant	-0.002	0.066	-0.030	0.975	Prob. > F	0.150
					R²	0.058
					Root MSE	0.082
VIX	0.014	0.006	2.500*	0.015	Num. of obs.	70
VIX*MCAP	-9.06E-07	3.24E-07	-2.800**	0.007	F(2 , 67)	4.220*
Constant	0.005	0.062	0.080	0.936	Prob. > F	0.019
					R²	0.113
					Root MSE	0.080
VIX	0.003	0.005	0.680	0.499	Num. of obs.	70
VIX*BtM	0.010	0.009	1.060	0.291	F(2 , 67)	1.530
Constant	0.007	0.065	0.100	0.919	Prob. > F	0.225
					R²	0.057
					Root MSE	0.082
VIX	0.015	0.006	2.700**	0.009	Num. of obs.	70
VIX*Idiosync. Vol.	-0.004	0.001	-2.560*	0.013	F(2 , 67)	4.310*
Constant	-0.010	0.064	-0.150	0.881	Prob. > F	0.017
					R²	0.103
					Root MSE	0.080

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[16] Defined as VIX value multiplied with specific stock characteristic value for that month.

$$Disposition\ Effect_i = \beta_0 + \beta_1 * VIX_i + \beta_2 * VIX_i * Stock\ Charactheristic_i + \varepsilon_i$$

Results from the stock characteristics analysis are presented in Table VI. These results show that two multiple regressions between the dispositions effect, VIX and interaction terms are statistically significant. The first is the multiple regression run on the disposition effect, VIX and VIX*Market Capitalization. The joint explanatory power of the regression is an F-statistic of 4.220, implying a significance level of 0.019. VIX and VIX*Market Capitalization coefficients show p-values of 0.015 and 0.007 respectively. The second statistically significant multiple regression is between the disposition effect, VIX and VIX*Idiosyncratic Volatility where the joint explanatory power is an F-statistic of 4.310. On the individual coefficient level VIX and VIX*Idiosyncratic volatility are both significant with p-values of 0.009 and 0.013 respectively. The VIX coefficients in both regressions as well as the VIX*Idiosyncratic Volatility coefficient of -0.004 are regarded to be of economic significance. However, the VIX*Market Capitalization coefficient of -9.06E-07 is considered too small to have any economic impact on the disposition effect.

  Similar regressions are run after winsorizing the interaction terms at one percent tails. However, these additional tests[17] do not significantly change our initial results.

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[17] See "Table A.IV" in Appendix A.

VI. Discussion

Implications of Market Sentiment Results

Our results suggest that there is no correlation between the disposition effect and market sentiment. The difference between PGR and PLR does not seem to be driven by aggregated beliefs on market direction.

One reason might be that although the number of realized gains compared to realized losses may increase in times of high market sentiment, so may the total amount of winning stocks compared to losing stocks as well, creating little change in the proportion values. The same applies for low market sentiment, reducing both realized gains compared to realized losses and paper gains to paper losses, again causing little change in proportion values. Another motivation could be that investors with upward market beliefs follow a strategy where they hold on to both winners and losers as both types are expected to perform better in the future. Given that the present amount of paper gains and losses are the same, the PGR and the PLR will both decrease but the difference between the two will remain similar. This explanation seems less likely as paper gains and losses are expected to change as well. In addition, Frydman et al. (2011) have shown that investors experience a realization utility when they sell stocks at a gain, making it difficult to motivate why investors in our data would ignore this appeal.

It should be noted that we do not reject that self-justification may be a cause of the disposition effect. However, our results indicate that using investors' aggregated beliefs on market direction as an estimator does not explain it.

Implications of Implied Market Volatility Results

We find positive significant economic correlation between the disposition effect and the VIX on a monthly basis. This finding is strengthened by the theory of mean reversion, where investors believe that stock prices will eventually move to their historical averages. Over performing stocks will decline in value whilst underperforming ones will increase. The rational strategy for an investor believing in mean reverting stocks is to sell winners before they decline in value and hold on to losers until they rise. The connection between implied market volatility and mean reversion is that in times of market uncertainty, higher standard deviation, the probability that stock prices will change is larger. This also suggests that there

is a larger chance that stocks will mean revert and that they will do so faster, motivating investors to hold on to losers and sell winners, hence increasing the disposition effect.

Implications of Stock Characteristics Results

Our study shows significant statistical correlation for two of the eight tested stock characteristics. The first is a multiple regression run between the disposition effect, VIX and the VIX*Market Cap interaction term. The second is a multiple regression run between the disposition effect, VIX and the VIX*Idiosyncratic Volatility interaction term. Although both interaction terms are statistically significant, we only consider VIX*Idiosyncratic Volatility to be of economic significance. The coefficient value of -0.004 implies that investors' realizations of stocks with high idiosyncratic volatility tend to decrease the disposition effect in times of high implied market volatility. However, the positive coefficient of the VIX variable from this multiple regression is 0.015, which indicates that the monthly average idiosyncratic volatility of realized stocks is required to be substantially high to cancel out this positive effect.

Problematization

The first concern of our study is a selection bias as we only use data from one brokerage house in one country, the United States of America. Perhaps this is a brokerage house that targets a specific group of investors. Secondly, our data may include a survivorship bias as the most unsophisticated investors do not stay in the stock market. These are also the investors who are most likely to be disposed to realize winners over losers.

Further, estimators will always remain estimators. Although we believe Baker and Wurgler's (2006, 2007) index to be a good proxy for investor sentiment, it will never perfectly replicate investors aggregated beliefs on market direction. The same rationale applies to the VIX Index. Although it is the most widely used estimator of implied volatility it is not flawless.

Finally, the accounting data used for estimating stock characteristics is not available on a monthly basis. As mentioned earlier, we use the last accounting information for each month where these values are not available. Most accounting data is supplied on a quarterly basis resulting in two months without correct values. This bias is even more applicable to the dividend yield and earning yield variables as dividend and earnings are usually only presented

once a year. As our analysis only applies to six years this implies that very few of these values are correct. To get better estimates one could calculate the mean between two subsequent earnings reports.

VII. Conclusion and Future Research

Conclusion

This paper investigates potential drivers for investors' disposition to realize winning stocks and hold on to losing ones. Analysis is performed on two behavior variables, market sentiment and implied market volatility. Results show no significant correlation between the disposition effect and market sentiment which indicates that investors' disposition towards realizing winners over losers is not motivated by their aggregated belief on market movement. However, a positive correlation of statistic and economic significance is found between the disposition effect and implied market volatility. This suggests that investors have a higher propensity towards realizing winners than losers in times of high expected market uncertainty. In addition, this paper finds that idiosyncratic volatility is a stock characteristic which is significantly represented in the increase of the disposition effect in times of high anticipated market volatility.

Future Research

We believe that it would be of high academic interest to test our correlation findings between the disposition effect and implied market volatility on demographic data. Especially demographic variables that have already been reported to show difference in the disposition effect, for example investor sophistication where the more sophisticated investors tend to show a smaller tendency towards realizing winners over losers. The question to be asked is if these already established differences change in times of high respectively low implied market volatility?

Further, it would be interesting to perform investigations on other behavioral drivers than market sentiment and implied market volatility as well as additional stock characteristics analysis. To achieve stronger stock characteristics tests it is recommended to use a larger time span as accounting data is most commonly only available on quarterly basis. Finally we suggest that a study should be done on the disposition effect around certain macro events and crisis. These analyses should also be linked to implied market volatility.

VIII. References

Badrinath, S., and Wilber Lewellen, 1991, "Evidence on Tax-Motivated Securities Trading Behavior", *Journal of Finance* 46, 369-382.

Baker, Malcolm, and Jeffrey Wurgler, 2006, "Investor Sentiment and the Cross-Section och Stock Returns", *Journal of Finance* 61, 1645-1680.

Baker, Malcolm, and Jeffrey Wurgler, 2007, "Investor Sentiment in the Stock Market", *Journal of Economic Perspectives* 21, 129-151.

Barber, Brad M., and Terrance Odean, 2000, "Trading is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors", *Journal of Finance* 55, 773-806.

Barber, Brad M., Yi-Tsung Lee, Yu-Jane Liu, and Terrance Odean, 2009, "Just How Much Do Individual Investors Lose By Trading?", *Review of Financial Studies* 22, 609-632.

DeLong, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann, 1990, "Noise Trader Risk in Financial Markets", *Journal of Political Economy* 98, 703-738.

Dyl, Edward, 1977, "Capital Gains Taxation and the Year-End Stock Market Behavior", *Journal of Finance* 32, 165-175.

Festinger, Leon, 1957, "A theory of Cognitive Dissonance", Stanford University Press, Stanford, CA.

Frydman, Cary, Nicholas Barberis, Colin Camerer, Peter Bossaerts and Antonio Rangel, 2011, "Testing Theories of Investor Behavior Using Neural Data". Available at < http://www.haas.berkeley.edu/groups/finance/ru_july11.pdf>.

Grinblatt, Mark, and Matti Keloharju, 2000, "The Investment Behavior and Performance of Various Investor Types: A Study of Finland's Unique Data Set", *Journal of Financial Economics* 55, 43-67.

Hillebrand, Eric, 2003, "A Mean-Reversion Theory of Stock-Market Crashes". Available at <http://www.bus.lsu.edu/economics/papers/pap03_10.pdf>.

Jagadeesh, Narasimhan, and Sheridan Titman, 1993, "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency", *Journal of Finance* 48, 65-91.

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

Lakonishok, Josef, and Seymour Smidt, 1986, "Volume for Winners and Losers: Taxation and Other Motives for Stock Trading", *Journal of Finance* 41, 951-974.

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

Odean, Terrance, 1999, "Do Investors Trade Too Much?", *American Economic Review* 89, 1279-1298.

Poterba, James M., and Lawrence H. Summers, 1988, "Mean Reversion in Stock Prices: Evidence and Implications", *Journal of Financial Economics* 22, 27-59.

Schlarbaum, Gary G., Wilber G. Lewellen, and Ronald C. Lease, 1978, "Realized Returns on Common Stock Investments: The Experience of Individual Investors", *Journal of Business* 51, 299-325.

Shefrin, Hersh, and Meir Statman, 1985, "The Disposition to Sell Winners Too Early and Ride Losers Too Long", *Journal of Finance* 40, 777-790.

Shleifer, Andrei, and Robert Vishny, 1997, "The Limits of Arbitrage", *Journal of Finance* 52, 35-55.

Appendices

Appendix A

Table A.I
PGR, PLR and Disposition Effect Test Results for Normality

This table presents the results from a normality test performed for our PGR, PLR and disposition effect values. The results significantly establish that these variables all approximately follow a normal distribution.

Skewness/Kurtosis tests for Normality

Variable	Num. Of obs.	Pr(Skewness)	Pr(Kurtosis)	Adj. Chi² (2)	Prob. > Chi²
PGR	70	1.00E-04	0.003	18.460	1.00E-04
PLR	70	0.007	0.042	9.720	0.008
Disposition Effect	70	0.003	0.003	14.080	0.001

Table A.II
PGR, PLR and Disposition Effect Test Results for Normality

This table presents the results from a normality test performed for our PGR, PLR and disposition effect values after observations are dropped as a consequence of merging the variables with stock characteristics data. The results significantly establish that these variables all approximately follow a normal distribution.

Skewness/Kurtosis tests for Normality

Variable	Num. Of obs.	Pr(Skewness)	Pr(Kurtosis)	Adj. Chi² (2)	Prob. > Chi²
PGR	70	0.006	0.059	9.620	0.008
PLR	70	0.002	0.003	14.840	0.001
Disposition Effect	70	0.167	0.009	7.840	0.020

Table A.III
Regression: Disposition Effect w.r.t. 1-Month Lagging VIX Index

This table reports descriptive statistics and the main results from an identically executed regression as in Table IV with the exception that VIX values are moved forward a month to control for potential lagging effects. Robust standard errors are used to correct for heteroscedasticity.

Explanatory Power

Number of obs.	69
F (1, 67)	3.190
Prob. > F	0.079
R²	0.056
Root MSE	0.081

Linear Regression

Disposition Effect	Coefficient	Std. Err.	t-statistic	P >	t	
VIX Index	0.009	0.005	1.790	0.079
Constant	-0.036	0.068	-0.540	0.594

Table A.IV

Regression: Disposition Effect w.r.t. VIX and Interaction Terms

This table reports regression results from 8 multiple linear regressions between the disposition effect, VIX and interaction terms between VIX and 8 different stock characteristics. All variables are measured on a monthly basis. The different stock characteristics are; assets, equity, earnings yield, trading volume, dividend yield, market capitalization, book-to-market ratio and idiosyncratic volatility. Robust standard errors are used to correct for heteroscedasticity. *, and ** indicates that the t-statistic is statistically significant at the 5% and 1% levels, respectively.

Multiple Linear Regressions

Disposition Effect	Coefficient	Std. Err.	t-statistic	P > |t|	Explanatory Power	
VIX	0.004	0.004	1.020	0.309	Num. of obs.	70
VIX*Assets	3.86E-07	2.89E-07	1.330	0.187	F(2 , 67)	1.520
Constant	0.005	0.065	0.080	0.937	Prob. > F	0.227
					R²	0.051
					Root MSE	0.082
VIX	0.004	0.004	0.930	0.357	Num. of obs.	70
VIX*Liabilities	5.94E-07	3.45E-07	1.720	0.090	F(2 , 67)	1.880
Constant	0.005	0.064	0.070	0.941	Prob. > F	0.160
					R²	0.061
					Root MSE	0.082
VIX	0.010	0.005	1.950	0.055	Num. of obs.	70
VIX*Equity	-1.63E-06	1.49E-06	-1.090	0.280	F(2 , 67)	1.920
Constant	0.023	0.066	0.350	0.730	Prob. > F	0.155
					R²	0.048
					Root MSE	0.083
VIX	0.007	0.005	1.390	0.169	Num. of obs.	70
VIX*Earnings Yield	0.077	0.132	0.580	0.565	F(2 , 67)	1.990
Constant	0.010	0.062	0.160	0.875	Prob. > F	0.145
					R²	0.041
					Root MSE	0.083
VIX	0.005	0.004	1.170	0.245	Num. of obs.	70
VIX*Dividend Yield	0.903	0.600	1.510	0.137	F(2 , 67)	1.950
Constant	-0.002	0.066	-0.030	0.975	Prob. > F	0.150
					R²	0.058
					Root MSE	0.082
VIX	0.014	0.006	2.500*	0.015	Num. of obs.	70
VIX*MCAP	-9.06E-07	3.24E-07	-2.800**	0.007	F(2 , 67)	4.220*
Constant	0.005	0.062	0.080	0.936	Prob. > F	0.019
					R²	0.113
					Root MSE	0.080
VIX	0.003	0.005	0.680	0.499	Num. of obs.	70
VIX*BtM	0.010	0.009	1.060	0.291	F(2 , 67)	1.530
Constant	0.007	0.065	0.100	0.919	Prob. > F	0.225
					R²	0.057
					Root MSE	0.082
VIX	0.015	0.006	2.700**	0.009	Num. of obs.	70
VIX*Idiosync. Vol.	-0.004	0.001	-2.560*	0.013	F(2 , 67)	4.310*
Constant	-0.010	0.064	-0.150	0.881	Prob. > F	0.017
					R²	0.103
					Root MSE	0.080

Appendix B

Table B.I
Baker and Wurgler's Sentiment Index From 1991-1996

This table show the market sentiment index between 1991-1996 developed by Baker and Wurgler (2006, 2007). In this study, the values from the first columns named SENT^ are used as proxies for retail investor sentiment.

Month	SENT^	SENT	DSENT^	DSENT	Month	SENT^	SENT	DSENT^	DSENT
Feb-91	-0.652	-0.361	-0.327	0.065	Jan-94	-0.067	0.036	-0.519	-0.440
Mar-91	-0.690	-0.413	0.076	0.585	Feb-94	-0.135	-0.030	0.663	0.846
Apr-91	-0.417	-0.431	-2.420	-0.085	Mar-94	-0.151	-0.038	0.016	0.319
May-91	-0.326	-0.361	0.542	0.088	Apr-94	-0.224	-0.069	-0.961	-1.215
Jun-91	-0.381	-0.334	-0.379	-0.029	May-94	-0.209	0.045	0.098	-0.318
Jul-91	-0.463	-0.456	-0.170	0.010	Jun-94	-0.060	0.148	0.037	-0.420
Aug-91	-0.228	-0.537	-0.635	0.206	Jul-94	-0.098	0.129	-0.506	-0.164
Sep-91	-0.298	-0.535	-0.049	0.111	Aug-94	0.010	0.195	0.847	0.496
Oct-91	-0.343	-0.563	0.371	0.696	Sep-94	0.050	0.241	-0.055	0.540
Nov-91	-0.287	-0.425	0.552	0.367	Oct-94	-0.009	0.196	0.117	0.261
Dec-91	-0.255	-0.365	0.377	0.531	Nov-94	-0.024	0.236	-0.076	-0.376
Jan-92	-0.054	-0.293	1.277	1.618	Dec-94	-0.056	0.183	0.015	-0.209
Feb-92	0.000	-0.150	0.513	0.187	Jan-95	0.028	0.244	-0.468	-0.767
Mar-92	0.012	-0.035	0.140	-0.334	Feb-95	-0.052	0.264	0.202	0.416
Apr-92	-0.294	-0.076	-2.091	-2.223	Mar-95	-0.093	0.193	-0.167	0.043
May-92	-0.276	-0.097	-0.613	-0.164	Apr-95	-0.189	0.045	-0.810	-1.058
Jun-92	-0.209	-0.110	-0.217	-0.289	May-95	-0.213	-0.049	0.505	0.557
Jul-92	-0.247	-0.128	0.371	0.261	Jun-95	-0.226	-0.072	0.931	1.232
Aug-92	-0.183	-0.081	-0.350	-0.372	Jul-95	-0.282	-0.134	0.531	1.206
Sep-92	-0.074	-0.033	0.376	0.350	Aug-95	-0.299	-0.042	0.205	0.371
Oct-92	-0.105	-0.057	1.363	1.278	Sep-95	-0.211	0.007	-0.103	-0.425
Nov-92	-0.096	0.005	0.222	-0.120	Oct-95	-0.179	0.022	-0.390	0.227
Dec-92	0.008	0.096	0.812	0.471	Nov-95	-0.084	0.064	0.977	0.658
Jan-93	-0.064	0.189	-0.787	-0.460	Dec-95	-0.013	0.083	-0.457	-0.228
Feb-93	0.084	0.236	0.017	-0.225	Jan-96	0.033	0.102	-0.802	-0.871
Mar-93	0.091	0.159	0.536	1.103	Feb-96	0.023	0.086	1.701	1.393
Apr-93	-0.189	-0.097	-1.397	-1.002	Mar-96	0.092	0.114	0.133	0.311
May-93	-0.265	-0.191	0.618	1.408	Apr-96	0.006	0.015	1.329	1.501
Jun-93	-0.366	-0.216	0.460	0.590	May-96	0.013	0.056	0.171	0.838
Jul-93	-0.277	-0.180	-0.279	0.231	Jun-96	0.182	0.233	-0.714	-1.036
Aug-93	-0.419	-0.250	0.547	0.943	Jul-96	0.269	0.335	-1.271	-1.209
Sep-93	-0.391	-0.206	0.607	1.145	Aug-96	0.444	0.436	0.212	0.146
Oct-93	-0.262	-0.076	0.324	0.378	Sep-96	0.417	0.431	0.247	0.355
Nov-93	-0.119	0.009	0.240	0.343	Oct-96	0.447	0.405	0.345	-0.128
Dec-93	-0.120	0.029	0.330	0.731	Nov-96	0.412	0.403	-0.579	-0.103

Table B.II
PGR, PLR and Disposition Effect Values From 1991-1996

This table demonstrates our calculated PGR, PLR and corresponding disposition effect values from February 1991 to November 1996. Please see sections Data and Methodology to observe how the figures are determined.

Month	PGR	PLR	Disposition Effect	Month	PGR	PLR	Disposition Effect
Feb-91	0.327	0.167	0.160	Jan-94	0.343	0.323	0.020
Mar-91	0.303	0.183	0.120	Feb-94	0.409	0.224	0.185
Apr-91	0.362	0.162	0.200	Mar-94	0.531	0.173	0.358
May-91	0.254	0.252	0.002	Apr-94	0.330	0.246	0.084
Jun-91	0.320	0.215	0.105	May-94	0.321	0.233	0.088
Jul-91	0.294	0.231	0.063	Jun-94	0.405	0.217	0.188
Aug-91	0.289	0.222	0.066	Jul-94	0.285	0.257	0.028
Sep-91	0.297	0.186	0.110	Aug-94	0.277	0.240	0.036
Oct-91	0.286	0.212	0.074	Sep-94	0.305	0.215	0.091
Nov-91	0.312	0.188	0.124	Oct-94	0.263	0.235	0.028
Dec-91	0.218	0.292	-0.074	Nov-94	0.285	0.247	0.038
Jan-92	0.514	0.127	0.387	Dec-94	0.207	0.273	-0.066
Feb-92	0.402	0.171	0.231	Jan-95	0.371	0.311	0.061
Mar-92	0.438	0.175	0.262	Feb-95	0.313	0.315	-0.002
Apr-92	0.354	0.230	0.124	Mar-95	0.293	0.304	-0.011
May-92	0.354	0.205	0.149	Apr-95	0.293	0.262	0.031
Jun-92	0.344	0.224	0.120	May-95	0.312	0.234	0.077
Jul-92	0.314	0.226	0.088	Jun-95	0.289	0.221	0.068
Aug-92	0.364	0.194	0.169	Jul-95	0.277	0.192	0.085
Sep-92	0.347	0.203	0.144	Aug-95	0.270	0.200	0.070
Oct-92	0.296	0.221	0.076	Sep-95	0.279	0.178	0.101
Nov-92	0.270	0.229	0.040	Oct-95	0.253	0.201	0.051
Dec-92	0.256	0.228	0.027	Nov-95	0.244	0.208	0.036
Jan-93	0.390	0.257	0.133	Dec-95	0.205	0.236	-0.031
Feb-93	0.368	0.254	0.114	Jan-96	0.257	0.361	-0.104
Mar-93	0.353	0.231	0.122	Feb-96	0.368	0.194	0.174
Apr-93	0.355	0.226	0.129	Mar-96	0.294	0.213	0.081
May-93	0.314	0.225	0.088	Apr-96	0.260	0.229	0.031
Jun-93	0.305	0.229	0.076	May-96	0.283	0.177	0.106
Jul-93	0.307	0.229	0.078	Jun-96	0.296	0.193	0.104
Aug-93	0.265	0.241	0.025	Jul-96	0.312	0.219	0.094
Sep-93	0.282	0.208	0.074	Aug-96	0.310	0.157	0.153
Oct-93	0.283	0.188	0.095	Sep-96	0.266	0.185	0.081
Nov-93	0.298	0.189	0.109	Oct-96	0.288	0.157	0.131
Dec-93	0.223	0.264	-0.042	Nov-96	0.234	0.197	0.037

Table B.III
Stock Characteristic Values From 1991-1996

This table shows values of the eight stock characteristics tested for as variables explaining the significant correlation between the disposition effect and implied market volatility (VIX) in this study. Stock characteristic values are obtained for stocks traded in our trading account data from February 1991 to November 1996 and collected from Wharton Research Data Services (WRDS). The eight stock characteristic variables tested are; assets, equity, liabilities, market capitalization, book-to-market ratio, idiosyncratic volatility (firm specific volatility), dividend yield and earnings yield. See section Data for further information and the motivation to use these variables.

Month	Assets	Equity	Liabilities	MCAP	BtM	Idiosync. Vol.	Dividend Yld.	Earnings Yld.	Month	Assets	Equity	Liabilities	MCAP	BtM	Idiosync. Vol.	Dividend Yld.	Earnings Yld.
Feb-91	3376	1666	1711	8093	0.362	1.633	0.002	0.008	Jan-94	8749	2259	6491	7202	0.391	1.325	0.003	0.009
Mar-91	9622	1968	7654	5388	0.210	2.062	0.003	0.006	Feb-94	7680	2022	5657	6668	0.394	1.443	0.003	0.010
Apr-91	9682	1909	7774	5502	0.164	1.672	0.003	0.008	Mar-94	8193	2086	6108	5954	0.390	1.786	0.003	0.012
May-91	9915	2175	7740	6147	0.258	1.607	0.003	0.007	Apr-94	7545	2004	5541	5612	0.396	1.713	0.003	0.011
Jun-91	9778	2063	7715	4796	0.556	1.877	0.005	0.007	May-94	10172	2415	7757	6704	0.396	1.765	0.004	0.012
Jul-91	10775	2169	8606	5702	0.468	1.533	0.004	0.006	Jun-94	9750	2193	7557	6193	0.450	2.154	0.004	0.014
Aug-91	12778	2290	10488	6559	0.543	1.490	0.004	0.007	Jul-94	8264	2183	6080	6007	0.425	1.263	0.003	0.015
Sep-91	10646	2792	7854	7106	0.318	1.736	0.004	0.005	Aug-94	9708	2508	7200	6989	0.411	1.487	0.004	0.014
Oct-91	8267	2104	6163	6235	0.373	1.591	0.003	0.006	Sep-94	7559	2006	5553	5915	0.417	1.218	0.003	0.013
Nov-91	8860	2100	6759	6288	0.410	1.602	0.003	0.007	Oct-94	7864	2116	5748	6290	0.388	1.611	0.003	0.013
Dec-91	9766	2419	7347	6796	0.481	1.960	0.004	0.003	Nov-94	7843	2224	5619	6717	0.434	1.239	0.003	0.011
Jan-92	9329	2170	7158	6180	0.426	1.832	0.003	0.003	Dec-94	8738	2262	6477	6473	0.465	1.249	0.004	0.012
Feb-92	7757	1626	6130	4909	0.515	1.599	0.003	0.005	Jan-95	9147	2597	6550	7149	0.424	1.405	0.003	0.014
Mar-92	8728	1814	6913	4837	0.502	1.391	0.003	0.004	Feb-95	10118	2403	7715	7326	0.422	1.169	0.004	0.013
Apr-92	10603	2452	8151	6459	0.459	1.761	0.004	0.003	Mar-95	10032	2526	7506	7816	0.387	1.570	0.003	0.014
May-92	11538	2809	8730	6885	0.506	1.325	0.004	0.005	Apr-95	10484	2711	7774	7740	0.400	1.557	0.003	0.014
Jun-92	11547	3232	8315	8126	0.511	2.199	0.005	0.011	May-95	8717	2588	6128	7850	0.418	1.754	0.003	0.013
Jul-92	11965	2957	9008	7498	0.497	1.305	0.005	0.005	Jun-95	8275	2335	5939	8033	0.361	2.156	0.002	0.013
Aug-92	10049	2328	7722	6533	0.483	1.134	0.005	0.010	Jul-95	8134	2421	5713	8631	0.357	1.946	0.002	0.013
Sep-92	8316	2158	6159	5723	0.473	1.555	0.004	0.006	Aug-95	7247	2194	5053	8774	0.346	2.462	0.002	0.012
Oct-92	9244	2652	6592	6478	0.499	1.659	0.004	0.004	Sep-95	7974	2373	5601	9298	0.346	1.850	0.002	0.009
Nov-92	9193	2565	6629	5896	0.495	1.354	0.004	0.003	Oct-95	6768	2284	4483	9643	0.318	2.502	0.002	0.010
Dec-92	12735	3634	9102	6847	0.457	1.779	0.006	-0.021	Nov-95	6727	2205	4521	8352	0.325	2.484	0.002	0.010
Jan-93	10183	2540	7643	6182	0.437	1.576	0.004	-3.16E-04	Dec-95	5318	1715	3603	6560	0.392	2.148	0.002	0.008
Feb-93	9429	2473	6956	6249	0.406	1.775	0.004	-0.001	Jan-96	8318	2411	5908	8722	0.349	2.503	0.002	0.010
Mar-93	10259	2176	8083	6007	0.429	1.503	0.004	0.005	Feb-96	9622	2668	6954	9404	0.351	2.061	0.002	0.011
Apr-93	10571	2396	8174	6802	0.421	1.750	0.004	0.003	Mar-96	9049	2379	6670	9302	0.328	1.733	0.002	0.010
May-93	7039	1939	5100	5826	0.423	1.593	0.003	0.006	Apr-96	7383	2261	5122	9074	0.322	2.258	0.002	0.009
Jun-93	7954	1810	6143	5579	0.375	2.255	0.004	0.002	May-96	7535	1996	5539	7894	0.335	2.198	0.002	0.006
Jul-93	9402	2065	7337	6260	0.379	1.431	0.004	-0.005	Jun-96	6962	1782	5180	7351	0.313	2.985	0.002	0.008
Aug-93	8017	1979	6039	6676	0.391	1.393	0.004	0.004	Jul-96	8786	2757	6029	12014	0.322	2.716	0.002	0.009
Sep-93	7023	1713	5310	5907	0.362	1.820	0.003	0.009	Aug-96	9705	2682	7023	10379	0.334	1.469	0.002	0.009
Oct-93	7281	1963	5319	6098	0.376	1.440	0.004	0.008	Sep-96	8396	2514	5882	10544	0.354	2.302	0.002	0.009
Nov-93	9943	2424	7519	6954	0.381	1.503	0.004	0.009	Oct-96	8989	2706	6282	11419	0.345	1.867	0.002	0.009
Dec-93	8917	2252	6666	6503	0.400	1.179	0.003	0.007	Nov-96	9100	2643	6457	11190	0.367	2.068	0.002	0.009