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# Equity Sell Disciplines across the Style Box

Robert S. Krisch

## ABSTRACT

This study examines the use of four major equity sell disciplines across the equity style box. Specifically, large-cap and small-cap securities are tested to see which of the four sell disciplines consistently produces the best portfolio returns. Data from the Plan Sponsor Network (PSN) are used to calculate each portfolio's benchmark-adjusted return (BAR), information ratio, and Sharpe ratio. These ratios are used to evaluate sell discipline strategy based on each portfolio's market capitalization and style focus. Three regressions are run for each BAR, information ratio and Sharpe ratio. The analysis is repeated for all four corners of the style box. The results show that there is not a specific sell discipline criterion that consistently produces the best portfolio performance. The majority of the regression results were not significant due the fact that the calculated  $p$ -value does not meet the minimum required significance level of 10%.

# Equity Sell Disciplines across the Style Box

## **Introduction**

There has been a great deal of attention over the years as to when to buy a stock, but not nearly as much about the decision to sell. Most investors follow conventional buy decision rules for stock purchases, including a bottom-up approach (choosing a single stock based on its attractiveness), top down approach (picking a stock starting with a macro-level analysis), and others. Although the sell decision is not stressed as much, it is at least equally important. The sell decision works in concert with the buy decision to determine whether an investor experiences a gain or loss.

Investors who do use a sell discipline criterion to determine the best time to sell an investment typically establish them even before a stock is purchased. This is to lessen the chance that the investor's emotions play a part in the sell decision. As defined in the Plan Sponsor Network (PSN) database, the six principal sell discipline criteria include Down from Cost, Up from Cost, Target Price, Valuation Level, Fundamental Deterioration, and Opportunity Cost. These six sell disciplines can be divided into two categories: objective and subjective approaches.

There has not been extensive academic research on sell discipline, and data are available from only one source, PSN. PSN provides data on thousands of portfolios, including which sell discipline is used for each respective portfolio. Along with that, the database contains other information about the portfolios, such as portfolio returns and market capitalization (micro, small, medium, and large).

## **Sell Disciplines**

The six principal sell discipline criteria are as follows.

- 1) Down from Cost – At the time of purchase, the portfolio manager specifies a maximum price decline that triggers a sale.
- 2) Up from Cost – At the time of purchase, the portfolio manager specifies a maximum price rise that triggers a sale.
- 3) Target Price – At the time of purchase, the portfolio manager specifies a price that represents full valuation; when the stock reaches this price a sale is triggered.
- 4) Valuation Level – Depending on the portfolio manager’s proprietary valuation model score, if a stock becomes fully priced in the model, it must be replaced.
- 5) Fundamental Deterioration – Depending on the portfolio manager’s ongoing due diligence, a belief that business or industry fundamentals are deteriorating warrants a sale, regardless of valuation.
- 6) Opportunity Cost – Depending on the portfolio manager’s primary equity decision-making criterion, whenever a better stock becomes available, sell the current stock holding.

## **Literature Review**

Sell discipline research began with Faugere, Shawky, and Smith (2004). Faugere et al. examine the six sell discipline criteria, with two found to be standouts. Both fundamental deterioration and valuation level are found to be the best sell disciplines to use in bull and bear markets respectively. During bull markets, investors appear to be more successful (produce a higher Sharpe ratio) with the subjective criterion “fundamental deterioration.” During bear markets, investors achieved better performance using an objective sell discipline, “valuation level.” The “target price” criterion was found to be a close second in all situations. This finding serves as the prime empirical motivation for the present study’s first hypothesis, concerning “all stocks.” Performance measures used in the analysis include benchmark-adjusted returns, information ratios, and downside volatility.

In an ideal situation, an investor wants to buy a stock when there is good value and good growth potential. An equally important question becomes when to sell the stock. Bernstein (1993) advises investors to consider an earnings expectations life cycle as a clock. “From one to three o’clock there is bad growth, from three to six o’clock there is bad value, from six to nine o’clock there is good value and from nine to twelve o’clock there is good growth.” Clearly, investors want to buy in at six o’clock when there is good value and good growth left, and cash out when the stock hits the twelve o’clock mark to maximize any gains. If a good sell discipline is in place from the start of the investment process, the better the investor’s chance of selling close to the twelve o’clock mark, which will result in the maximum gains.

Choosing a sell discipline can be a challenge in itself, but then comes the need to maintain the discipline to implement it. Many investors who choose a sell discipline will get nervous about the news that comes out about their investments and sometimes sell prematurely. As Norris (2002) notes, this is due to the fact that investors fear failure (losing money) and have a strong desire for success, which means realizing a gain. Peter and Steven (2005) state that these desires produce a psychological bias known as the disposition effect (or trade disposition), in which investors realize their gains yet fail to sell losing investments. Investors who are able to avoid falling prey to the disposition effect increase their return potential. To prevent a trade disposition, investors should set strong sell disciplines and understand that realizing a loss is part of successful investing. Boyarshinov & Magdon-Ismail (2010) emphasize that successful investors must realize that they always have three options in front of them: buy, sell, or do nothing. Usually, an equity investor’s sell discipline will give them the answer because a strong sell disciplines will either trigger a sale or indicate when to continue holding. In short, a clear sell discipline rigorously followed helps to negate the disposition effect.

Johnson and Collins (2000) are perhaps the first researchers to mention sell discipline. They do so in the context of separately managed accounts (SMAs), which are a portfolio of assets under the management of a professional investment firm. Johnson and Collins note that, “Portfolio managers rely on high performance achieved through strong sell disciplines, low expenses, and tax efficiency. They use sell disciplines to assess fundamental strengths and weaknesses across the entire portfolio in order to achieve good returns.”

According to Elton, Gruber, & Blake (2014), studies show that after analyzing 2,627 SMA’s over a ten-year span, it has been confirmed that even the worst indexes produced better returns than the average SMA. This is because indexes give an investor security through diversification in the market. In a sense, investing in an index is an effective sell discipline. An example of this is the Dow Jones Industrial Average. The Dow has the stocks it includes in its index determined by the editors of the *Wall Street Journal*. In determining these stocks, they use a subjective approach and constantly update the index. In a sense, a sell discipline is implemented into the Dow automatically due to this, so investors need not worry about when to sell specific stocks, only when to sell the index itself. In other words, the best returns are located in indexes in part due to this “automatic” sell discipline, but if an investor chooses to not invest in an index, it will be beneficial to implement and follow a sell discipline to achieve a good return.

Another way to look at sell disciplines is how they can and should be implemented in the case of short positions. An investor who shorts a stock is attempting to realize a gain by betting that the stock price will decrease. A strategy that may be profitable is not merely to sell an investment, but to actually sell short based on a sell discipline criterion.

This paper addresses the question of which sell disciplines produce the best performance for different types of US common stocks. It has long been documented that different types of equity securities experience disparate long-term return and risk characteristics. For example, Fama and French (1993) propose a three-factor asset pricing model that takes into account enduring risk premia on small-cap and value stocks.

More recently according to Fama & French (2007), small cap stocks with high positive returns tend to become large-cap stocks over time. This increase in size is due to size and value premiums of average stock returns. The trend is that growth stocks tend to have downward price-to-book ratio convergence and value stocks tend to have an upward price-to-book ratio trend. Put simply, small-cap strategies will produce the highest returns due to value premiums, but it takes a skilled investor to capitalize on this.

Along with this, Peterson, Jachini, and Lam (2011) note that active management, disciplined investors, and small-cap strategies will produce the best returns. Specifically, active investors need to have strong sell disciplines in order to produce high returns. Peterson et al. further state that the most successful SMA managers documented a strong negative relationship between assets under management and future performance. This is due to the fact that an investment manager might have too many accounts under management and cannot properly attend to each one, which will hinder overall performance. Put simply, an investor should invest using small-cap strategies to achieve the highest gains, while not having too many accounts to manage. They must pick a few winning stocks in order to efficiently manage a productive portfolio and enforce their sell disciplines at the proper times.

Finally, additional evidence is provided by Christopherson, Ding, & Greenwood (2002), who note that during the 1990's assets under management (AUM) increased dramatically.

According to Christopherson et al., investment managers specializing in small-cap stocks experienced dramatic asset growth and increasing returns. This was due to the fact that small cap stocks have a high ceiling for gains due to value premiums and investors can capitalize on them if an effective sell discipline is put into place.

## **Hypotheses**

The main hypotheses for this study can be stated as follows.

### All Stocks

H<sub>0</sub>: Target Price is not associated with the highest performance

H<sub>1</sub>: Target Price is associated with the highest performance

### Across the Equity Style Box

H<sub>0</sub>: The superior sell discipline criterion does not vary by fund type

H<sub>1</sub>: The superior sell discipline criterion does vary by fund type

The first hypothesis for this study is that target price will be associated with the highest portfolio performance. This is motivated by the findings of Faugere, Shawky, and Smith (2004) because they noted that the target price sell discipline performed the second best in all economic conditions. Along with this, target price is an objective sell discipline, so there is less question on when to execute it. The target price sell discipline states that when a stock hits a certain price, a sale is triggered. Across the board due to target price's objective approach, it is safe to predict that it will produce the most consistent performance.

The second hypothesis for this study is that the superior sell discipline criterion does vary by fund type. This paper's study is designed to test if small cap stocks respond differently as compared to large cap stock with respect to sell discipline. According to Faugere, Shawky, and Smith (2004), the best sell discipline depends on the economic environment (fundamental deterioration for bull markets and valuation level for bear markets). In light of this study, it would be desirable for there to be a distinction between the most effective sell discipline for small cap and large cap stocks.



## Data and Methodology

In order to test both hypotheses stated above, data from PSN is gathered and refined. The goal of the data manipulation is to find portfolios that were classified as “value” or “growth” and utilize large or small market capitalization strategies. PSN has data on 18,443 portfolios, but only 4,051 portfolios meet the requirements to be in the equity style box.

Exhibit 1 shows the breakdown of the four corners of the style box used in this study. These four corners include; large market capitalization portfolios that invest in growth stocks (1390); large market capitalization portfolios that invest in value stocks (1396); small market capitalization portfolios that invest in growth stocks (639); and small market capitalization portfolios that invest in value stocks (626). Along with that, each corner of the style box is further broken down by sell discipline that each portfolio uses. Unfortunately, there was not enough data available for the up from cost and down from cost sell disciplines for their results to be considered significant, so those limited results were excluded from this study.

**Exhibit 1: Frequency Distribution for PSN Equity Portfolio Size, 2016**

	Large Capitalization (>\$7 Billion)	Small Capitalization (>\$500 Million - <\$2 Billion)	Grand Total
<b>Growth</b>	<b>1390</b>	<b>639</b>	<b>2029</b>
Fundamental Deterioration	737	385	1122
None	35	6	41
Opportunity Cost	37	14	51
Target Price	82	58	140
Valuation Level	180	94	274
(Blank)	319	82	401
<b>Value</b>	<b>1396</b>	<b>626</b>	<b>2022</b>
Fundamental Deterioration	334	155	489
None	21	10	31
Opportunity Cost	36	10	46
Target Price	163	97	260
Valuation Level	542	278	820
(Blank)	300	76	376
<b>Grand Total</b>	<b>2786</b>	<b>1265</b>	<b>4051</b>

After all the data was groomed for inconsistencies, the final 4051 remaining portfolios had a benchmark-adjusted return (BAR), information ratio, and Sharpe ratio calculated. The benchmark-adjusted return was effortlessly calculated due to the fact that the finalized PSN data are broken down into benchmark-adjusted return for every month each portfolio was in existence. The only step needed for this calculation was to average the monthly returns for every portfolio. BAR shows the amount of risk each portfolio takes on compared to against a benchmark. Exhibit 2 shows the results for the annualized benchmark-adjusted return of the 4,051 portfolios across the style box.

### Exhibit 2: Average Benchmark-Adjusted Returns (BAR)

	Large Capitalization (>\$7 Billion)	Small Capitalization (>\$500 Million - <\$2 Billion)	Grand Total
<b>Growth</b>	<b>9.76%</b>	<b>9.93%</b>	<b>9.81%</b>
Fundamental Deterioration	10.35%	6.27%	8.94%
None	12.62%	27.32%	15.17%
Opportunity Cost	10.06%	14.26%	11.30%
Target Price	8.78%	9.11%	8.91%
Valuation Level	13.93%	20.29%	15.93%
(Blank)	6.15%	14.82%	7.89%
<b>Value</b>	<b>8.96%</b>	<b>7.61%</b>	<b>8.53%</b>
Fundamental Deterioration	6.03%	10.41%	7.40%
None	10.79%	-9.12%	6.36%
Opportunity Cost	9.04%	6.69%	8.56%
Target Price	15.31%	10.42%	13.44%
Valuation Level	8.49%	4.44%	7.07%
(Blank)	9.53%	12.35%	10.12%
<b>Grand Total</b>	<b>9.36%</b>	<b>8.78%</b>	<b>9.18%</b>

Using the benchmark-adjusted return, the information ratio is also computed. The information ratio is the average monthly BAR divided by the standard deviation of the monthly portfolio BAR's. The information ratio is a measure of the risk-adjusted return of a financial

security, in the same spirit as the Sharpe ratio. Exhibit 3 contains the results for the information ratio for the 4,051 portfolios across the style box.

### Exhibit 3: Average Information Ratio

	Large Capitalization (>\$7 Billion)	Small Capitalization (>\$500 Million - <\$2 Billion)	Grand Total
<b>Growth</b>	<b>0.0581</b>	<b>0.0689</b>	<b>0.0615</b>
Fundamental Deterioration	0.0576	0.0514	0.0554
None	0.1127	0.1327	0.1162
Opportunity Cost	0.0682	0.0709	0.0690
Target Price	0.0469	0.0701	0.0562
Valuation Level	0.0660	0.0886	0.0731
(Blank)	0.0524	0.1239	0.0668
<b>Value</b>	<b>0.0581</b>	<b>0.0642</b>	<b>0.0600</b>
Fundamental Deterioration	0.0450	0.0525	0.0474
None	0.0642	-0.0550	0.0377
Opportunity Cost	0.0706	0.1322	0.0833
Target Price	0.0702	0.1043	0.0833
Valuation Level	0.0538	0.0511	0.0528
(Blank)	0.0719	0.0869	0.0751
<b>Grand Total</b>	<b>0.0581</b>	<b>0.0666</b>	<b>0.0608</b>

The Sharpe ratio is the final performance measure computed. The Sharpe ratio is each investment's average risk premium divided by its standard deviation of return. Essentially this is a measure of the portfolio manager's effectiveness at creating wealth. For this calculation, the monthly rate of a 3-month T-bill is subtracted from the respective monthly return reported in PSN for each portfolio. Each portfolio's monthly risk premiums are averaged in order to obtain the numerator of the Sharpe ratio. Then the standard deviation of the portfolio's monthly return is used as the denominator of the Sharpe ratio. Exhibit 4 lists the results of these computations across the corners of the style box.

### Exhibit 4: Average Sharpe Ratio

	Large Capitalization (>\$7 Billion)	Small Capitalization (>\$500 Million - <\$2 Billion)	Grand Total
<b>Growth</b>	<b>0.1057</b>	<b>0.1269</b>	<b>0.1124</b>
Fundamental Deterioration	0.1007	0.1267	0.1096
None	0.1417	0.1379	0.1412
Opportunity Cost	0.1502	0.1291	0.1448
Target Price	0.0913	0.1222	0.1044
Valuation Level	0.1012	0.1328	0.1120
(Blank)	0.1158	0.1221	0.1170
<b>Value</b>	<b>0.1425</b>	<b>0.1545</b>	<b>0.1463</b>
Fundamental Deterioration	0.1446	0.1602	0.1497
None	0.1069	0.1264	0.1131
Opportunity Cost	0.1250	0.1131	0.1225
Target Price	0.1380	0.1631	0.1473
Valuation Level	0.1370	0.1485	0.1409
(Blank)	0.1609	0.1653	0.1618
<b>Grand Total</b>	<b>0.1241</b>	<b>0.1407</b>	<b>0.1293</b>

## **Empirical Analysis**

Exhibits 2, 3, and 4 show BAR, information ratio, and Sharpe ratio (shown above) are highlighted to show the highest performance for each corner of the equity style box. Upon initial review of the BAR, information ratio, and Sharpe ratio, there is no sell discipline that consistently shows the best overall returns. This is contrary to the initial hypothesis that target price would show the best overall portfolio return. Along with this, the best sell discipline does vary by fund type as the initial hypothesis stated, but it does not consistently show the same variations for the best returns across the three ratios computed.

In order to make sense of the significance of the BAR, information ratio, and Sharpe ratio, regressions are necessary. The regression specification involves using dummy variables for each of the sell disciplines. For these three ratios, specifically the ratio tested was input as the dependent variable and the independent variables were the four sell disciplines (dummy variables) tested minus one. The omitted class is “blank,” meaning the portfolio manager did not report to PSN if s/he used a sell discipline. Listed in Exhibits 5, 6, and 7 are output from the regressions run for the three ratios tested in this study.

### Exhibit 5: Benchmark-Adjusted Returns (BAR) Regression Results

<b>BAR Regression Statistics</b>				
Multiple R	0.0304			
R Square	0.0009			
Adjusted R Square	-0.0003			
Standard Error	0.3884			
Observations	4259			
<i>F-Stat</i>	0.7853			
<i>p-value</i>	0.5601			

  

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0948	0.0133	7.1112	0.0000
Fundamental Deterioration Overview	-0.0144	0.0165	0.8688	0.3850
None	0.0482	0.0523	0.9208	0.3572
Opportunity Cost	-0.0037	0.0389	0.0956	0.9239
Target Price	0.0195	0.0233	0.8357	0.4033
Valuation Level	0.0009	0.0173	0.0544	0.9566

### Exhibit 6: Information Ratio Regression Results

<b>Information Ratio Regression Statistics</b>				
Multiple R	0.0470			
R Square	0.0022			
Adjusted R Square	0.0010			
Standard Error	0.1891			
Observations	4258			
<i>F-Stat</i>	1.8803			
<i>p-value</i>	0.0943			

  

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0729	0.0065	11.2284	0.0000
Fundamental Deterioration Overview	-0.0205	0.0081	-2.5473	0.0109
None	0.0114	0.0255	0.4461	0.6555
Opportunity Cost	-0.0035	0.0189	-0.1856	0.8527
Target Price	0.0005	0.0114	0.0453	0.9639
Valuation Level	-0.0094	0.0084	-1.1141	0.2653

### Exhibit 7: Sharpe Ratio Regression Results

<i>Sharpe Ratio Regression Statistics</i>	
Multiple R	0.0505
R Square	0.0026
Adjusted R Square	0.0015
Standard Error	0.1307
Observations	4902
<i>F-Stat</i>	2.5065
<i>p-value</i>	0.0283

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1417	0.0047	30.3932	0.0000
Fundamental Deterioration Overview	-0.0183	0.0055	-3.3118	0.0009
None	0.0020	0.0149	0.1345	0.8930
Opportunity Cost	-0.0049	0.0122	-0.4014	0.6881
Target Price	-0.0115	0.0075	-1.5371	0.1243
Valuation Level	-0.0116	0.0058	-2.0008	0.0455

The regression results above have their *p*-values highlighted if they have a significance level of 5% or better. When looked at closely only the fundamental deterioration overview (FDO) sell discipline for information ratio, FDO sell discipline for Sharpe ratio, and the valuation level sell discipline for Sharpe ratio show significant results. Essentially this means that only these three results (two being FDO) can reliably be used when judging if there is a better sell discipline to implement. Specifically, for these three significant results, they were among the worst performers in their respective category, so they can be reliably distinguished as the worst sell disciplines to implement.

To further explore these results, 12 more regressions are needed. Each of the four corners of the style box must have its BAR, information ratio, and Sharpe ratio tested through a regression for significance. Listed below are the 12 regressions across the style box.

## Exhibit 8: Large Capitalization Growth Stock Regression Results

### Large Cap Growth BAR

<i>Regression Statistics</i>	
Multiple R	0.0734
R Square	0.0054
Adjusted R Square	0.0008
Standard Error	0.3294
Observations	1095
<i>F-Stat</i>	1.1782
<i>p-value</i>	0.3178

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0615	0.0203	3.0256	0.0025
Fundamental Deterioration Overview	0.0420	0.0245	1.7117	0.0872
None	0.0647	0.0783	0.8266	0.4086
Opportunity Cost	0.0391	0.0626	0.6258	0.5316
Target Price	0.0263	0.0459	0.5729	0.5668
Valuation Level	0.0779	0.0340	2.2901	0.0222

### Large Cap Growth Information Ratio

<i>Regression Statistics</i>	
Multiple R	0.0571
R Square	0.0033
Adjusted R Square	-0.0013
Standard Error	0.1551
Observations	1095
<i>F-Stat</i>	0.7119
<i>p-value</i>	0.6145

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0524	0.0096	5.4803	0.0000
Fundamental Deterioration Overview	0.0052	0.0116	0.4495	0.6531
None	0.0603	0.0368	1.6358	0.1022
Opportunity Cost	0.0158	0.0295	0.5376	0.5909
Target Price	-0.0055	0.0216	-0.2542	0.7994
Valuation Level	0.0136	0.0160	0.8508	0.3951



## Large Cap Growth Sharpe Ratio

<i>Regression Statistics</i>				
Multiple R	0.0724			
R Square	0.0052			
Adjusted R Square	0.0013			
Standard Error	0.1623			
Observations	1254			
<i>F-Stat</i>	1.3157			
<i>p-value</i>	0.2547			

  

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1158	0.0103	11.194	0.0000
Fundamental Deterioration Overview	-0.0151	0.0120	-1.2561	0.2093
None	0.0259	0.0301	0.8614	0.3892
Opportunity Cost	0.0343	0.0293	1.1710	0.2418
Target Price	-0.0245	0.0216	-1.1338	0.2571
Valuation Level	-0.0147	0.0162	-0.9057	0.3653

Above are the three regressions for the large capitalization growth portion of the style box (all significant results are highlighted yellow). For large capitalization growth stock the only regression that showed significant results is the FDO sell discipline for BAR and the valuation level sell discipline for BAR. The levels of significance are 0.0872 and 0.0222 respectively. This is even more significant because the BAR for large cap growth stocks showed that valuation level produced the best return, so it can confidently be said that this result was accurate.

## Exhibit 9: Small Capitalization Growth Stock Regression Results

### Small Cap Growth BAR

<i>Regression Statistics</i>	
Multiple R	0.1682
R Square	0.0283
Adjusted R Square	0.0184
Standard Error	0.3169
Observations	495
<i>F-Stat</i>	2.8491
<i>p-value</i>	0.0151

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1482	0.0390	3.7997	0.0002
Fundamental Deterioration Overview	-0.0855	0.0431	-1.9864	0.0475
None	0.1250	0.1632	0.7658	0.4442
Opportunity Cost	-0.0056	0.0962	-0.0580	0.9538
Target Price	-0.0571	0.0621	-0.9199	0.3581
Valuation Level	0.0547	0.0550	0.9955	0.3200

### Small Cap Growth Information Ratio

<i>Regression Statistics</i>	
Multiple R	0.1157
R Square	0.0134
Adjusted R Square	0.0033
Standard Error	0.2248
Observations	495
<i>F-Stat</i>	1.3271
<i>p-value</i>	0.2512

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1239	0.0277	4.4794	0.0000
Fundamental Deterioration Overview	-0.0726	0.0305	-2.3762	0.0179
None	0.0088	0.1157	0.0757	0.9397
Opportunity Cost	-0.0530	0.0682	-0.7774	0.4373
Target Price	-0.0538	0.0440	-1.2219	0.2223
Valuation Level	-0.0353	0.0390	-0.9060	0.3654

### Small Cap Growth Sharpe Ratio

<i>Regression Statistics</i>	
Multiple R	0.0290
R Square	0.0008
Adjusted R Square	-0.0079
Standard Error	0.1152
Observations	578
<i>F-Stat</i>	0.0963
<i>p-value</i>	0.9927

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1221	0.0154	7.9301	0.0000
Fundamental Deterioration Overview	0.0046	0.0165	0.2753	0.7832
None	0.0158	0.0495	0.3196	0.7494
Opportunity Cost	0.0070	0.0367	0.1903	0.8492
Target Price	0.0000	0.0220	0.0021	0.9983
Valuation Level	0.0107	0.0197	0.5435	0.5870

Above are the three regressions for the small capitalization growth portion of the style box (all significant results are highlighted yellow). The only significant results include the FDO sell discipline for BAR and FDO sell discipline for information ratio. Their levels of significance according to their *p*-values are 0.0475 and 0.0179 respectively. These two values do not match the best sell discipline for this portion of the style box, but they do offer supporting evidence that they are indeed not the top sell discipline for this section of the style box.

## Exhibit 10: Large Capitalization Value Stock Regressions

### Large Cap Value BAR

<i>Regression Statistics</i>	
Multiple R	0.0763
R Square	0.0058
Adjusted R Square	0.0011
Standard Error	0.3397
Observations	1058
<i>F-Stat</i>	1.2312
<i>p-value</i>	0.2922

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0953	0.0226	4.2155	0.0000
Fundamental Deterioration Overview	-0.0350	0.0314	-1.1139	0.2656
None	0.0126	0.0936	0.1347	0.8929
Opportunity Cost	-0.0048	0.0692	-0.0700	0.9442
Target Price	0.0579	0.0385	1.5045	0.1328
Valuation Level	-0.0104	0.0279	-0.3718	0.7101

### Large Cap Value Information Ratio

<i>Regression Statistics</i>	
Multiple R	0.0528
R Square	0.0028
Adjusted R Square	-0.0020
Standard Error	0.1976
Observations	1057
<i>F-Stat</i>	0.5880
<i>p-value</i>	0.7093

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0719	0.0131	5.4735	0.0000
Fundamental Deterioration Overview	-0.0269	0.0183	-1.4725	0.1412
None	-0.0078	0.0544	-0.1424	0.8868
Opportunity Cost	-0.0014	0.0402	-0.0340	0.9729
Target Price	-0.0017	0.0224	-0.0772	0.9384
Valuation Level	-0.0181	0.0162	-1.1171	0.2642

### Large Cap Growth Sharpe Ratio

<i>Regression Statistics</i>	
Multiple R	0.0927
R Square	0.0086
Adjusted R Square	0.0046
Standard Error	0.1101
Observations	1255
<i>F-Stat</i>	2.1631
<i>p-value</i>	0.0559

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1609	0.0073	21.9745	0.0000
Fundamental Deterioration Overview	-0.0163	0.0097	-1.6860	0.0920
None	-0.0540	0.0263	-2.0546	0.0401
Opportunity Cost	-0.0358	0.0202	-1.7707	0.0769
Target Price	-0.0228	0.0116	-1.9737	0.0486
Valuation Level	-0.0239	0.0088	-2.7253	0.0065

Above are the three regressions for the large capitalization value portion of the style box (all significant results are highlighted yellow). The only significant results for these regressions are located in the Sharpe ratio regression. All sell disciplines tested show levels of significance and are as follows: FDO 0.920, none 0.0401, opportunity cost 0.00769, target price 0.0486, and valuation level 0.0065. Put simply, this means that all values reported under the Sharpe ratio section of this regression are significant and show supporting evidence that managers that did not report a using a sell discipline produced the best portfolio returns. On the flip side, it also shows supporting evidence that all other sell disciplines in this portion of the style box according to Sharpe ratio did not produce the best portfolio returns.

## Exhibit 11: Small Capitalization Value Stock Regressions

### Small Cap Value BAR

<i>Regression Statistics</i>	
Multiple R	0.0493
R Square	0.0024
Adjusted R Square	-0.0079
Standard Error	0.7315
Observations	488
<i>F-Stat</i>	0.2344
<i>p-value</i>	0.9473

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1235	0.0937	1.3181	0.1881
Fundamental Deterioration Overview	-0.0194	0.1166	-0.1663	0.8680
None	-0.2147	0.3776	-0.5685	0.5699
Opportunity Cost	-0.0566	0.2919	-0.1938	0.8464
Target Price	-0.0193	0.1265	-0.1522	0.8791
Valuation Level	-0.0791	0.1053	-0.7511	0.4530

### Small Cap Value Information Ratio

<i>Regression Statistics</i>	
Multiple R	0.1352
R Square	0.0183
Adjusted R Square	0.0081
Standard Error	0.1812
Observations	488
<i>F-Stat</i>	1.7960
<i>p-value</i>	0.1121

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.0869	0.0232	3.7444	0.0002
Fundamental Deterioration Overview	-0.0344	0.0289	-1.1903	0.2345
None	-0.1419	0.0935	-1.5174	0.1298
Opportunity Cost	0.0454	0.0723	0.6274	0.5307
Target Price	0.0174	0.0313	0.5567	0.5780
Valuation Level	-0.0358	0.0261	-1.3731	0.1704

### Small Cap Value Sharpe Ratio

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<i>Regression Statistics</i>	
Multiple R	0.0982
R Square	0.0096
Adjusted R Square	0.0010
Standard Error	0.0952
Observations	579
<i>F-Stat</i>	1.1157
<i>p-value</i>	0.3507

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	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.1653	0.0124	13.3318	0.0000
Fundamental Deterioration Overview	-0.0051	0.0147	-0.3453	0.7300
None	-0.0389	0.0341	-1.1421	0.2539
Opportunity Cost	-0.0522	0.0341	-1.5324	0.1260
Target Price	-0.0022	0.0160	-0.1354	0.8923
Valuation Level	-0.0168	0.0137	-1.2284	0.2198

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Above are the three regressions for the small capitalization value portion of the style box. All three regressions for this part of the style box did not show any sign of significance for all sell disciplines tested. For this corner of the style box, the evidence of the three regressions supports that there is no clear sell discipline that produces the best portfolio returns for small capitalization value stocks.

## Conclusion

Overall, this study had ambiguous findings due to the fact that there is not clearly one superior sell discipline that appears as superior across the four corners of the equity style box. The four corners of the style box include: large-cap growth portfolios; large-cap value, small-cap growth, and small-cap value.

One hypothesis of this study predicted that the target price sell discipline would produce the highest and most consistent portfolio return according to BAR, information ratio, and Sharpe ratio. Across the style box, the evidence shows that target price was not the best overall sell discipline to implement. The only time target price is shown to be the top sell discipline criterion was using BAR as a measure for the performance of large-cap growth portfolios. Even in this case, the  $p$ -value for the estimate coefficient for target price is 0.1328, indicating insignificance.

Along with this, the other hypothesis of this study suggest that sell discipline would vary by fund type, but this variation is not consistent across the style box. Specifically when BAR, information ratio, and Sharpe ratio for every fund are calculated the best sell discipline is different for each of the three ratios. In addition to this, only 9 of the possible 216 results are significant across the 12 style boxes according to the regression results.

In conclusion, the PSN data do not suggest that there is a superior sell discipline that every investor should implement to maximize his or her portfolio performance.



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