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ORIGINAL SCIENTIFIC PAPER

Beyond the Returns - the U.S. Mutual Funds Value and Growth Style Weighted Sector Portfolios Investment Performance Attribution

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ABSTRACT
The aim of this study is to provide insight into the portfolios constructed out of sector mutual funds, based on value and growth investment styles. Moreover, this study does not exclusively consider the returns, but it looks beyond them by incorporating the holdings data into portfolio performance attribution. We use two different sector mutual funds across the US sectors, over the observed decade. The findings show that smart money was not able to produce the value on the cumulative basis. We show that growth style was favourable over the observed decade. In addition, by implementing the growth style based on Shiller price-to-earnings in the portfolio construction and assigning sector weights the tested portfolio offset partially and fully the negative effect by managers' stock selection. Overall, the holdings-based relative portfolios attribution in relation to appropriate benchmarks gave additional insight into dynamics of the alpha creation and the loss of alpha. Brinson-Fackler and Brinson-Hood-Beebower attribution models are used including distinct model versions. In addition, the geometric attribution model is used to provide analytical consistency for multi-period attribution.

Key words: *Brinson models, geometric attribution, mutual funds' performance, allocation effect, selection effect*

JEL Classification: G110

INTRODUCTION

In an effort to examine investment performance it is quite common to focus solely on the returns. Based on the return track record different risk metrics can be calculated. They can be based solely on portfolio return (such as Value-at-Risk) or in relation to the benchmark (such as tracking error). Together with the benchmark return data they are used to present risk-adjusted measures (such as information ratio).

There are plenty of regression based multi-factor models that are used to examine investment performance of the institutional investors. Usually used factors can be related to investment style, macroeconomic or microeconomic attributes.

However, commonly overlooked data by researchers are holdings data, for both portfolio and benchmark. To get a deeper level of insight, it is necessary to understand the sources of the

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investment active performance, thus there is a necessity to look beyond the return-based approach and include holdings data into analysis.

The aim of this study is to closely examine the investment performance of portfolios that are composed out of the US sector mutual funds in relation to the broad market index S&P500. Weights for portfolios sectors exposure were assigned according to the investment style.

Furthermore, we broke down the sector allocation and security decisions across 11 sectors, for each of the 10 observed years, using two-set of returns and holdings data, for both value and growth style investment style, with the annual rebalancing frequency. Also, the multi-period issue was addressed in the appropriate way and the cumulative results were presented.

To achieve that we deployed asset-grouping attribution models. Two different arithmetic attribution models were used including different model versions. In addition, geometric attribution model was used to provide analytical consistency for multi-period attribution.

The assumptions are that an investor assigns the weights to sector in the US, based on Shiller price-to-earnings ratio, and to achieve that exposure he/she uses sector mutual funds. This can be observed from the perspective of the fund-of-funds as well, that portfolio is composed out of mutual funds units.

The rest of study provides theoretical background, data source, reasoning for the used methodology, as well as presented results and discussions, followed by conclusions.

LITERATURE REVIEW

Various regression models have been used to explain the source of the return and risk. These models are known in investment performance attribution as factor-based models.

One of the most prominent example of multi-factor model is Fama and French (2015) five-factor model. The five-factor model extends the three-factor model by adding two factors: robust-minus-weak profitability (RMW) and low-minus-high (conservative-minus-aggressive) investment (CMA). Previously commonly used Fama and French (1993) three-factor model in academia for empirical research, uses the market beta, small minus big (SMB), and high-minus-low book-to-market ratio (HML). Another extension to the model is Carhart (1997) four-factor model, that uses momentum as additional factor. Lastly, the most used model due to its simplicity is Capital Asset Pricing Model (CAPM), despite that it failed many empirical tests (Eugene F. Fama and Kenneth R. French, 2004).

There is also a special sub-group within factor models, that are non-linear models. Traditional non-linear models are Treynor-Mazuy (1966) model and Henriksson-Merton (1981) model. Abergel and Thomas (2021) introduced a different approach to the performance analysis of multi-factor investment strategies. Characteristic of this methodology is a cross-sectional projection of asset returns onto the factors to form approximate portfolio returns. Also, it shows nonlinear interaction terms between factors that produce the investment portfolio construction, as well as a natural and intuitive decomposition of the portfolio performance as the sum of factor contributions. Lastly, this study offers practical applications to multi-factor equity strategies.

As an alternative to return-based attribution, there is an asset-based approach. This approach requires, in addition to returns, beginning period holdings data for the portfolio and benchmark. This approach is not only return-based, like the factor-based approach. Asset-based approach can be holdings-based (including different frequency of holdings data) and transaction-based. To avoid unexplained residuals, that are especially prominent in the portfolios that deploy strategies with high turnover and whose underlying exhibits high volatility, transaction-based approach is preferred over holdings-based approach (Spaulding, 2018).

Spaulding (2018) performed empirical comparison between transaction and holdings-based attribution. Former can be less precise especially if the lower frequency is used. Also, if the turnover of the observed portfolio is high then it can lead to unexplained residual. In addition, the author finds that the residuals caused by holdings-based analysis can be extensive and are not always necessarily correlated with turnover, as might be anticipated.

Within asset-based approach the most used models are Brinson models, such as Brinson-Fackler (1985) and Brinson-Hood-Beebower models (1986). However, since the introduction of these models both standard terminology and the interpretation have slightly changed. The terminology that is almost universally accepted now is asset (segment) allocation (term that was used by Brinson and Fachler was market selection), security selection and interaction effect (term that was used by Brinson and Fachler was cross-product).

Vashisht and Gupta (2014) study underlines the concept of performance attribution, the methodology used by two of the most important performance attribution models namely Brinson-Hood-Beebower model and Brinson-Fachler model. The study also discusses different approaches used for performance attribution, like arithmetic or geometric and the periodicity effects in carrying out attribution for multi-periods.

Peng (2020) used holding-based approach to analyze actively managed mutual funds in China. His research suggests that there is a positive correlation between holding-based model and regression model, Fama-French three-factor model that he used for the comparison. During the observed period he found that most of the Chinese mutual funds were able to deliver positive stock selection effect. However, most of the funds fail to deliver positive asset allocation effect due to inability to predict policy changes.

Interestingly when it comes to the interaction effect, contrary to the original authors that perceived interaction effect (cross-product) as residual value, Spaulding (2003/2004), Campisi (2004) and Bacon (2008) perceive it as a direct result of the combined allocation and selection effects. Latter two authors proposed that interaction effect should be included within selection effect, since it is not an inherent part of the investment decision process.

Arithmetic attribution has a disadvantage over geometric attribution when it comes to multi-period attribution. Arithmetic return for the multi-period fails to include the compound effect over time. To overcome this issue different algorithms have been used for smoothing and linking returns. Initially, they were introduced by GRAP (1997) and Carino (1999) and additional solutions have been offered by Menchero (2000), Frongello (2002) and Bonafede and others (2002). Reztsov (2011) offers detailed comparison between arithmetic and geometric approach. Also, this study offers linking algorithm that is order independent.

On another side, geometric excess return for the full observed period can be calculated from the compounded total allocation and selection effects, without residual. For multi-period attribution geometric approach is preferable (Bacon, Carl R., 2002).

When it comes to investment style, Pettengill et. al. (2014) performed mutual funds investment style performance analysis that included period of 1979 to 2012. Their findings go in favor of value over growth mutual funds. They showed that value funds outperform growth funds especially in terms of lower realized risk and higher realized terminal wealth.

When it comes to allocation, selection and interaction effect for the individual segments, their total geometric values for the whole period do not compound to the total excess return. This is the reason why Weber and Arno (2018) address them as semi-geometric models.

Also, Menchero (2000/2001) presented a model that could be perceived as fully geometric, since individual allocation and selection effects compound through time. When it comes to multi-currency attribution, traditional Brinson model was adjusted initially by Ankrim and Hensel (1992) followed by Karonsky and Singer (1994).

DATA AND METHODOLOGY

Data

Data that were used for the calculations includes the following inputs portfolio sector weights (w_i), portfolio sector returns (R_i), benchmark sector weights (W_i) and benchmark sector returns (B_i), for the period 2011 to 2020. Holdings-based approach with the annual frequency was deployed. Portfolios sector weightings were based on value and growth investment styles.

To distinguish between investment styles, we used historical sector price-to-earnings ratio adjusted according to Professor Shiller. That means that earnings were calculated as a 10-year average at any given point.

Data was obtained from S&P Global, and Fidelity and Morning Star mutual funds data bases. Total sector returns were used.

Manager sector peers' groups returns were used and obtained from the Morning Star mutual funds data base. They cover all 11 sectors that are classified by Global Industry Classification Standard (GICS): Information Technology, Health Care, Financials, Consumer Discretionary, Communication Services, Industrials, Consumer Staples, Energy, Utilities, Real Estate, and Materials.

Also as a represented group, mutual funds that were used to construct the Fidelity portfolios are the following ones: Fidelity Select Communication Services Portfolio (FBMPX), Fidelity Select Consumer Discretionary Portfolio (FSCPX), Fidelity Select Consumer Staples Portfolio (FDFAX), Fidelity Select Energy Portfolio (FSENX), Fidelity Select Financial Services Portfolio (FIDSX), Fidelity Select Health Care Portfolio (FSPHX), Fidelity Select Industrials Portfolio (FCYIX), Fidelity Select Technology Portfolio (FSPTX), Fidelity Select Materials Portfolio (FSDPX), Fidelity Real Estate Investment Portfolio (FRESX), and Fidelity Select Utilities Portfolio (FSUTX).

During the observed period S&P 500 index composite sectors have changed. Real Estate was spun off from the financial sector post September 16, 2016. Due to that we decided to include allocation towards Real Estate sector post-2016, to make it more comparable to the S&P 500 benchmark. Telecommunication Services sector was renamed to Communication Services, with issues added from other sectors post September 20, 2018. We use the latter name throughout the whole observed period.

Methodology

Four different portfolios made up of the sector mutual funds were used. First portfolio is Value Weighted Peers Sector Mutual Funds Portfolio. Where, as the name suggests sector weights allocation was based towards sectors with the relatively low Shiller price-to-earnings ratios. Here we have used managers' average returns for the given sectors from the whole database of Morning Star mutual funds. The same approach was used to construct the Value Weighted Fidelity Mutual Funds portfolio, using only the returns for Fidelity sector mutual funds.

Portfolio sector weights were assigned proportional to sectors with relatively higher Shiller price-to-earnings ratio and was used to implement the growth strategy for two different series. Thus, we constructed the following portfolios Growth Weighted Morning Star Peers Sector Mutual Funds portfolio and Growth Weighted Fidelity Sector portfolio.

For performance attribution asset-grouping models used in research are two Brinson models, as well as the geometric approach.

Brinson-Hood-Beebower Model

The first one is Brinson-Hood-Beebower model, where total allocation effect is calculated in the following way.

Benchmark return (B) is the weighted sum of the individual segment returns.

$$B = \sum W_i B_i \tag{1}$$

Semi-benchmark return (B_s) is a hybrid measure, that uses portfolio weights and benchmark segment returns.

$$B_s = \sum w_i B_i \tag{2}$$

Allocation effect for the individual segment (A_i):

$$A_i = (w_i - W_i) B_i \tag{3}$$

Total allocation effect can be expressed as:

$$B_s - B = \sum w_i B_i - \sum W_i B_i = \sum (w_i - W_i) B_i = \sum A_i \tag{4}$$

It represents the value that is added/lost by having different segment weights in portfolio than the segment weights in the benchmark. As long the portfolio has overweighted the sector in which benchmark has delivered positive results the allocation effect will be positive.

Next, for securities selection within the sector we need to take in consideration the selection effect, that is calculated in the following way.

In addition to previously used benchmark return (B), another hybrid metrics needs to be used, and that is semi-portfolio return (R_s). It uses the benchmark sector weights and portfolio sector returns.

$$R_s = \sum W_i R_i \tag{5}$$

Selection effect for the individual sector (S_i)

$$S_i = W_i (R_i - B_i) \tag{6}$$

When it comes to total selection effect, it is expressed as following:

$$R_s - B = \sum W_i R_i - \sum W_i B_i = \sum W_i (R_i - B_i) = \sum S_i \tag{7}$$

It represents the value that is added/lost by having different securities weights in the portfolio segment than the securities weights in the benchmark segment.

This version of the model has a residual, when compared to the total excess return. The residual can be explained by interaction effect, and when included it fully explains the excess return. The excess return can be obtained in the following way.

$$B_s - B + R_s - B + R - R_s - B_s + B = R - B \tag{8}$$

Brinson-Fachler Model

Where the agency supported the research, authors should have a funding acknowledgement in the form of a sentence as follows: We used two different versions of Brinson-Fachler model.

Allocation in both versions is the same. However, it is different than in Brinson-Hood-Beebower model because it takes in account not only individual sector benchmark return but also total benchmark return.

$$B_s - B = \sum(w_i - W_i)(B_i - B) = \sum A_i \quad (9)$$

On another hand, selection effect can be shown in two different versions (with and without interaction effect).

Version with the self-standing interaction effect.

Pure selection is expressed as:

$$R_s - B = \sum W_i (R_i - B_i) \quad (10)$$

Interaction effect is the following:

$$R - R_s - B_s + B = \sum(w_i - W_i)(R_i - B_i) \quad (11)$$

Version with the combined selection and interaction effects.

In this version of the model, the selection is expressed as following:

$$R - B_s = \sum w_i (R_i - B_i) = \sum S_i \quad (12)$$

To summarize, BHB and BF models' attribution results difference is due to individual segment allocation effect. However, the total allocation effect results are the same. Selection effect is the same based on these two models and is presented in that manner.

Geometric Model

In addition, we used geometric attribution approach, where:

Individual sector geometric allocation effect is the following:

$$A_i^G = (w_i - W_i)\left(\frac{(1 + B_i)}{(1 + B)} - 1\right) \quad (13)$$

Total geometric allocation effect is:

$$A^G = \frac{(1 + B_S)}{(1 + B)} - 1 = \sum A_i^G \quad (14)$$

Individual sector geometric selection effect is:

$$S_i^G = w_i \left(\frac{(1 + R_i)}{(1 + B_i)} - 1\right)\frac{(1 + B_i)}{(1 + B_S)} \quad (15)$$

Total geometric selection effect is:

$$S^G = \frac{(1 + R)}{(1 + B_S)} - 1 = \sum S_i^G \quad (16)$$

Lastly, geometric excess return is expressed as:

$$R^G_{exc} = \frac{(1 + R)}{(1 + B)} - 1 \tag{17}$$

Important property, for the multi-period attribution of the geometric approach is the following:

$$R^G_{exc} = (1 + S^G)(1 + A^G) - 1 = \frac{(1 + R)}{(1 + B)} - 1 \tag{18}$$

RESULTS AND DISCUSSION

In this section we present our findings of performance attribution for the analyzed portfolios.

First, we answered the question did the mutual fund investment managers add or lose value for investors by making security selection decisions in comparison to S&P500 sector returns. In other words, we discuss the stock selection effect within sectors, for both Morning Star mutual funds sector peers and Fidelity mutual sector funds.

Actually, this gives us the answer to the question “how smart is the smart money” for the observed period. Then we dive into each of the four portfolios and try to understand the source of alpha (or negative alpha). More precisely, portfolio performance attribution, is based on Brinson-Fachler and Brinson-Hood-Beebower model, as well as the geometric model that addresses the multiperiod performance.

How smart is the smart money?

In order to get the insight into managers’ stock picking skills, it is necessary to consider the selection effect. We would like to point out that the selection effects are the same no matter which version of the Brinson’s models we use for performance attribution. Used version of the Brinson model will play a role only later when we discuss the allocation effect, but for the stock selection it is irrelevant. This is the reason why we present selection effect only based on two different data series, and not at the portfolio level.

When we analyze the Morning Star database sector mutual funds (Figure 1) for most of the observed years majority of sector mutual funds have underperformed in relation to the average stock performance for the given sector. That shows that managers, on average, were not able to beat their appropriate sector benchmarks.

Cumulative combined selection effect for the whole 10-year period is negative and it was -18.22%. However, relative performance in relation to the sector benchmark is quite heterogenous across the sectors.

Results suggest that there is a certain level of consistency in alpha that managers were able to produce for the certain sectors. One of the rare examples of positive alpha consistency is health care sector. However, majority of the sector mutual funds from the Morning Star database exhibit negative alpha with a relative high level of consistency year-over-year.

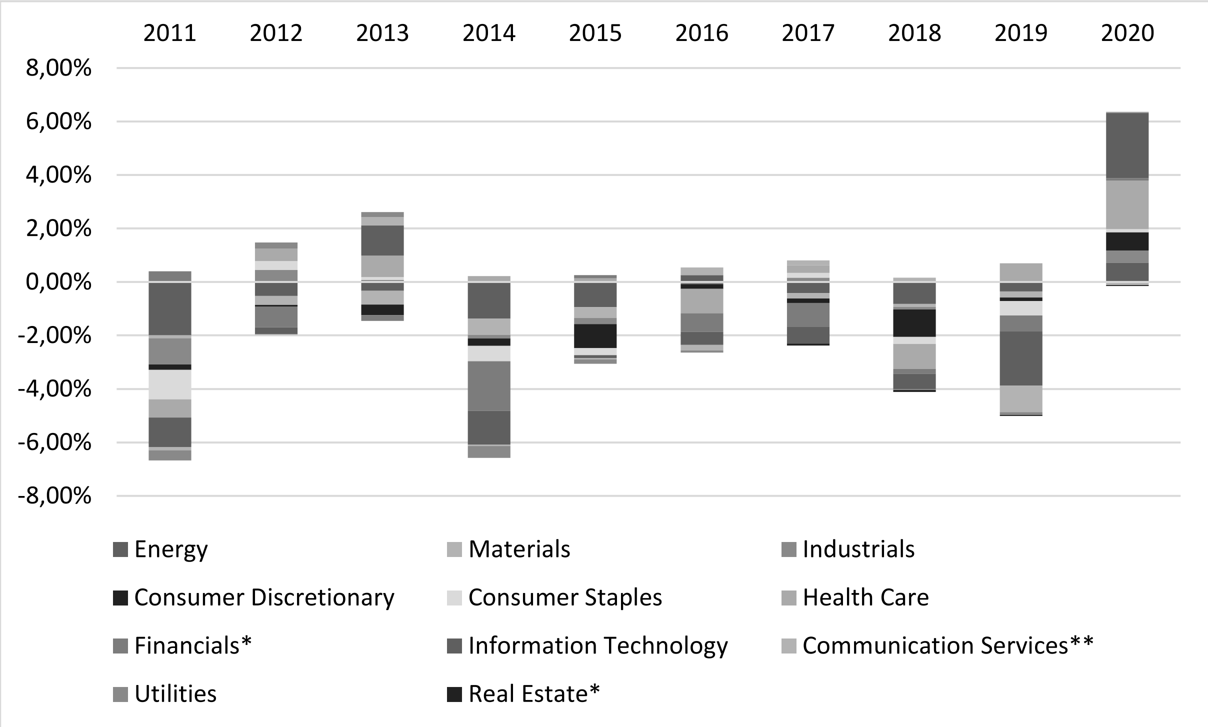

Figure 1. Morning Star Peers Sector Mutual Funds Portfolio Combined Selection Effect

Source: Authors

When we analyze the stock selection effect of the Fidelity sector mutual funds, our finding show that Fidelity managers did overall better in relation to the Morning Star sector peers (Figure 2). The majority of differences in returns in relation to Morning Star Peers can be assigned to the period of 2014 until 2019. Where, Fidelity managers for certain sectors managed to add value to stock selection whereas their peers almost universally underperformed in relation to the benchmark for the mentioned period.

Also, our findings suggest that managers for the given funds were able to beat their peers on consistent base. This is especially prominent for Information Technology, Communication Services and Health Care. However overall, on cumulative bases total selection effect is still negative and it was -4.40%.

However, what is common for both series is that the year 2020 is an outlier for both. That suggests that the managers' stock selection decisions were superb in relation to S&P500 sector benchmarks almost for all sectors. This might suggest that there are certain biases in managers' stock selection in general such as the company size or investment style that are widely spread throughout their investment philosophy and strategy. Furthermore, this can be an explanation through the relative high level of correlation of stock selection effect between Fidelity and Morning Star Peers.

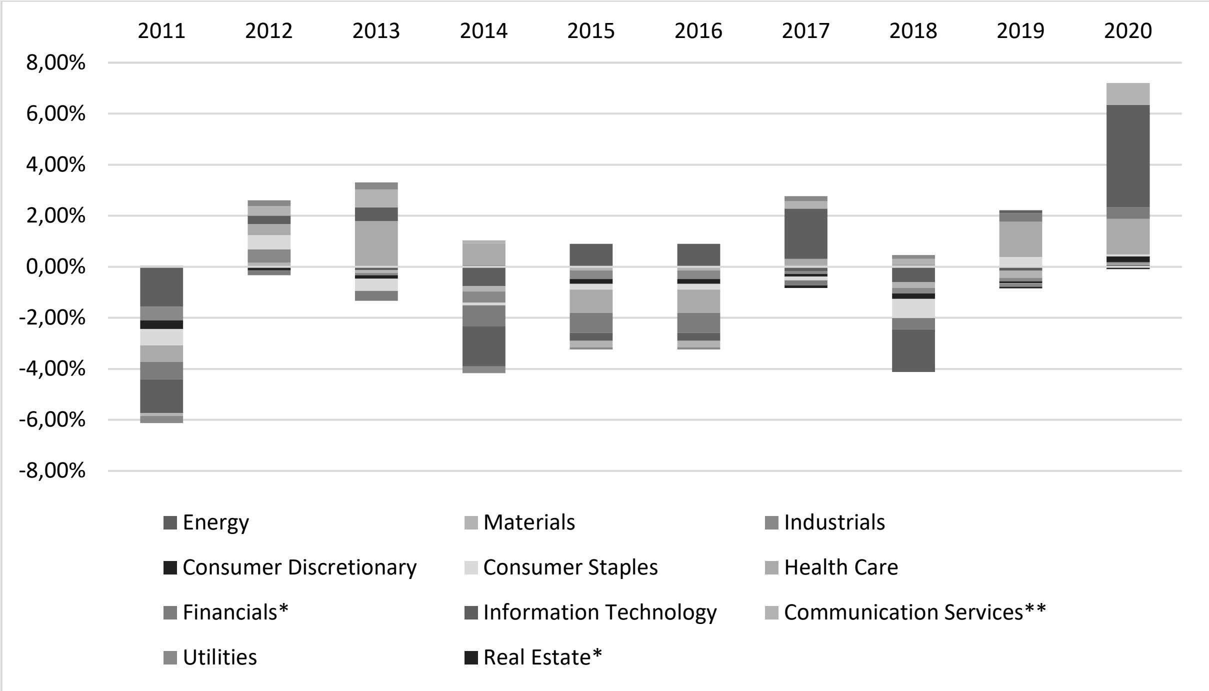

Figure 2. Fidelity Sector Mutual Funds Portfolio Combined Selection Effect

Source: Authors

Value Weighted Morning Star Peers Sector Mutual Funds Portfolio

It is important to stress out that when it comes to sector allocation effect Brinson-Fachler and Brinson-Hood-Beebower models they produced the same total allocation effect for any given period, in our case a year. On another hand, allocation effect is differently allocated across the sectors. Figure 3 is an example of comparison of allocation effect of Brinson-Fachler and Brinson-Hood-Beebower models.

For example, according to the Brinson-Fachler model the highest negative allocation effect for the year 2020 is the Energy sector -1.79% and according to the Brinson-Hood-Beebower model it is for the Information Technology sector -1.28%. However, total allocation effect for year 2020 is the same based on both Brinson's models and it is -3.33%

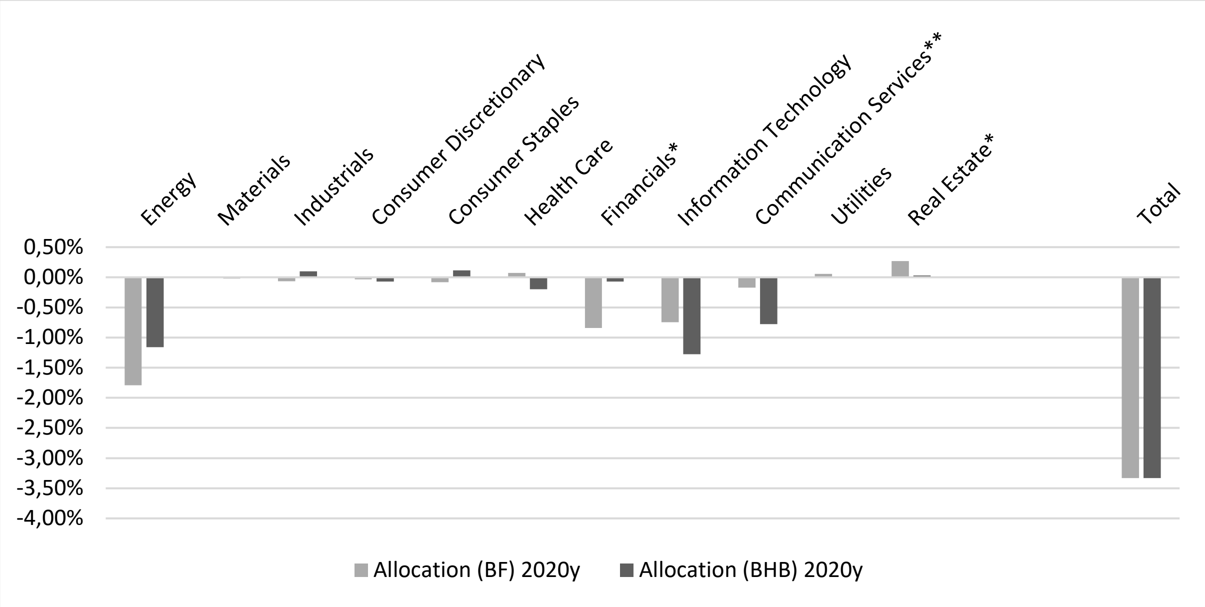

Figure 3. Value Weighted Morning Star Peers Sector Mutual Funds Portfolio – Allocation Effect BF vs. BHB model comparison

Source: Authors

Figure 4 shows arithmetic attribution results for each of the analyzed years. It can be observed that Value Weighted Morning Star Peers Sector Mutual Funds underperformed in relation to the S&P500 sector benchmarks for eight of ten years that can be noticed based on excess return. Moreover, sector allocation based on value investment style and higher assigned weights towards the sector with the lower price-to-averaged-earnings. Sector allocation effect is positive for two periods and security selection effect is positive for only one period. Clearly, value investment style was not in favour for the observed decade. Moreover, negative alpha produced by sector mutual funds managers made even worse results. As a result, only two years of positive total excess return for Value Weighted Morning Star Peers Sector Mutual Funds Portfolio.

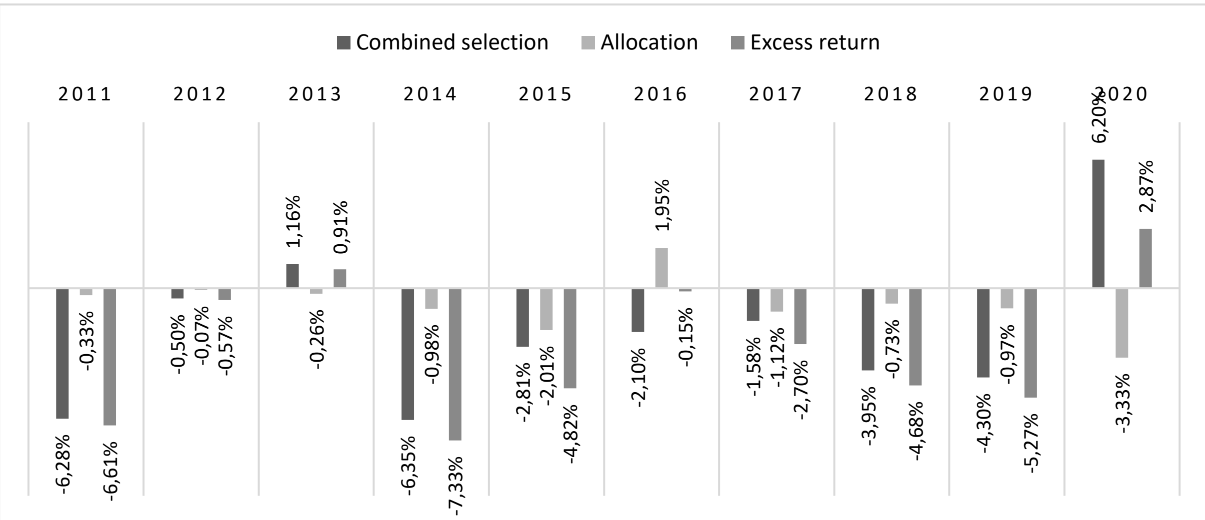

Figure 4. Value Weighted MS Peers Sector Mutual Funds Total Portfolio Allocation and Selection Annual Effects – Arithmetic Approach

Source: Authors

Multiperiod Attribution and Geometric Approach

For the cumulative 10-year period arithmetic attribution approach is not appropriate. It can be only used by implementing different types of algorithms. Geometric approach does not leave residual, and it is not order dependent. Therefore, it is a preferable approach.

Also, excess returns for single periods cannot be linked geometrically together to get the excess return for multiperiod. Figure 5 shows annual geometric excess return. However, as stated linked annual geometric excess returns to get the geometric return for the 10-year period would be a mistake.

Table 1 summarizes the geometric attribution results for the 10-year period. Geometrical excess return is negative, and it is -23.77%. It was obtained as geometrical excess return between portfolio geometrical multiperiod return and benchmark geometrical multiperiod return.

Another way how the excess geometric return for the multiperiod can be obtained is to calculate total multiperiod effect. Because geometric attribution does not leave residual, they must be equal.

Sector allocation geometric effect for the 10-year period is negative, as a result of underweighting the sectors that had high Shiller price-to-earning ratio and overweighting the ones that had lower than average S&P500 Shiller price-to-earning ratio.

Stock selection for the Value Weighted Morning Star Peers Sector Mutual Funds Portfolio is even more negative and the value for investors is lost for the observed period. Allocation and selection effects are geometrically linked, and the result is in the line with the previously calculated 10-year excess return.

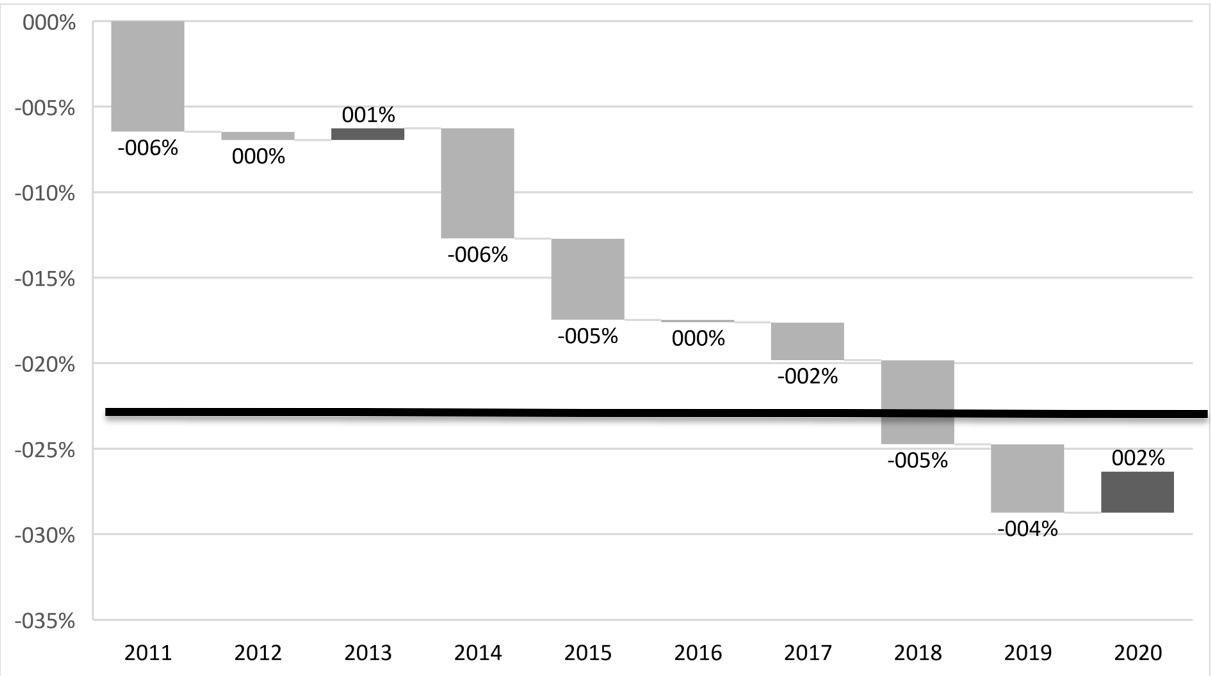

Figure 5. Value Weighted MS Peers Sector Mutual Funds Total Portfolio – Annual and Total Cumulative Geometric Excess Returns

Source: Authors

Table 1. Value Weighted MS Peers Sector Mutual Funds Total Portfolio - Multiperiod Geometric Attribution

Portfolio compound return	Benchmark compound return	10y Excess return	Allocation effect compound	Combined selection effect compound	10y Total effect
180.43%	267.89%	-23.77%	-6.79%	-18.22%	-23.77%

Source: Authors

Value Weighted Fidelity Sector Mutual Funds Portfolio

Here we have another portfolio which was constructed based on value investment style. However, this time Fidelity Sector mutual funds were used to assign portfolio weights. Stock selection effect was positive half of the observed time period. In all of the observed years when selection effect was positive it was significant enough to offset negative allocation effect and produce total positive excess return for the given year. Such as in the 2020, 2019, 2017, 2013 and 2012 years (Figure 6).

On another side, unfavourable value investment style resulted in only one year of positive sector allocation effect out of the whole decade. It was the main factor why overall excess returns are negative and they only added to the negative stock selection effect. Overall, negative excess returns are present in half of the observed years, and they were more significant than the positive ones.

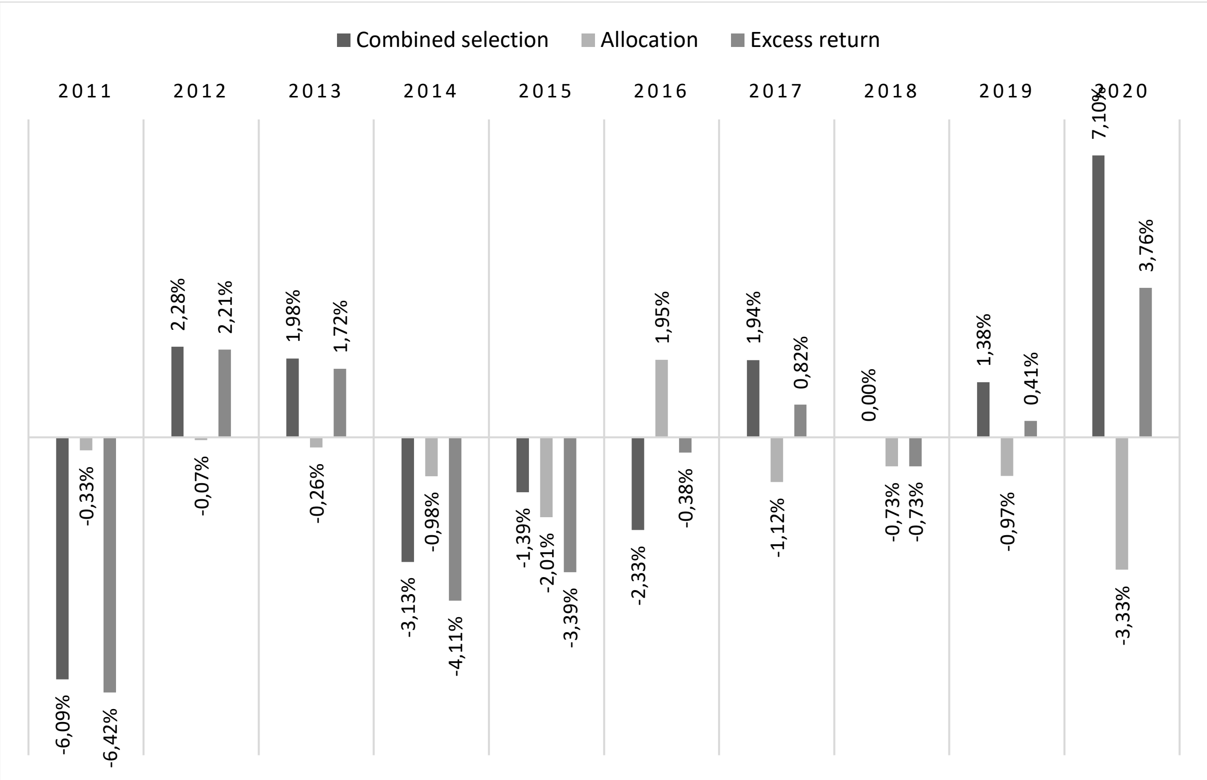

Figure 6. Value Weighted Fidelity Sector Mutual Funds Total Portfolio Allocation and Selection Annual Effects – Arithmetic Approach

Source: Authors

Multiperiod Attribution and Geometric Approach

When we observe a decade as a whole, we use once again, the geometric approach. (Figure 7). Because of the previously explained known properties of the excess return for the multi period, negative total geometric sector allocation effect and negative combined geometric security selection effect were used to calculate the total effect for the whole period. Total effect is also negative, as expected and it is -10.72% (Table 2).

These results are in line with the geometric difference between the Value Weighted Fidelity Sector Mutual Funds Portfolio return and S&P500 benchmark return.

For the observed decade, portfolio produced 228.46% and the benchmark produced 267.89% which resulted in excess return of -10.72% which is by definition the same as the total effect for the whole multiperiod.

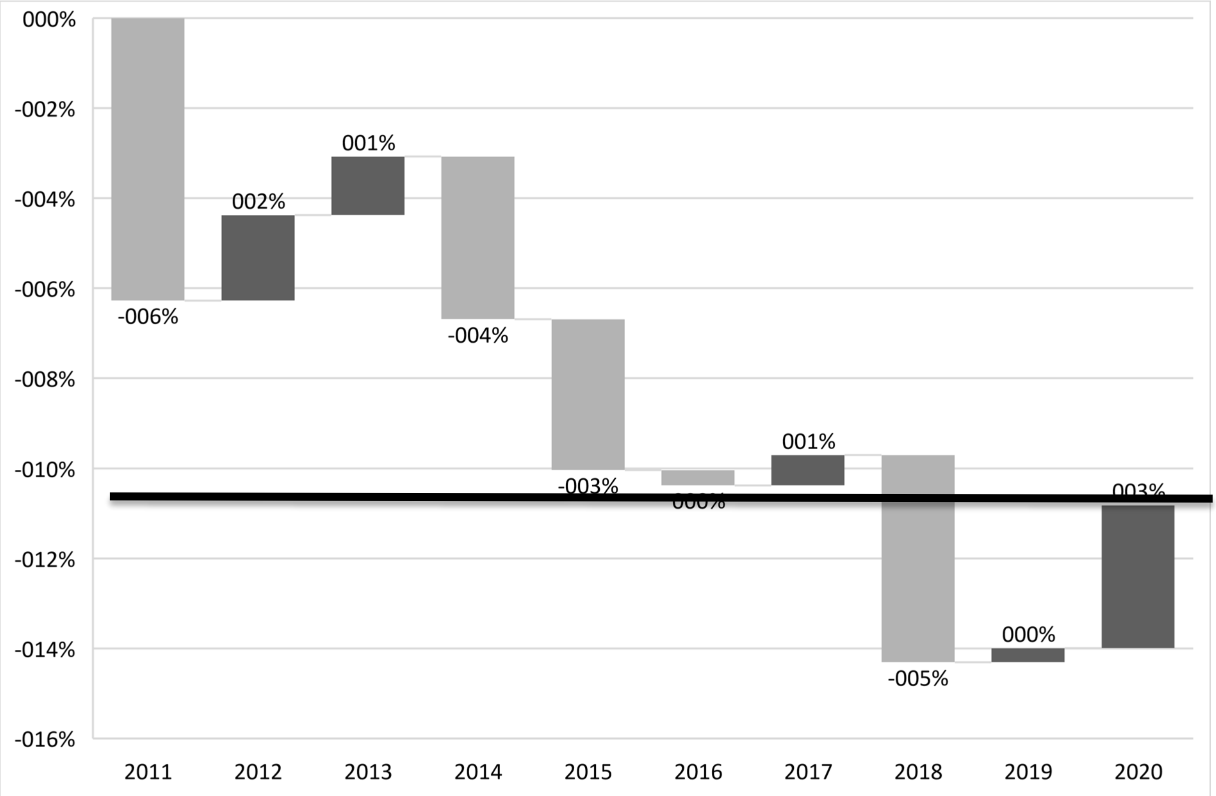

Figure 7. Value Weighted Fidelity Sector Mutual Funds Total Portfolio – Annual and Total Cumulative Geometric Excess Returns

Source: Authors

Table 2. Value Weighted Fidelity Sector Mutual Funds Total Portfolio - Multiperiod Geometric Attribution

Portfolio compound return	Benchmark compound return	10y Excess return	Allocation effect compound	Combined selection effect compound	10y Total effect
228.46%	267.89%	-10.72%	-6.79%	-4.22%	-10.72%

Source: Authors

Growth Weighted Morning Star Peers Sector Mutual Funds Portfolio

Moving to the growth style portfolios, we are starting with the portfolio that is constructed by sector peers. Sector allocation effect, this time, is drastically different than the one that we obtained using the value style investment strategy. By assigning higher portfolio weights to the sectors with lower Shiller price-to-earnings ratio we ended with the nine out ten years positive sector allocation effects. This as a result did not have a major impact on annual total excess returns that one might expect. This is because the stock selection effect for Morning Star Peers is strong enough to offset the positive allocation effect as a result of the growth style. Overall, only three out of ten observed years ended with the positive excess return (Figure 8).

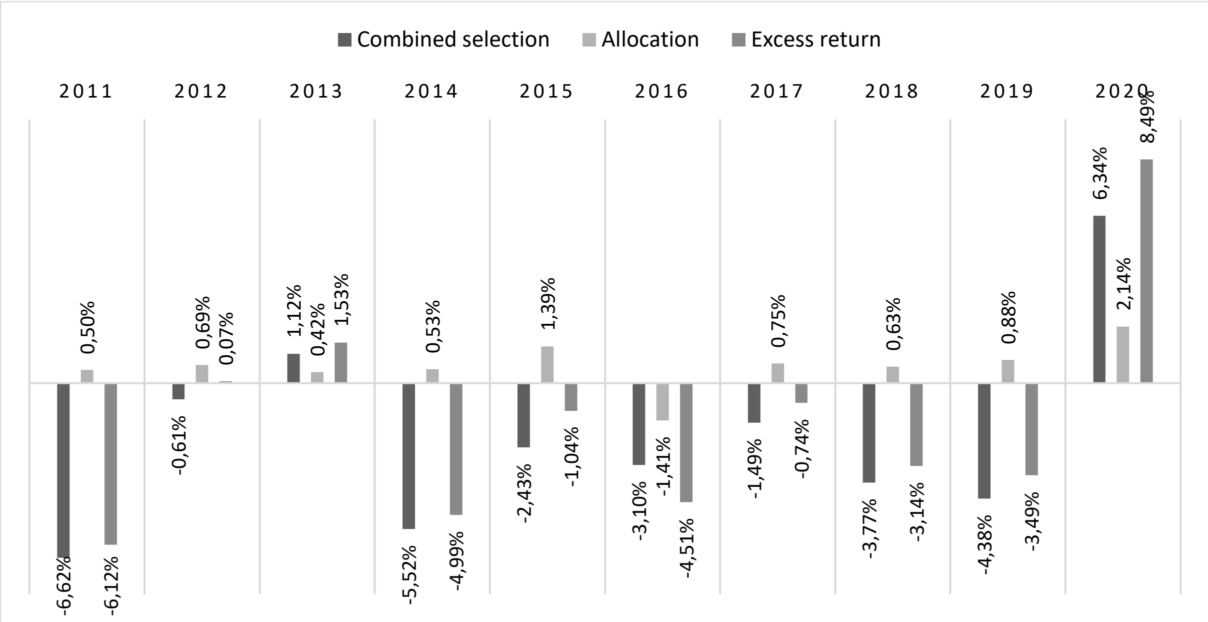

Figure 8. Growth Weighted MS Peers Sector Mutual Funds Total Portfolio Allocation and Selection Annual Effects – Geometric Approach

Source: Authors

Multiperiod Attribution and Geometric Approach

By observing the whole decade for Growth Weighted Morning Star Peers Sector Mutual Funds Portfolio, it can be seen that portfolio return of 218.89% was still below the benchmark return and it produced negative excess return of -13.32% (Figure 9) (Table 3).

This is despite the positive sector allocation effect of 5.87% because managers from the Morning Star database made many suboptimal stock selection decisions in comparison to the benchmark and they fully offset all the positive effect of the growth investment style that was implemented in the portfolio construction.

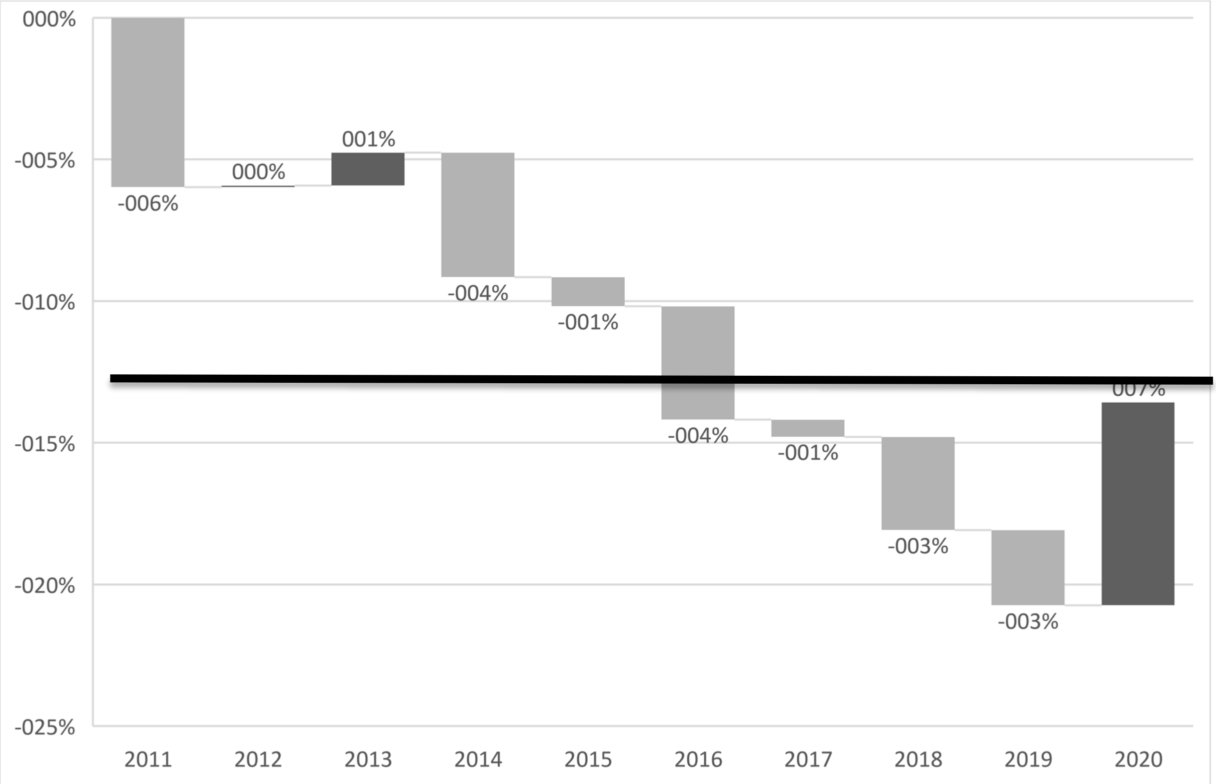

Figure 9. Growth Weighted MS Peers Sector Mutual Funds Total Portfolio – Annual and Total Cumulative Geometric Excess Returns

Source: Authors

Table 3. Growth Weighted MS Peers Sector Mutual Funds Total Portfolio - Multiperiod Geometric Attribution

Portfolio compound return	Benchmark compound return	10y Excess return	Allocation effect compound	Combined selection effect compound	10y Total effect
218.89%	267.89%	-13.32%	5.87%	-18.12%	-13.32%

Source: Authors

Growth Weighted Fidelity Sector Portfolio

Moving to the growth investment style portfolio that was constructed using only Fidelity sector mutual funds our findings are very different than for the other portfolios. Positive sector allocation effect for nine years this time together with the lower negative sector selection effect resulted in six out of ten periods of positive excess return (Figure 9).

For individual years positive allocation effect, in certain years it partially offset negative security selection effect and in other years they were working in synergy with one another. The most prominent example of synergy is the year 2020.

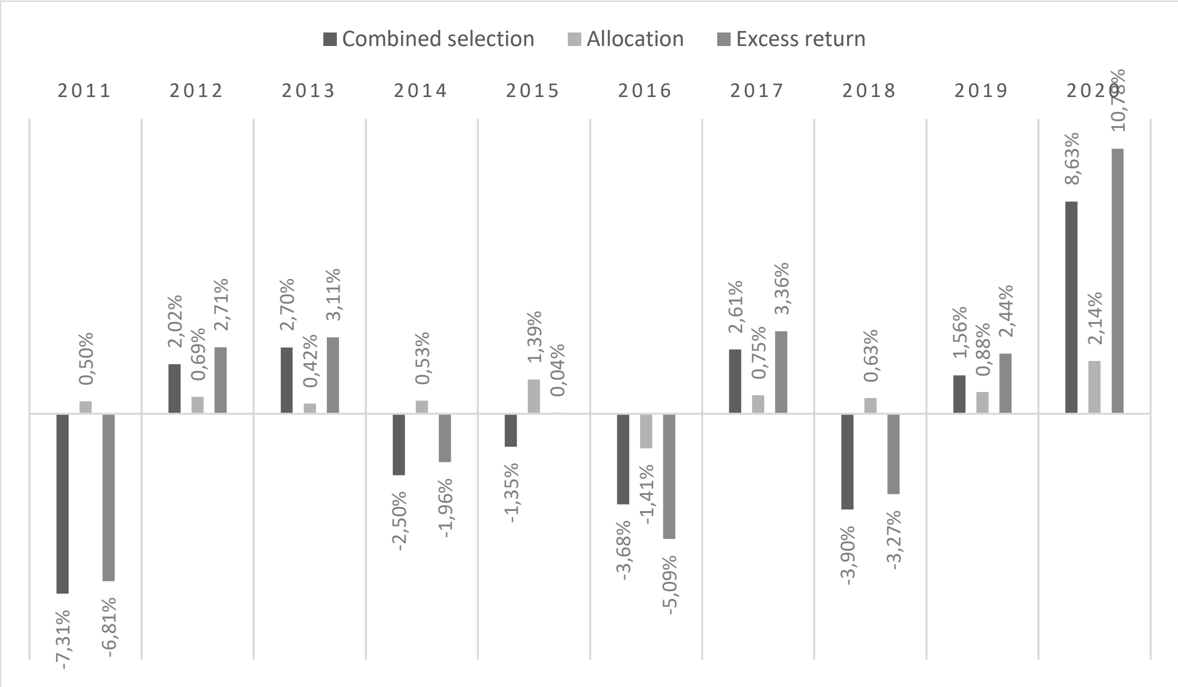

Figure 10. Growth Weighted Fidelity Sector Mutual Funds Total Portfolio Allocation and Selection Annual Effects – Geometric Approach

Source: Authors

Multiperiod Attribution and Geometric Approach

As with other portfolios we performed multiperiod attribution. However, this time our results are different in a sense that total excess return was slightly positive. This means that portfolio outperformed the benchmark on the cumulative basis for the observed ten-year period. Despite the negative selection effect as a result of Fidelity managers' suboptimal stock selection decisions on average Growth Weighted Fidelity Sector Portfolio was able to beat the benchmark by implementing growth investment style (Figure 11).

Moreover, for the whole period sector allocation effect was 5.87% and selection effect together with interaction effect negative -4.40%. That led to the slightly positive total effect of 1.21% which can be also obtained by portfolio compound return of 272.33% in relation to the benchmark (Table 4).

Important note is that combined selection effect includes the interaction effect. That is the reason why the combined selection is not the same between value and growth portfolio using the same data series.

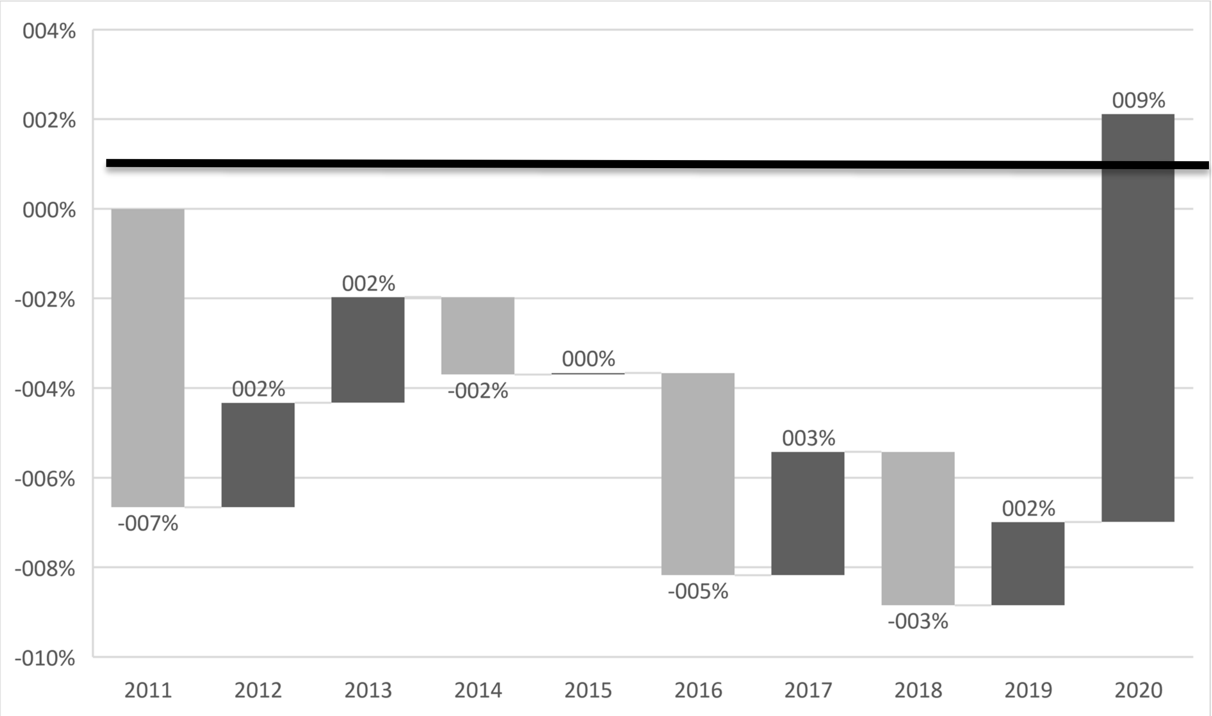

Figure 11. Growth Weighted Fidelity Sector Mutual Funds Total Portfolio – Annual and Total Cumulative Geometric Excess Returns

Source: Authors

Table 4. Growth Weighted Fidelity Sector Mutual Funds Total Portfolio - Multiperiod Geometric Attribution

Portfolio compound return	Benchmark compound return	10y Excess return	Allocation effect compound	Combined selection effect compound	10y Total effect
272.33%	267.89%	1.21%	5.87%	-4.40%	1.21%

Source: Authors

CONCLUSION

By incorporating holdings data into performance attribution, we were able to get a closer insight in the portfolios investment performance that are composed out of the US sector mutual funds in relation to the benchmarks. Especially valuable was to analyze sector mutual funds performance using different models and approaches, as well as to construct investable portfolios and implement the performance attribution of the same ones. This gave us opportunity to draw certain conclusions.

Growth style overperformed value style based on the sector allocation effect. Portfolio sector weighting was based on Shiller price-to-earnings ratio. Reason why growth style was favourable over value style is because sectors where investors were ready to pay the highest earning multiplier were the ones that had the highest price appreciation, over the observed decade. Expectations for the high growth rate of earnings in the future created a price momentum. This is especially prominent in the Information Technology sector.

Smart money underperformed when it comes to stock selection within sector mutual funds. This was true for average sector mutual fund from the Morgan Star database, as well as selected Fidelity sector funds.

In addition, both sector selection and sector allocation effects are quite heterogenous across the sectors. That means that managers in different sectors were not equally successful to beat their appropriate benchmarks.

There is a strong correlation of stock selection effect between Morning Star and Fidelity sector mutual funds year-over-year. Reason for this might be related to certain fundamental biases in investment philosophy and strategy of sector mutual funds managers.

Finally, total excess return for multiperiod was only slightly positive for one out of four analyzed portfolios. After finding out that the stock selection effect is negative, it was clear that the positive total excess return must be driven by significant enough sector selection effect that would be able to offset the average suboptimal stock selection decisions of managers. Value style underperformed the benchmark so there was no chance for value portfolios to beat the benchmark. Growth portfolios had the mixed success in regard to delivering alpha. Growth Weighted Morning Star Peers Sector Mutual Funds Portfolio did not produce a positive alpha. Even in relation to the Value Weighted Fidelity Sector Mutual Funds Portfolio, it slightly underperformed. The reason for this is the difference in stock selection skills between average sector mutual funds manager and selected Fidelity sector mutual funds managers. The Growth Weighted Fidelity Sector Portfolio had small enough negative stock selection effect, that it was possible to be fully offset by value that was produced with the growth style sector weighting on annual basis.

This study was limited on equity only sector mutual funds that had only exposure to domestic market. Because the mutual funds have exposure to USD we did not have to incorporate the FX market attribution. Also having mutual funds that are equity only made performance attribution comparable. In addition, the attribution for self-standing years is more intuitive for users using arithmetic models. However, when it comes to multiperiod, the whole ten-year period was more adequate to be analyzed by geometric attribution. Hence, we presented the multi-period excess return in relation to total effect, without residual.

In addition, we used holdings-based approach that works fine with our assumptions of buy-and-hold mutual funds units for 1-year period. However, with the portfolios that have high turnover, transaction-based approach would be more appropriate. Also, we used total returns to calculate portfolio return. From the perspective of an investor, he/she would inquire mutual funds fees, as well as tax burden.

In summary, the study shows that the sector mutual funds did not add value on average, based on negative stock selection effect. However, the negative selection effect could have been offset, in some cases partially in others fully, by assigning sector portfolio weights based on growth investment style.

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