A Framework for Understanding Defensive Equity Investing

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At a basketball game, you always hear the home crowd chanting 'DEFENSE! DEFENSE!' when the other team has the ball, although you never hear them yelling 'OFFENSE! OFFENSE!' when their team has the ball. Defense is obviously important to people in sports, and it should be no different in investing.

Today, investors, plan sponsors and consultants are faced with an abundance of different types of new equity strategies to consider when making equity allocation decisions: "Indexing," "Smart Beta," "Alternative Beta," "Active Equity," "Defensive Equity" and "Low Volatility" are some common examples. The last two strategies became popular after the 2008 Global Financial Crisis due to the downside protection they exhibited during the equity meltdown. In this note, we suggest a framework for understanding these strategies and thinking about how they fit with investors' current allocations. We also introduce PanAgora's Defensive Equity factor strategies and present them in this framework.

We define the term "factor investing" to mean investing in portfolios with intentional persistent factor exposures. For all factor strategies, investors, at a minimum, form expectations of a strategy's return and volatility characteristics. Based on these two fundamental characteristics, factor investing is broadly separated into two groups: return enhancing factor investing and volatility reducing factor investing. Return enhancing factors like Quality, Value and Momentum are generally thought of as factors that can enhance a portfolio's return independently of how the benchmark or the broad market is performing. Volatility reducing factors are expected to reduce a portfolio's drawdowns when the broad market is falling. They provide downside protection which suggests that the performance expectations are conditional on the market environment. While both of these approaches are based on factor investing, this difference in the conditionality of the payoff is important for understanding defensive strategies. In the remainder of this note, we discuss a framework for assessing different factor investing approaches, introduce PanAgora's approach to factor investing and discuss how plans[1] can use these portfolios in their equity allocations.

Framework for Comparing Factor Portfolios

Investors have some expectation of a factor strategy's return and risk characteristics. In addition to using return and risk characteristics to compare different factor portfolios, our framework adds characteristics based on participation rates that are also useful for describing strategies. "Upside participation and downside protection" can be rigorously defined and empirically analyzed for strategies

[1]The term "plan" as used herein refers to any institutional investor (*e.g.*, pension plan, retirement system, endowment fund or other institution).

relative to an index (Qian 2015). From upside and downside participation rates we derive the average participation and the participation advantage, or the difference between upside and downside participation rates. The average participation gives an intuitive measure of the strategy's defensiveness, while the participation advantage indicates the efficiency of the strategy's ability to generate value by exploiting the asymmetric co-movement of the portfolio with the benchmark. Using all six of these characteristics (return, risk, upside participation, downside participation, average participation and participation advantage), we can better understand how strategies fit into an overall equity allocation.

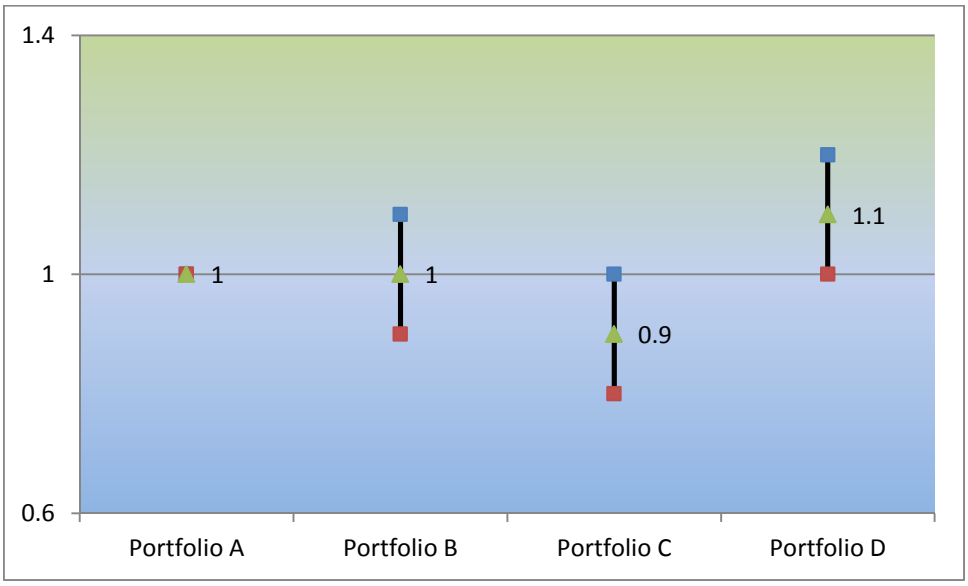
A hypothetical example may help. The table in Exhibit 1 shows four portfolios. Portfolio A has an upside participation of 1.00, and so has the same return as the benchmark when the benchmark is up. It also has a downside participation of 1.00, which yields an average participation of 1.00 and a participation advantage of 0.00. Clearly, this is the benchmark itself, but other portfolios that cling tightly to the benchmark will have similar characteristics. Portfolio B has an upside participation of 1.10 and a downside participation of 0.90. This means that the portfolio will beat the benchmark approximately by a factor of 0.20 over a full market cycle as indicated by the participation advantage. However, the average participation is 1.00, which indicates that the portfolio is not defensive, but is neutral. Our convention is that portfolios with average participations above 1.0 are cyclical, portfolios with average participations below 1.0 are defensive and lastly, the deviation of the average participation from 1.0 indicates the level of cyclicality or defensiveness of a portfolio. Portfolio C has no advantage on the upside, but does on the downside, meaning that this portfolio is defensive with an average participation of 0.90. Finally, portfolio D has an advantage on the upside, but no advantage on the downside, which means this portfolio is cyclical with an average participation of 1.10. This expanded framework has the advantage of allowing us to consider the characteristics that are conditional on how the market performs.

Exhibit 1: Hypothetical portfolio statistics shows a range of defensive characteristics

	Portfolio A	Portfolio B	Portfolio C	Portfolio D
Upside Participation	1.00	1.10	1.00	1.20
Downside Participation	1.00	0.90	0.80	1.00
Average Participation	1.00	1.00	0.90	1.10
Participation Advantage	0.00	0.20	0.20	0.20

Shown for illustrative purposes only. Source: PanAgora.

Exhibit 2: Graphical representation of Hypothetical portfolios shows a range of defensiveness



Shown for illustrative purposes only. Source: PanAgora.

Taking all of these characteristics under consideration, it is useful to think of a category of defensive strategies that is broader than just low volatility (or minimum volatility) strategies. These strategies can be based on the inclusion of low volatility stocks, weighting schemes that emphasize low volatility stocks or diversification, but they all have the goal of reducing the volatility of the portfolio in a useful way. Specifically, they produce a portfolio with asymmetric participation rates, which yields a positive participation advantage with an average participation below 1.00.

Factor Portfolios

Return Enhancing Factors

Return enhancing factors like Quality, Value and Momentum are generally thought of as factors that can enhance a portfolio's return independently of the benchmark's performance. Thus, expectations for these factors are not conditional on the market environment in the sense that investors expect to be compensated in both up and down markets. Since the factors are expected to pay off unconditionally, there is an expectation of a positive participation advantage. Smart beta portfolios based on these factors are typically run constrained to a capitalization-weighted index, and, therefore, any asymmetry in their upside/downside participation comes only from the factor exposure. In our framework, return enhancing factor portfolios are expected to be neutral with an average participation near 1.00, similar to the hypothetical Portfolio B above.

Volatility Reducing Strategies

Volatility reducing strategies, such as Low Volatility or Minimum Variance, are expected to meaningfully reduce a portfolio's drawdowns when markets fall by providing downside protection. The performance expectation for defensive factors is thus dependent on market conditions. Yet it stands to reason that no one invests in low-volatility equity portfolios simply to reduce a portfolio's volatility; the most direct way to obtain a portfolio with lower volatility is to reduce the capital invested in an index portfolio and hold the remainder in cash, as expressed in Exhibit 3. However, this would produce a portfolio that has symmetric market participation, in that it would participate in up-markets at exactly the same rate as it would participate in down-markets. This would yield a portfolio with equal upside and downside participation, but no participation advantage.

Exhibit 3: Participation ratio statistics for hypothetical Index plus cash portfolio

	Index + 30% cash
Upside Participation	0.70
Downside Participation	0.70
Average Participation	0.70
Participation Advantage	0.00

Shown for illustrative purposes only. Source: PanAgora.

Instead low-volatility investors invest in low-volatility portfolios because of an expected asymmetry between the portfolios downside participation and its upside participation. Specifically, investors expect low-volatility portfolios to have participation advantages greater than 0.0 and average participation below 1.0.

This simple comparison highlights that return enhancing portfolios and volatility reducing portfolios need not be mutually exclusive approaches, and the benefits of both can be obtained through thoughtful portfolio construction that emphasizes diversification. For return enhancing factor portfolios, the only way to ensure high factor exposure is to emphasize high factor stocks. As a simple case, if you include only high factor stocks in the portfolio, the weighting is unimportant and the portfolio will have high factor exposure. On the other hand, there are two ways to make a portfolio of any stocks defensive. Similar to the first case, the investor can simply include stocks with low volatility characteristics and the weighting has little impact. The second method is through the mechanism of diversification which makes any set of stocks relatively defensive. Diversification allows us to alter a portfolio in a way that does not lower the average stock volatility, but nevertheless lowers the portfolio volatility. This is a very important point because as long as asset weighting is done correctly, a portfolio of stocks with any high factor exposure can be made more defensive while retaining its high factor exposure characteristic. The integration of factor-based stock selection with thoughtful portfolio construction is the key to building defensive portfolios with return enhancing factor exposures.

Standard factor indices

We will start by using this framework to look at standard MSCI indices. In Exhibit 4, we show some statistics on the cap-weighted MSCI World Index (MSCI World), the MSCI World Diversified Multi-Factor (MSCI DMF) Index and the MSCI World Minimum Volatility (MSCI MinVol) Index. For excess return and Sharpe ratio calculations, we subtract the US 3-month Treasury yield for the absolute portfolio returns.

Exhibit 4: MSCI index performance statistics from 1/31/1999 through 6/30/2017

	MSCI World	MSCI DMF	MSCI MinVol
Return (Ann.)	5.30	9.08	6.32
Excess Return (Ann.)	3.42	7.14	4.43
Standard Deviation	15.16	15.36	10.73
Sharpe Ratio	0.23	0.47	0.41
Upside Participation	1.00	1.08	0.66
Downside Participation	1.00	0.91	0.52
Average participation	1.00	1.00	0.59
Participation Advantage	0.00	0.18	0.15

Shown for illustrative purposes only. Source: PanAgora. Past Performance is not a guarantee of future results

From this we can see the following:

1) Comparing MSCI World and MSCI DMF, we can see the marginal effect of adding factors to the cap-weighted index. The historical annual returns increase from 5.30% to 9.08%, but volatility does not materially change (15.16% to 15.36%). The factors have paid off in both up and down markets, which is indicated by the positive participation advantage of 0.18, but the strategy is not defensive as its average participation is 1.00.
2) Comparing MSCI World and MSCI MinVol, we can see the impact of reducing portfolio volatility through asset selection. The historical annualized return increases a bit from 5.30% to 6.32%, but the volatility is strongly reduced from 15.16% to 10.73%. The MSCI MinVol index beat the MSCI WI due to its participation advantage of 0.15 and is strongly defensive with an average participation of 0.59, well below 1.00.

PanAgora's Defensive Equity Strategies

PanAgora has a number of defensive equity strategies that obtain exposures to different factors. We begin with our low volatility and multi-factor strategies as examples of investing in volatility reducing factors and return enhancing factors. Even though these strategies have different targeted exposures, they share a common portfolio construction methodology. We use asset selection to limit the portfolio to stocks with the desired factor exposure, and use asset weighting that uses risk diversification to build a defensive portfolio.

Asset selection: For each stock in our investable universe, we combine the factor score with a proprietary diversification score. The factor scores ensure that we choose only stocks with high factor exposures, and the diversification score ensures that we end up with a collection of stocks that are highly diversified.

Asset Weighting: Once the subset of stocks with high factor exposure is chosen, we use our Risk Parity portfolio construction process to build a portfolio that is risk balanced. Through our research on equity portfolios, we have determined that the dimensions that are most important to diversify across are sectors, countries (if applicable) and individual stocks. Each dimension is important for different reasons:

1) Sector diversification protects against business cycle risk. By way of comparison the cap-weighted benchmark is highly concentrated in cyclical sectors, which leads to unnecessarily large drawdowns when markets sell off.
2) Country diversification protects against geo-political and policy risk. Being diversified across countries insulates the portfolio from country shocks that can come from unpredictable geo-political events as well as changes in policy.
3) Stock diversification protects from idiosyncratic risk arising from company-specific shocks.

This diversification gives the portfolio a defensive characteristic relative to other weighting schemes by reducing risk concentrations. Given that the portfolio includes only high factor exposure stocks, diversification increases the defensiveness of the portfolio without significantly changing exposure to the intended factors.

In Exhibit 5, we show statistics on two of our strategies. The first strategy is a Defensive Equity Low-Volatility (DELV) strategy that targets stocks with low-volatility. The second is a Defensive Equity Multi-Factor (DEMF) strategy that targets stocks with high exposures to Quality, Value, and Momentum characteristics. In general, we find that we add value through both asset selection and asset weighting. The following table compares these strategies to the three MSCI benchmarks shown in Exhibit 4.

Exhibit 5: Backtested Performance Statistics from 1/30/1999 through 6/30/2017 (backtested)

	MSCI World	MSCI DMF	MSCI MinVol	DEMF (Backtest)	DELV (Backtest)
Return (Ann.)	5.30	9.08	6.32	11.25	8.83
Excess Return (Ann.)	3.42	7.14	4.43	9.28	6.89
Standard Deviation	15.16	15.36	10.73	13.42	10.48
Sharpe Ratio	0.23	0.47	0.41	0.69	0.66
Upside Participation	1.00	1.08	0.66	0.95	0.69
Downside Participation	1.00	0.91	0.52	0.62	0.42
Average participation	1.00	1.00	0.59	0.78	0.56
Participation Advantage	0.00	0.18	0.15	0.33	0.27

1/1999-6/2017. Source: PanAgora. The hypothetical backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

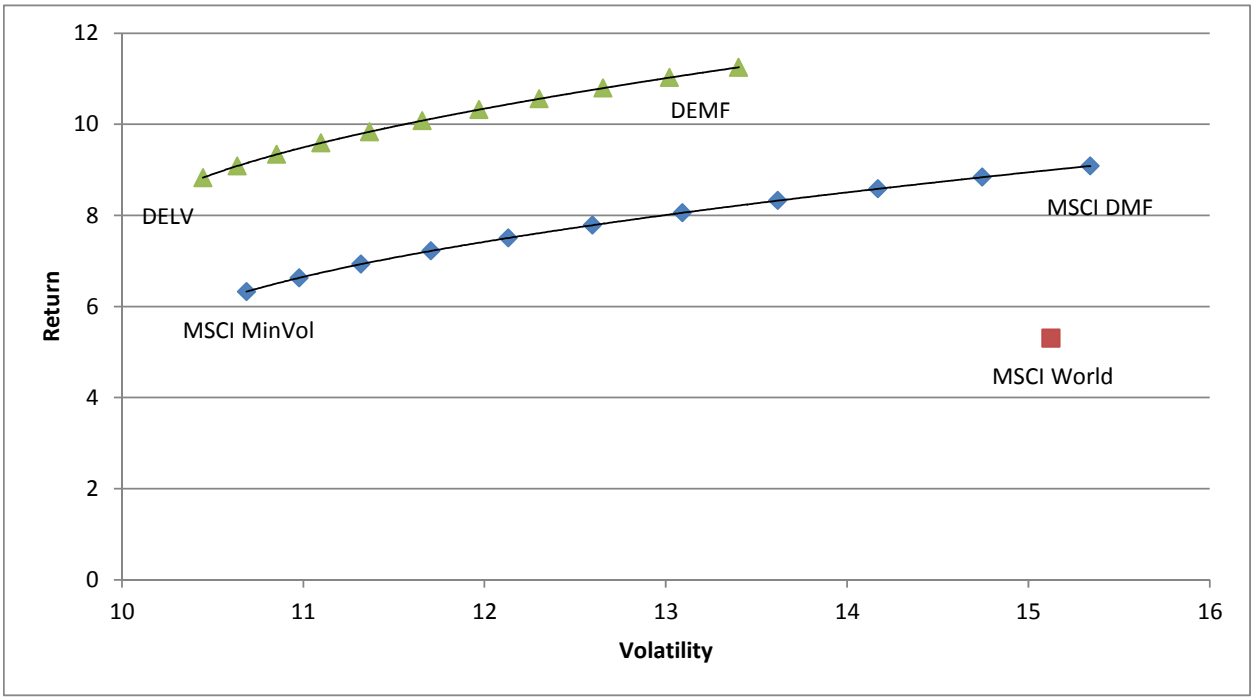
1) Comparing the MSCI World with either the MSCI DMF or PanAgora's DEMF portfolio shows the marginal benefit of targeting stocks with higher factor exposures, but the DEMF comparison highlights the additional benefit gained from building a diversified portfolio of stocks with high factor exposure. The downside participation is much lower for the DEMF portfolio than that of the MSCI DMF portfolio as a result of the superior risk diversification achieved through risk parity based portfolio construction techniques. The result is an increase in the participation advantage from 0.18 to 0.33 and a reduction in the average participation from 1.00 to 0.78.
2) Comparing the MSCI World with either MSCI MinVol or PanAgora's DELV, we also see value added as a result of strong downside protection. However, while the volatility of the MSCI MinVol and DELV portfolios are similar, the diversification benefit that DELV has over MSCI MinVol can be seen in DELV's higher upside participation and its lower downside participation. This increases the participation advantage from 0.15 for MSCI MinVol to 0.27 for DELV.

How should plans think about defensive equity strategies?

Plans by their very nature are interested in meeting their return objective in a consistent, or stable, manner to meet future obligations. Since plans typically have a sizable allocation to equity, an allocation to defensive equity can reduce a plan's expected drawdown. Many plans currently have allocations to both defensive equity strategies (i.e. minimum variance or low-volatility) and cyclical or neutral strategies. We can think of this as the plan investing at both ends of the defensive spectrum in that their minimum variance allocation is fully defensive while their factor based allocation is either neutral or cyclical. However, at the plan level the overall equity allocation is between these two extremes and the extent of the plan's defensiveness depends on the weight allocated to their portfolios.

On the following chart in Exhibit 6 we plot the reward-risk curve with end-points at the MSCI MinVol and MSCI DMF indexes. By adjusting weights for the MSCI MinVol and MSCI DMF portfolios, plans can choose where they want to be on the blue (lower) line. Similarly, we plot the curve defined by our two defensive equity portfolios, DELV and DEMF. The green (upper) line shows the options available to plans using these components. We include the MSCI World Index for reference.

Exhibit 6: Backtested Return/Risk curves generated by different weighted averages of DEMF/DELV and MSCI DMF/MSCI MinVol (return data from 1/30/1999 through 6/30/2017)

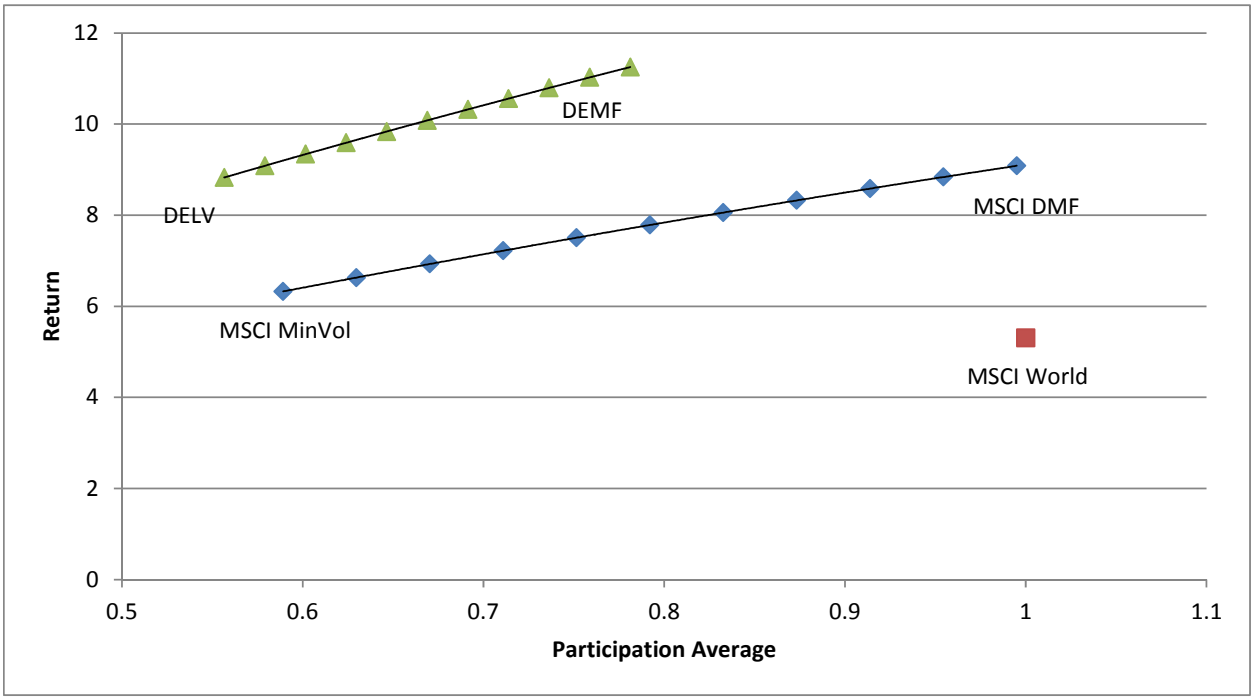


1/1999-6/2017. Source: PanAgora. The hypothetical backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

Exhibit 6 is a standard return-volatility chart that shows the trade-off between return and volatility for the portfolio choices. Notice that the curve defined by our backtested portfolios lies above the curve defined by the MSCI portfolios at every point. The distance between these two lines can be thought of as the benefit accrued to a higher level of diversification which is the primary difference between portfolios along those two curves.

We can also look at this trade-off in a slightly different way. The chart below shows the trade-off between expected return and portfolio defensiveness, and emphasizes that plans can choose the defensiveness of their overall portfolio, and then decide how to achieve it. Again in this graph we can see that for a given level of defensiveness, the backtested strategies offer more expected return.

Exhibit 7: Backtested Return/Defensiveness curves generated by different weighted averages of DEMF/DELV and MSCI DMF/MSCI MinVol (return data from 1/30/1999 through 6/30/2017)



1/1999-6/2017. Source: PanAgora. The hypothetical backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

Min-Vol Multi-Factor

The previous section discussed a plan's ability to adjust its defensiveness by adjusting the weight that it assigns to return enhancing and volatility reducing factors, respectively. However, a plan may also want to invest specifically in a defensive strategy that also has exposure to return enhancing factors. Plans should consider using the MSCI MinVol index as a benchmark, since it is an established benchmark in the defensive equity space, and then build a Defensive Equity Multi-Factor portfolio that matches the defensiveness of the MSCI MinVol index[2]. We can adjust the defensiveness of the portfolio by adjusting the inclusion of low-volatility stocks in the multi-factor portfolio until we obtain the same average participation as the MSCI MinVol index. We designate this portfolio the Defensive Equity Min Vol Multi-Factor (DEMVMF) portfolio.

Exhibit 8 shows performance statistics for the three MSCI indices and three Defensive Equity portfolios. We can see that MSCI MinVol, the DELV and DEMVMF portfolios have roughly the same volatility, but by adding factor exposures the return of the DEMVMF portfolio is higher than DELV portfolio.

[2] Another solution matches the volatility of the MSCI MinVol index. Matching the volatility or the defensiveness leads to similar results.

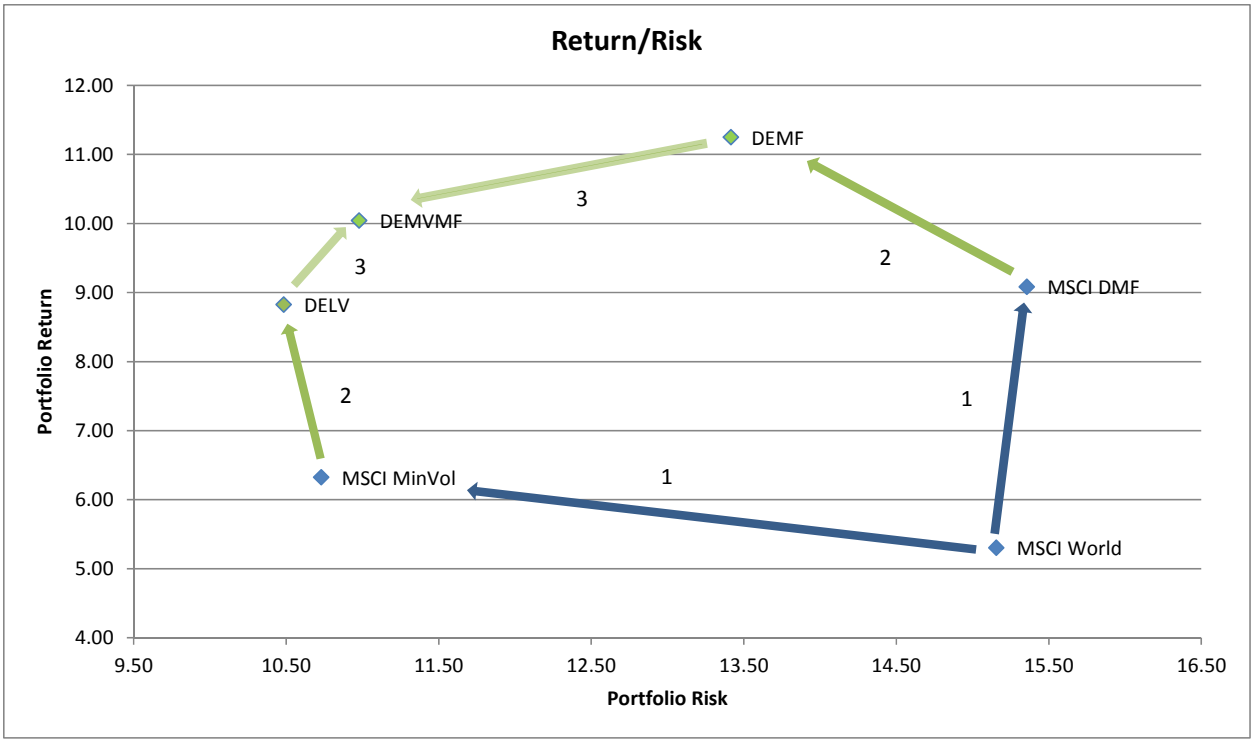
Exhibit 8: Backtested performance statistics for MSCI and PanAgora portfolios (return data from 1/30/1999 through 6/30/2017)

	MSCI World	MSCI DMF	MSCI MinVol	DEMF (Backtest)	DELV (Backtest)	DEMVMF (Backtest)
Return (Ann.)	5.30	9.08	6.32	11.25	8.83	10.04
Excess Return (Ann.)	3.42	7.14	4.43	9.28	6.89	8.09
Standard Deviation	15.16	15.36	10.73	13.42	10.48	10.98
Sharpe Ratio	0.23	0.47	0.41	0.69	0.66	0.74
Upside Participation	1.00	1.08	0.66	0.95	0.69	0.76
Downside Participation	1.00	0.91	0.52	0.62	0.42	0.44
Average participation	1.00	1.00	0.59	0.78	0.56	0.60
Participation Advantage	0.00	0.18	0.15	0.33	0.27	0.32

1/1999-6/2017. Source: PanAgora. The hypothetical backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

Using the return and volatility statistics, we plotted in Exhibit 9 the profiles of these six portfolios and make some observations about their factor exposures and diversification. Starting from the MSCI World Index in the bottom right corner, we can see the effect of adding factor exposures in the steps labeled (1) with blue arrows. By adding return enhancing factor exposures, we move up the chart to the MSCI DMF portfolio that has similar risk, but higher return, due to exposure to the factors. On the other hand, by reducing volatility, we move down to the MSCI MinVol index which has slightly higher return, but considerably less volatility. In the next step, labeled (2) with darker green arrows, we add diversification. On the right hand side of the chart, we add diversification to the factor MSCI DMF index. While this does result in higher return, it also results in considerably less volatility because of the volatility reducing effect of diversification. On the left hand side, adding diversification to the MSCI MinVol index does not reduce the volatility significantly because the portfolio volatility is already extremely low. There is an increase in return because the DELV has broader exposure to stocks and sectors that are not exclusively low-vol. In the final step, labeled (3) with light green arrows, we show the effect of building a multi-factor portfolio with defensiveness that matches that of the MSCI MinVol index. On the left hand side we see the required reduction in volatility from DEMF, but there is also a drop in return due to the required shift away from the return enhancing factor exposures to the low volatility exposures. One effect of building a best-of-breed portfolio is that the DEMVMF lies above the curve connecting DELV and DEMF, which means that it has better expected performance than a portfolio that merely averages DELV and DEMV.

Exhibit 9: Backtested Return and risk plot for select MSCI benchmarks and PanAgora portfolios (return data from 1/30/1999 through 6/30/2017)



1/1999-6/2017. Source: PanAgora. The backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

A Note on Benchmarking Defensive Strategies

One problem that defensive equity investors run into is benchmarking. Since the intention is to have a different risk characteristic, using tracking error to the cap-weighted benchmark is not useful since the cap-weighted benchmark is no longer the anchor for the strategy. The next table in Exhibit 10 shows tracking-error statistics relative to the cap-weighted benchmark and then relative to the MSCI MinVol Index. The MSCI MinVol column shows a tracking error of 7.6% against the cap-weighted benchmark, but this is not because it is taking large active bets against the benchmark, but rather because the two are fundamentally different with very different volatilities. Similarly, the Defensive Equity portfolios have tracking errors in the 6.82% to 8.52% range relative to the cap-weighted index.

Exhibit 10: Backtested Value added statistics for select MSCI benchmarks and PanAgora portfolios (return data from 1/30/1999 through 6/30/2017)

Relative to MSCI WI	MSCI World	MSCI DMF	MSCI MinVol	DEMF (Backtest)	DELV (Backtest)	DEMVMF (Backtest)
Value Added	0.00	3.78	1.02	5.95	3.52	4.74
Tracking Error	0.00	4.09	7.60	6.82	8.52	7.88
Information Ratio	N/A	0.92	0.13	0.87	0.41	0.60

Relative to MSCI MinVol	MSCI World	MSCI DMF	MSCI MinVol	DEMF	DELV	DEMVMF
Value Added	-1.02	2.76	0.00	4.93	2.50	3.72
Tracking Error	7.60	8.03	0.00	5.72	3.60	3.44
Information Ratio	-0.13	0.34	N/A	0.86	0.70	1.08

1/1999-6/2017. Source: PanAgora. The backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

The second table show tracking errors against the MSCI MinVol benchmark. In this case, the DELV portfolio has a very reasonable tracking error of 3.6%. The DEMF tracking error is fairly high at 5.72% but part of this is because of the large difference in portfolio volatility. By matching the MSCI MinVol benchmark's defensiveness, the DEMVMF portfolio has a tracking error that is much more in line with that of DELV.

Exhibit 11 continues this comparison by looking at participation rate statistics, first relative to the MSCI World Index and then relative to the MSCI MinVol Index. The first table shows that the MSCI MinVol index and all of the Defensive Equity portfolios can be characterized as Defensive, given that their average participation rates are below 1.0. More interesting is the second table which shows the statistics versus the MSCI MinVol. Unsurprisingly, the MSCI World Index and DEMF portfolio are characterized as being "cyclical" (relative to the MSCI MinVol Index) with an average participation of 1.20 and 1.15 respectively. The DELV is slightly "defensive", with an average of 0.94, driven by an upside participation in line with the benchmark (1.03) but a much lower downside participation rate of 0.84. Given that the volatilities are similar, this downside protection can probably be attributed to the diversification of the DELV portfolio. Finally, the DEMVMF portfolio is only slightly "defensive" but has a strong difference in participation rates due to exposure to the return enhancing factors.

Exhibit 11: Backtested capture ratio statistics for select MSCI benchmarks and PanAgora portfolios (return data from 1/30/1999 through 6/30/2017)

Relative to MSCI WI	MSCI World	MSCI DMF	MSCI MinVol	DEMF (Backtest)	DELV (Backtest)	DEMVMF (Backtest)
Upside Participation	1.00	1.08	0.66	0.95	0.69	0.76
Downside Participation	1.00	0.91	0.52	0.62	0.42	0.44
Average participation	1.00	1.00	0.59	0.78	0.56	0.60
Participation Advantage	0.00	0.18	0.15	0.33	0.27	0.32

Relative to MSCI MinVol	MSCI World	MSCI DMF	MSCI MinVol	DEMF (Backtest)	DELV (Backtest)	DEMVMF (Backtest)
Upside Participation	1.14	1.27	1.00	1.29	1.03	1.10
Downside Participation	1.26	1.15	1.00	1.02	0.84	0.84
Average participation	1.20	1.21	1.00	1.15	0.94	0.97
Participation Advantage	-0.12	0.12	0.00	0.27	0.19	0.26

1/1999-6/2017. Source: PanAgora. The backtested performance was derived from the retroactive application of a model with the benefit of hindsight. Backtest results presented are shown for illustrative purposes only. Performance is shown gross of fees. Backtest results do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. As with any investment, there is the possibility of profit as well as the risk of loss. Source: PanAgora. Past performance is not a guarantee of future results. Please see the disclosures at the end of this report for additional information regarding backtested performance and the indices.

Conclusion

Plans invest in equity portfolios to achieve certain return objectives, which may be helped by exposure to return enhancing factors. In addition, most plans also have a strong interest in capital preservation. This often leads them to invest in defensive strategies that are intended to reduce the risk of large capital loss when markets are down without giving up too much participation in the long-term appreciation of equity markets. The standard defensive choice is low-vol. However, low-volatility portfolios are not the only way by which to obtain defensive portfolio characteristics. This note has extended the standard framework of classifying expected return and volatility by including backtested performance statistics related to the upside and downside participation rates. If these participation rates are asymmetric, investors can take advantage of portfolio characteristics to protect the portfolio on the downside. Allocation decisions can be supported by using this framework to analyze and adjust defensiveness at the portfolio or plan level. Defensive equity strategies can use diversification to seek to make portfolios more defensive without constraining their portfolio exposures. As a result, they may be useful in structuring a plan's exposure to equities that is both defensive and has exposure to return enhancing factors. By adjusting the volatility of a portfolio, we may engineer a Defensive Equity Min Vol Multi-Factor strategy that matches the defensiveness of the MSCI Min Vol Index. This allows investors to have exposures to return enhancing factors in a defensive strategy that can be benchmarked to the MSCI Min Vol Index. Such a strategy may complement existing low-vol allocations because its use of

diversification in portfolio construction, making it quite different from other, more standard low-vol approaches, which also makes the portfolio itself diversifying within the plan.

References

Qian, E. “On the Holy Grail of ‘Upside Participation and Downside Protection’” The Journal of Portfolio Management Winter 2015, 41.

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The index benchmarks referenced herein are broad-based securities market indices and used for illustrative purposes only. Broad-based indices are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly into an index. The MSCI World Index represents large and mid-cap equity performance across 23 developed market countries. It covers approximately 85% of the free float-adjusted marked capitalization in each country and does not offer exposure to emerging markets.

The MSCI World Diversified Multi-Factor Index is based on the MSCI World Index, its parent index. The index aims to maximize exposure to four factors - Value, Momentum, Quality and Low Size - while maintaining a risk profile similar to that of the underlying parent index. The MSCI World Minimum Volatility (USD) Index aims to reflect the performance characteristics of a minimum variance strategy applied to the MSCI large and mid-cap equity universe across 23 developed market countries. The index is calculated by optimizing the MSCI World Index, its parent index, for the lowest absolute risk.

BACKTESTED PERFORMANCE: The model and hypothetical performance included in the presentation does not represent the performance of actual client portfolios. The performance is shown for illustrative purposes only. Historical performance presented herein is purely theoretical and involves the application of PanAgora quantitative strategies to historical financial data to show what decisions would have been made if the strategy were employed. These backtested performance results are shown for illustrative purposes only and do not represent actual trading or the impact of material economic and market factors on PanAgora's decision-making process for an actual PanAgora client account. Backtested performance results were achieved by means of a retroactive application of a model designed with the benefit of hindsight.

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The backtested performance presented in this book is based on the following assumptions: The investable universe for the backtest includes the MSCI World Index. The backtest presented includes all constituents of the aforementioned investable universe. Backtest holdings are based on the desired investment characteristics generated from the investment process described further in this presentation. Backtest returns presented are both gross of investment management fees and portfolio transaction costs. There were no changes made in the backtest approach in the time period presented herein.