A Different Approach to Low Volatility:

Select the Best Securities First

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The goal of low-volatility investing is to minimize the impact of drawdowns during market turbulence or bear markets. By minimizing the performance drag caused by volatility, investors aim to compound returns at higher rates over the long term.

The Problem:

Some early iterations of low-volatility strategies accomplish this by simply screening for the least volatile stocks. The drawback of this approach is that these portfolios often have large sector and industry concentrations, making them less appealing to investors looking for diversified market exposure. To address this shortcoming, a second generation of low-volatility strategies emerged. These strategies use a portfolio optimizer to construct a diversified low-volatility portfolio rather than simply gravitating to low-volatility stocks. While this marked a step forward in the evolution of low-volatility investing, some of these strategies still lack a critical element – consideration of the fundamental profile of the stocks selected.

The Solution:

The Nasdaq Victory US Multi-Factor Minimum Volatility Index™ (the "Index") attempts to enhance the methodology by including a multi-factor screening process that narrows the investable universe to stocks believed to be more likely to outperform, then applies a portfolio optimizer to lower volatility and diversify the index. The combination seeks alpha from the multi-factor screen and lower volatility from the optimized portfolio construction. This results in a portfolio designed to participate in rising or bull markets while outperforming during periods of heightened volatility or bear markets (best illustrated in the index's up/down market-capture ratio). Ultimately, the Index aims to provide superior risk-adjusted returns and a smoother path to long-term capital appreciation. The Index also considers its use of multiple factors in aggregate, with each security representing the appropriate exposure to all pertinent factors rather than a "bolt together" approach utilized by many other multi-factor approaches. The Index launched on May 26, 2017, and has back-test data available beginning on April 20, 2001.

In this document, we will describe the Index's two-step approach. We will discuss the efficacy of multi-factor investing and how it is applied in this strategy. Next, we will explain how a portfolio optimizer reduces portfolio volatility and how it is used in this approach to provide diversified market exposure. Finally, we will review the historical performance of the Index and compare it to several of its more traditional low-volatility peers.

Index Highlights

- The Index offers a next-generation approach to low-volatility investing.
- It seeks to provide a smoother path to long-term capital appreciation.

- This rules-based, low-cost solution is designed to be used as a core portfolio holding, broad market replacement, or tactical component.
- The Index employs a two-step approach that aims to deliver superior risk-adjusted equity returns.
  - STEP 1: A multi-factor model is used to narrow the investment universe to companies that score well on the following attributes: quality, value, profitability, growth, and momentum.
  - STEP 2: A portfolio optimizer minimizes overall portfolio volatility by weighting stocks based on the correlation of assets and a series of constraints designed to help diversify the portfolio.
- The Index is reconstituted and rebalanced semiannually on the third Friday in April and October (using data from the end of March and September, respectively).

Index Methodology Explained

Eligibility Criteria

To be eligible for inclusion in the Nasdaq Victory US Multi-Factor Minimum Volatility index, securities must first meet the following criteria:
- Be a member of its parent Nasdaq index:
  - The parent index for the Nasdaq Victory US Multi-Factor Minimum Volatility Index is the Nasdaq US Large Mid Cap Index™.
    - The Nasdaq US Large Mid-Cap Index is designed to track the performance of securities assigned to the United States that are included in the large/mid-cap segment. Securities eligible for the index are listed in the US on the Nasdaq or New York exchanges.
    - The number of securities in the index is 950 as of December 2022.
- One security per issuer is permitted (if an issuer has multiple securities, the security with the highest three-month average daily dollar trading volume will be selected for possible inclusion in the index).

Multi-Factor Investing

Before discussing the Index's multi-factor methodology, let's look at the basics of factor investing and explain why we believe a multi-factor approach is superior to a single-factor approach.

Factor investing is not a new concept. To fundamentally assess any investment, multiple factors must be considered. For example: How attractively valued is the investment? How fast is it growing? Is it a high-quality investment? Is it profitable? What is different about factor investing today is the increased computing power, which enables true multi-factor analysis and ranking of ever-larger investment universes. Many strategies in the marketplace take the approach of single-factor investing or pairing just a few factors together in their stock selection methodology. We believe multi-factor is a more durable long-term approach. As seen in the quilt chart below, there's little consistency year-to-year in factor leadership. The top-performing factor in one year might be the worst in the following year. Attempting to effectively time which factors to overweight in a given market environment is also very difficult to accomplish with consistency.

Factor Returns: Examining Best Practices for Smart Beta Exposure
*Cumulative Returns using Total Return data 12/29/2006 - 12/30/2022*

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Momentum 17.17	Low Vol -21.41	Value 53.56	Growth 26.89	Low Vol 14.78	Value 24.94	Value 47.47	Dividend 18.02	Low Vol 4.34	Dividend 31.39	Growth 26.20	Low Vol 0.27	BuyBack 34.09	Momentum 36.59	Value 34.25	Dividend 2.45
Quality 16.77	BuyBack -33.38	Growth 49.34	Momentum 26.58	BuyBack 10.04	Momentum 18.17	BuyBack 45.57	Low Vol 17.49	Dividend 2.37	Value 19.31	Momentum 23.30	Growth -4.53	Quality 33.63	Growth 29.35	BuyBack 32.62	Value -1.28
Growth 6.45	Benchmark -36.81	Equal Weight 44.64	Value 22.50	Dividend 8.58	Equal Weight 17.16	Growth 43.57	Quality 16.07	Growth 2.21	Equal Weight 14.51	Benchmark 21.70	Benchmark -4.56	Momentum 33.13	Benchmark 18.37	Equal Weight 29.41	Low Vol -4.59
Benchmark 5.14	Dividend -38.12	BuyBack 31.23	Equal Weight 21.37	Quality 6.28	Benchmark 15.99	Equal Weight 35.53	Equal Weight 14.06	Quality 1.67	Quality 14.30	Quality 19.10	Momentum -5.96	Benchmark 31.22	Quality 17.40	Growth 29.40	BuyBack -10.21
Equal Weight 0.90	Growth -38.80	Momentum 28.03	Dividend 20.88	Benchmark 1.89	Growth 14.88	Benchmark 32.31	Growth 13.89	Benchmark 1.25	BuyBack 12.88	Equal Weight 18.51	Quality -7.07	Equal Weight 28.91	Equal Weight 12.71	Benchmark 28.75	Equal Weight -11.62
Low Vol 0.58	Equal Weight -40.07	Benchmark 26.37	Quality 20.50	Momentum 1.53	Quality 14.31	Quality 32.28	Benchmark 13.46	Momentum 1.13	Benchmark 12.00	BuyBack 17.75	Dividend -7.47	Growth 28.35	BuyBack 8.45	Quality 28.03	Quality -15.77
BuyBack -2.23	Momentum -46.21	Low Vol 19.22	BuyBack 17.90	Growth 0.44	BuyBack 13.75	Momentum 31.69	BuyBack 12.74	Equal Weight -2.66	Low Vol 10.37	Low Vol 17.41	Equal Weight -7.82	Low Vol 28.26	Low Vol -1.11	Dividend 26.15	Benchmark -18.17
Value -4.28	Quality -46.35	Quality 12.59	Benchmark 15.06	Equal Weight -0.67	Low Vol 10.30	Dividend 30.54	Value 12.21	BuyBack -4.34	Growth 4.02	Value 17.29	BuyBack -10.52	Value 24.79	Dividend -3.81	Low Vol 24.42	Momentum -24.49
Dividend -15.32	Value -47.80	Dividend 3.57	Low Vol 13.36	Value -1.16	Dividend 6.25	Low Vol 23.59	Momentum 12.21	Value -8.42	Momentum 2.35	Dividend 8.77	Value -12.30	Dividend 24.75	Value -8.60	Momentum 7.72	Growth -27.55

**LEGEND OF RETURN FACTORS AND PROXY INVESTMENTS

Momentum
Invesco DWA Momentum ETF (PDP)

Seeks excess return through stocks with trends of strong relative past performance

Inception: 3/1/2007

Dividend Achiever
Invesco High Yield Equity Dividend Achievers ETF (PEY)

Seeks excess return through stocks with high dividend yields and/or history of raising dividends

Inception: 12/9/2004

Value
Invesco S&P 500 Pure Value ETF (RPV)

Seeks excess return through stocks with low prices relative to a fundamental value

Inception: 3/1/2006

Growth
Invesco S&P 500 Pure Growth ETF (RPG)

Seeks excess return through stocks with above-average fundamental growth metrics

Inception: 3/1/2006

Low Volatility
Invesco S&P 500 Low Volatility ETF (SPLV)

Seeks excess return through stocks with lower than average market volatility

Inception: 5/5/2011

BuyBack Achievers
Invesco BuyBack Achievers ETF (PKW)

Seeks excess return through companies executing high corporate stock buyback programs

Inception: 12/20/2006

Benchmark
SPDR S&P 500 ETF Trust (SPY)

A market capitalization weighted index comprised of approximately 500 US large-cap stocks

Inception: 1/22/1993

Quality
Invesco S&P 500 Quality ETF(SPHQ)

Seeks excess return through companies with relatively low debt and/or stable earnings growth metrics

Inception: 12/6/2005

Equal Weight
Invesco S&P 500 Equal Weight ETF (RSP)

An equal-weighted index comprised of approximately 500 US large-cap stocks

Inception: 12/9/2004

**For each factor, annual and cumulative returns were calculated using corresponding ETF Total Return data via Bloomberg except for Low Volatility given the insufficient SPLV ETF history available and underlying index data was used instead. For Momentum, backtested PDP price returns were used between 12/29/2006 – 2/28/2007 as total return data wasn't available. All PDP prices as of its inception on 3/1/2007 are total return.

A multi-factor approach attempts to outperform over the long term by providing diversified factor exposure. The chart below shows how the Nasdaq Victory US Multi-Factor Minimum Volatility Index (NQVMVUST) has performed versus several popular smart beta factor ETFs during the allotted time frame 12/29/2006 – 12/30/2022. The factors in the study are as follows: Momentum (PDP), Value (RPV), Dividend (PEY), Growth (RPG), Low Volatility (SPLV), BuyBack (PKW), Benchmark (SPY), and Quality (SPHQ). Both the table and chart below illustrate that multi-factor was the clear winner, with the highest absolute and risk-adjusted returns.

	MOMENTUM	VALUE	DIVIDEND ACHIEVERS	GROWTH	BUY BACK	BENCHMARK	QUALITY	LOW VOL	NQVMVUST
Cumulative Return	224%	226%	145%	364%	308%	269%	245%	301%	384%
Annualized Return	7.6%	7.7%	5.8%	10.1%	9.2%	8.5%	8.0%	9.1%	10.4%
Annualized Volatility	23%	27%	24%	23%	21%	20%	20%	16%	16%
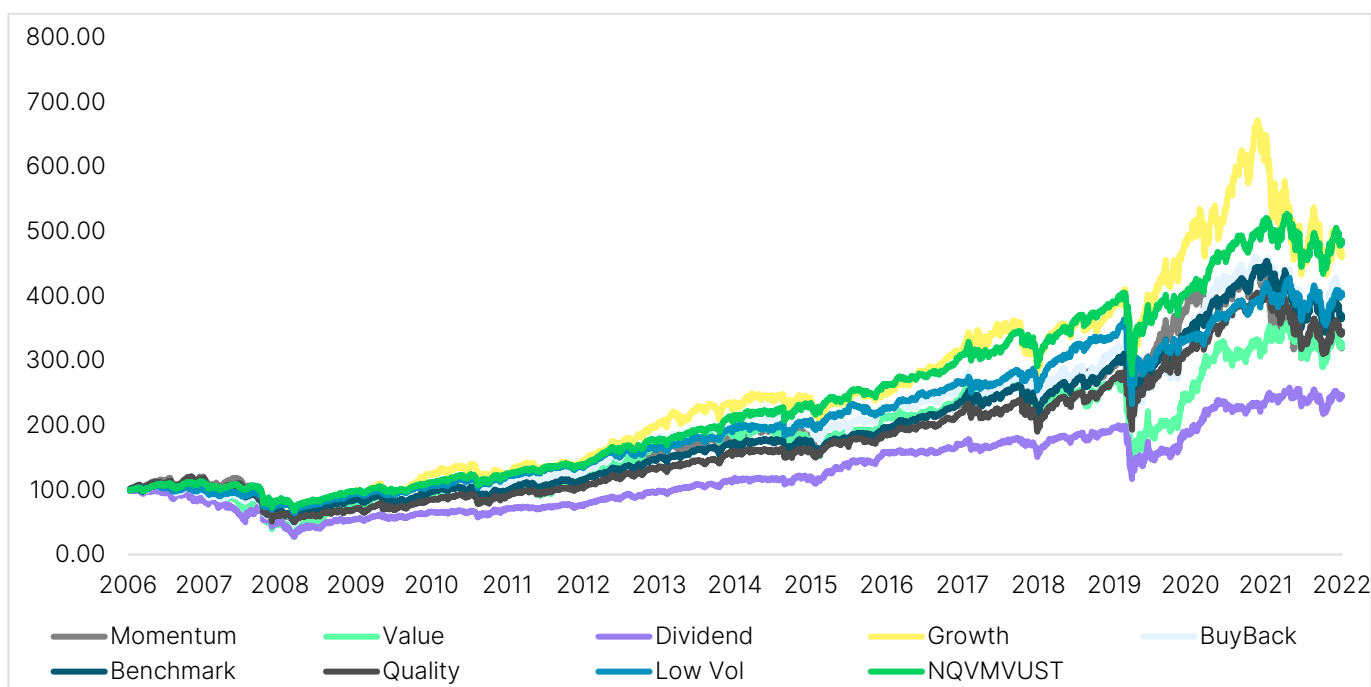
The Index's Multi-Factor Methodology

The objective of the multi-factor model is to narrow the Nasdaq US Large Mid Cap Index from approximately 1,000 constituents to a refined list of stocks with a higher likelihood of outperforming over a longer time horizon. Alternative low-volatility strategies apply the portfolio optimizer to the entire starting universe; however, in this approach, only the narrowed list of attractive companies is included in the optimization. It is this element of the process that differentiates this Index from other low-volatility strategies.

The multi-factor model ranks stocks by calculating a composite score for each security, comprised of its quality, profitability, valuation, growth, and momentum scores. After composite scores are calculated for each eligible security in the universe (all 1,000), the securities are placed into five evenly distributed quintiles, with the highest ranking 20% in quintile 1, the next highest 20% in quintile 2, and so on until the worst-ranked securities are in quintile 5. During portfolio optimization (which will be described in greater detail later), only stocks in quintile 1 can be purchased or added to. If an existing position in the Index falls to quintile 2, the optimizer is permitted to hold the position at its current weight but cannot add to it. Stocks in quintiles 3, 4, and 5 may not be held in the Index.

The chart below shows the factors and weights used in the Multi-Factor Model to calculate the composite scores.

PRIMARY FACTORS	SUB-FACTORS AND WEIGHT		SEEKS TO IDENTIFY
Quality	Stability	10%	History of delivering consistent results, with clean accounting and low levels of debt.
	EPS Quality	10%	
	Credit/Leverage	10%	
Profitability	Profitability	10%	Businesses that are less capital intensive with above-average returns on capital.
	Capital Spending	10%	
Value	Valuation	20%	Stocks that are attractively valued.
Growth	Growth	10%	Companies that are growing sales, cash flow, and dividends.
	Capital Deployment	10%	
Momentum	Momentum	10%	Positive price momentum and positive earnings revisions.

Companies in the financial sector use a slightly different calculation methodology. It is well-documented that analyzing cash flow metrics for financial companies poses many challenges, creating a less reliable picture of their true operating performance. For this reason, slight adjustments are made to the model for calculating the composite scores of financial companies. The model and weights applied to companies in the financial sector are reflected in the chart below.

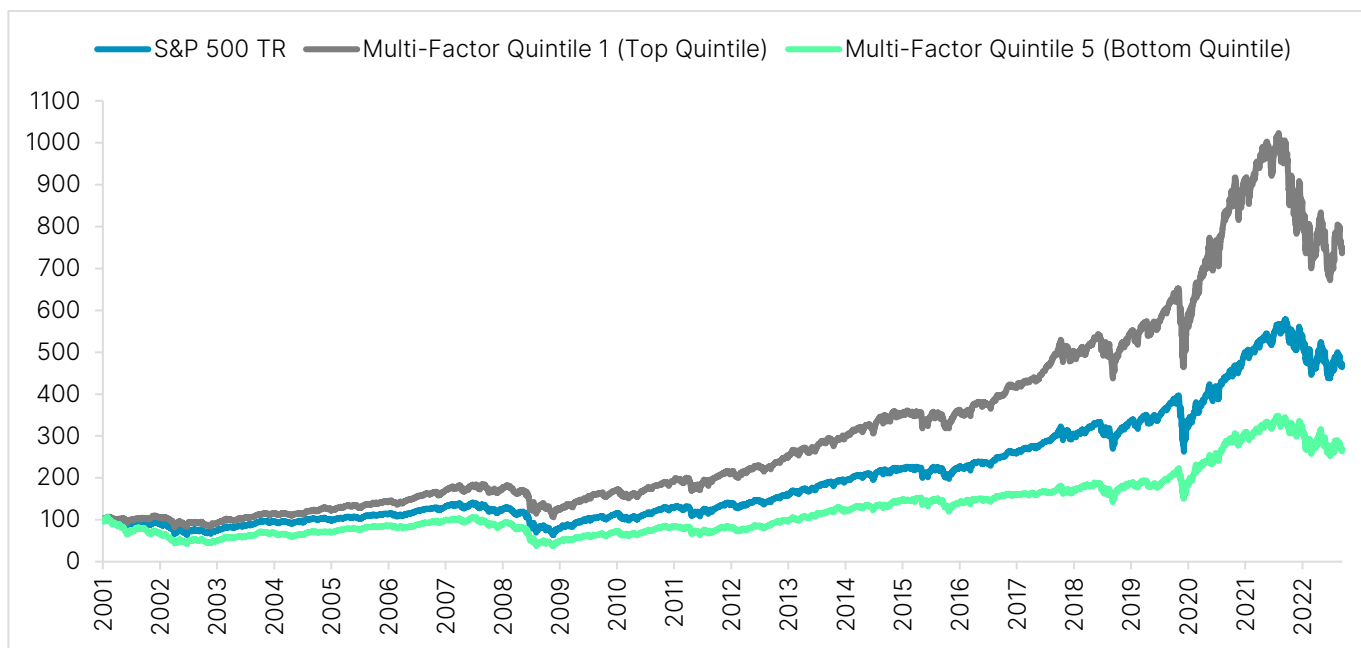| PRIMARY FACTORS	SUB-FACTORS AND WEIGHT		SEEKS TO IDENTIFY
Quality	EPS Quality	14.3%	History of clean accounting, with low levels of debt.
	Credit/Leverage	14.3%	
Profitability	Profitability	14.3%	Businesses with above-average returns on capital.
Value	Valuation	28.6%	Stocks that are attractively valued.
Growth	Capital Deployment	14.3%	Companies that are growing dividends or buying back stock.
Momentum	Momentum	14.3%	Positive price momentum and positive earnings revisions.

Multi-Factor Model Performance Stats: April 20, 2001 – December 30, 2022

We will start by looking at individual quintile performance and compare it to the S&P 500 Total Return Index. This analysis intends to show that quintile 1 securities perform the best, while securities ranked in quintile 5 perform the worst. While not shown, performance for Multi-Factor Quintiles 2, 3, and 4 all fall in between Multi-Factor Quintiles 1 and 5.
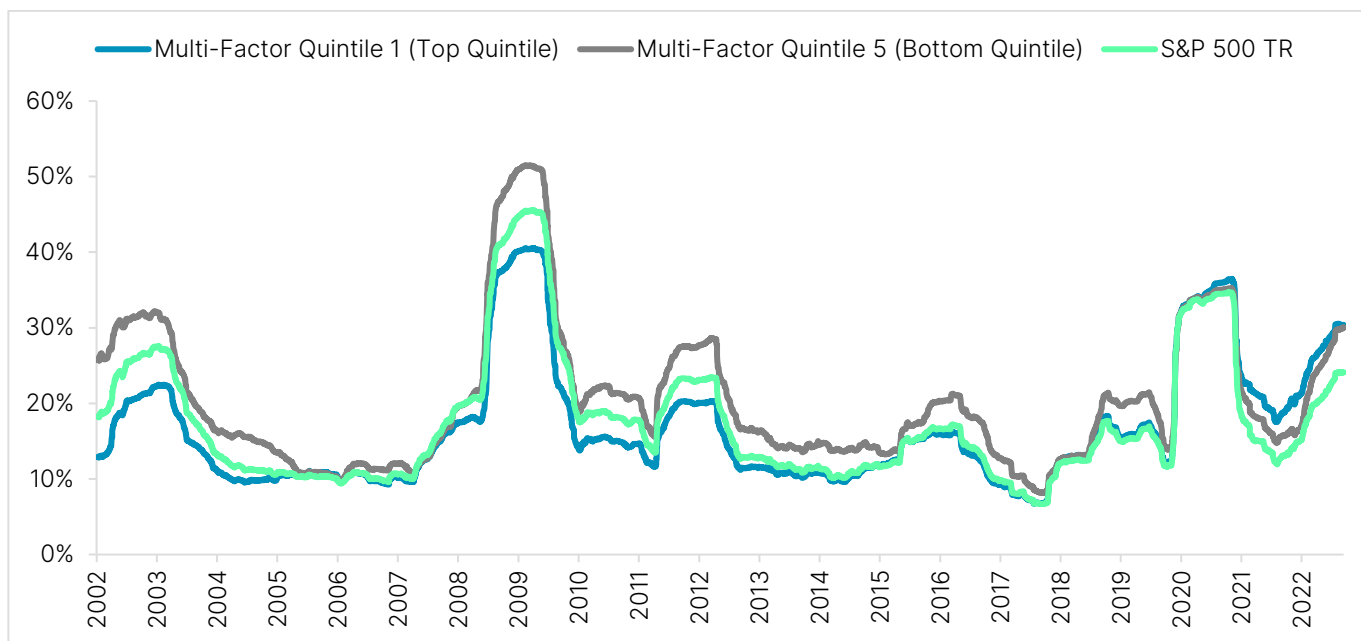
The table below confirms the benefits of the multi-factor quintile ranking approach. The top quintile provides significant outperformance versus the bottom quintile and the S&P 500 Total Return Index.

	S&P 500 TR	MULTI-FACTOR QUINTILE 1	MULTI-FACTOR QUINTILE 5
Cumulative Return	371%	650%	169.3%
Annualized Return	7.4%	9.7%	4.7%
Volatility	20%	19%	23%

To complete our analysis, the chart below confirms that the outperformance of the top quintile is achieved with lower volatility than quintile 5 and the S&P 500. This proves that selecting a "better basket" of securities to create a low-volatility solution is quite compelling.

Legend: S&P 500 TR — Multi-Factor Quintile 1 (Top Quintile) — Multi-Factor Quintile 5 (Bottom Quintile)

Stock Selection Results – Trailing Volatility

Legend: Multi-Factor Quintile 1 (Top Quintile) — Multi-Factor Quintile 5 (Bottom Quintile) — S&P 500 TR

Optimization

Allocation Optimization

As we've already discussed, before inputting securities into the optimization framework, we first run the multi-factor screening process.

After the assets for the Index have been selected, there is still more work to do. The Index must determine what percentage of the total holdings should be allocated to each stock. An analysis of the relationships

between the holdings can enable us to further reduce the portfolio volatility by carefully setting the allocation to each stock. The process of selecting these allocations to minimize volatility is called portfolio optimization.

It isn't necessarily obvious why one set of allocations would provide lower volatility than another. One reason is that the daily movements of certain stocks might be inversely correlated, meaning that on any particular day, they tend to move in different directions. When one goes up, the other goes down. It is advantageous to include stocks like this in a portfolio because they can dampen each other's volatility. Most financial analysts agree that a lower-volatility portfolio is also a lower-risk portfolio, so minimizing volatility can reduce the overall risk of an Index.

The Objective Function

The optimizer works by choosing a set of candidate allocations to each stock, evaluating the resulting candidate portfolio, then adjusting the allocations and re-evaluating. The process repeats until a specific objective is attained. This adjusting and testing are conducted thousands of times until the most favorable or optimal result is reached.

The goal for the optimizer is defined by the objective function. The objective function is an equation we can use to evaluate the quality of the portfolio. For the Index, our objective function is a sum of two components: volatility and turnover. Turnover refers to the degree to which the portfolio is moved from one set of assets to another during a rebalancing period. One hundred percent turnover would imply all assets are sold and an entirely new set of positions are entered. Significant turnover can result in higher transaction costs and tax implications that reduce the portfolio's performance.

Overall, we seek to minimize the sum of volatility and turnover. The degree to which one factor predominates over the other depends on the importance of the weights that we set. We have determined these weights over thousands of simulations to find the optimal risk-adjusted return.

At each rebalancing period, we apply the optimizer to the list of assets in the existing portfolio (and the new quintile 1) to find the set of allocations that minimizes the sum of volatility and turnover. We determine these weights over thousands of simulations to find the optimal risk-adjusted return.

Constraints

There are some limits to the optimizer's adjustments to the portfolio. These limits are called constraints. Overall, the optimization portion of the Index is intended to ensure that the Index tracks the performance of the Nasdaq US Large Mid Cap Index but with lower volatility. To help ensure the Nasdaq Victory US Multi-Factor Minimum Volatility Index does not diverge too significantly from the performance of the Nasdaq US Large Mid Cap Index, we limit the degree to which allocations can differ from the index. You can see the allocation constraint maximum differences listed in the Index Rebalancing section. These constraints help mitigate significant idiosyncratic or sector risk.

As the optimizer seeks to minimize the objective function (volatility and turnover), it must not violate any of these constraints. The result is a portfolio that seeks to minimize risk in three ways: low volatility, low turnover, and limited exposure to the sector and individual stock risk.

Index Rebalancing

The Index is reconstituted and rebalanced semiannually on the third Friday in April and October (using data from the end of March and September, respectively).
The Index employs a modified market capitalization weighting methodology. At each semiannual evaluation, the Index is rebalanced using an optimization process. The following constraints are applied:

- Securities that are in the first quintile are eligible for purchase.
- Securities in the second quintile are only eligible for inclusion if they were in the Index during the prior period. Their weights cannot increase as of the Index Evaluation reference date.
- Industry weights must be +/- 5.0% of the parent Nasdaq index.
- Growth, Value and Size style factors are constrained to +/- 0.5 standard deviations of the parent Nasdaq index.
- The maximum individual security weight is 2.5% greater than the weight of the security in its parent Nasdaq index at the time of initial inclusion and 3% greater than the weight of the security in its parent Nasdaq index if it is already a component in the Index.
- The maximum individual security weight is 50 times the weight of the security in its parent Nasdaq Index.
- Individual security weights are additionally constrained to a maximum weight defined by the security's liquidity (20-day ADDTV/$500 million).
- The minimum individual security weight is 0.25%.

Importance of Optimization: Additional Comparisons

Optimizing the multi-factor model not only reduces volatility but also helps generate even more substantial returns. An additional comparison that demonstrates the added benefit of the optimization process can be seen between April 2001 and December 2022; the NQVMVUST Index provided significant outperformance (+899%) vs. a market-cap-weighted basket of multi-factor quintile 1 stocks (+650%). Even more impressive is that it did so with lower volatility (15% vs. 19%). Remember that the multi-factor-ranked quintile 1, as a stand-alone model, outperformed the S&P 500; the optimized multi-factor model – the Nasdaq Victory US Multi-Factor Minimum Volatility Index – outperformed even the best of the quintiles during this period.

	NQVMVUST	MULTI-FACTOR QUINTILE 1
Cumulative Return	899%	650%
Annualized Return	11.2%	9.7%
Volatility	15%	19%
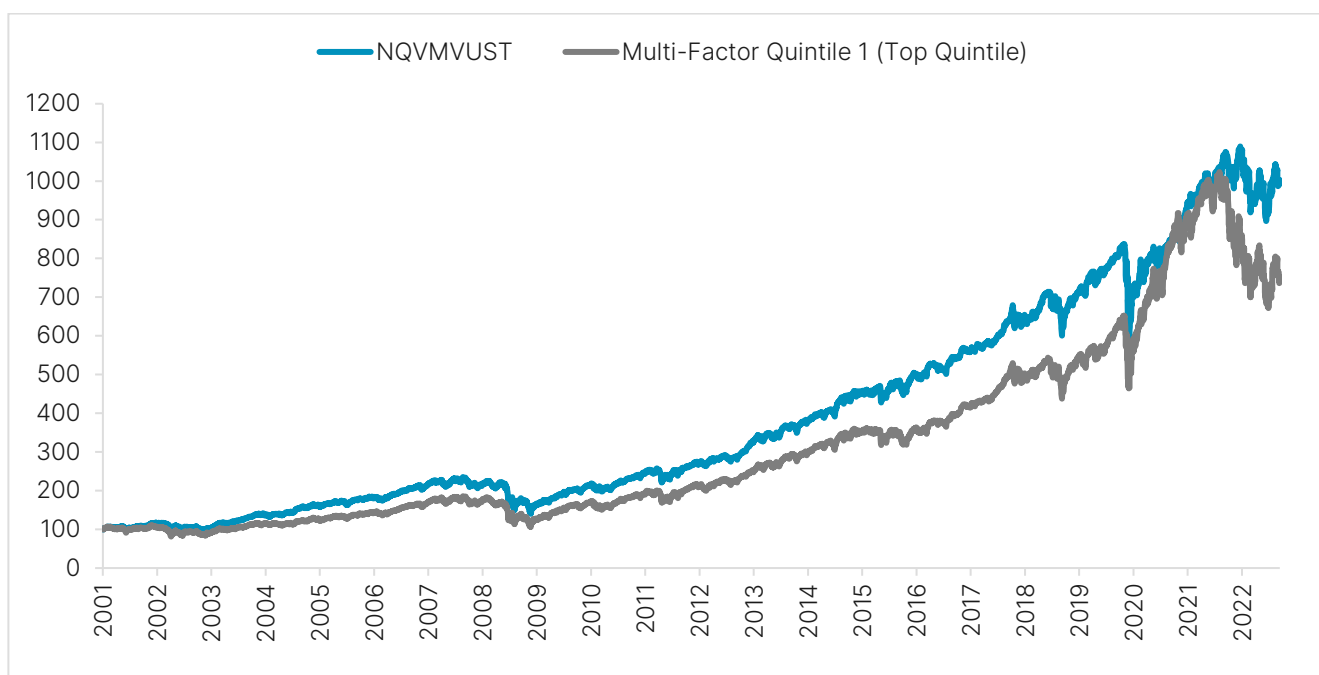
Index Performance:

Performance History: April 20, 2001 – December 30, 2022

Let us begin by looking at the overall performance between the Nasdaq Victory US Multi-Factor Minimum Volatility Total Return Index (NQVMVUST) and the Nasdaq US Large Mid Cap Total Return Index (NQUSBLMT) through December 30, 2022. Over the time frame studied, the Nasdaq Victory Multi-Factor Minimum Volatility Index returned 899% on a cumulative basis with 11.2% annualized return and 15% annualized volatility, which, we can see, not only vastly outperformed NQUSBLMT but did so with lower volatility.

	NQVMVUST	NQUSBLMT
Cumulative Return	899%	405%
Annualized Return	11.2%	7.7%
Volatility	15%	20%
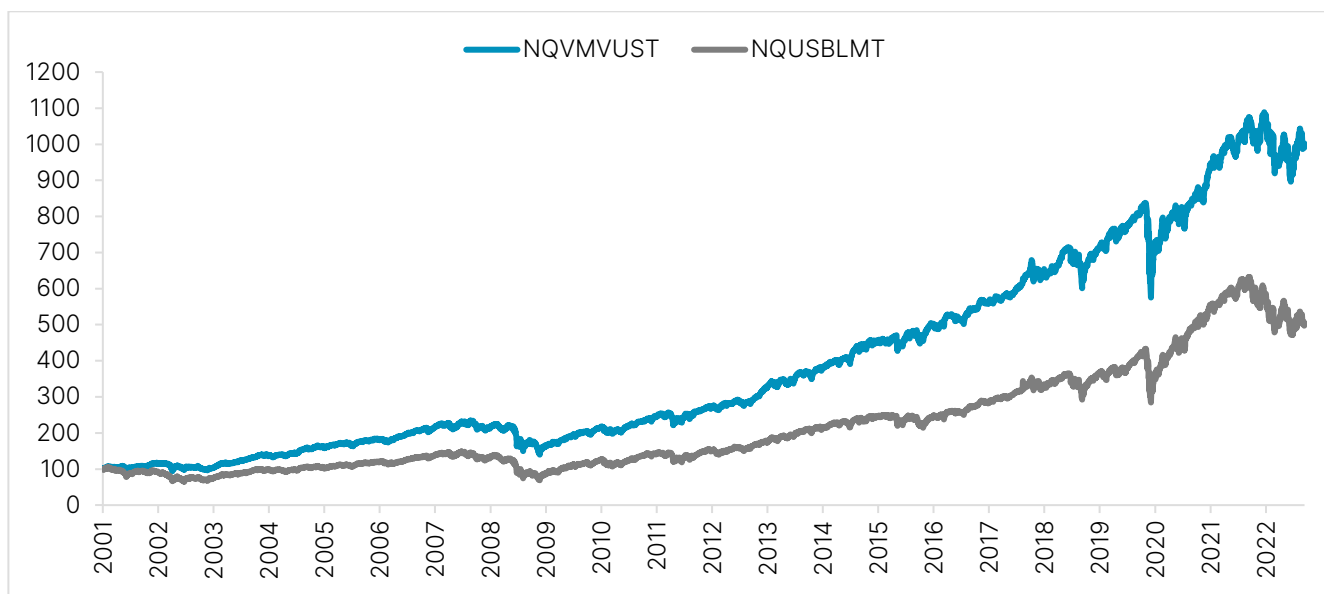
Performance Stats: April 20, 2001 – December 30, 2022

	NQVMVUST	NQUSBLMT
Beta	0.72	
Correlation	0.93	
Sharpe Ratio	0.74	0.39

Performance History – Peer Comparison: April 20, 2001 – December 30, 2022

Finally, let's compare the NQVMVUST Index to two other popular low-volatility indexes currently in the marketplace: the S&P 500 Low Volatility Total Return Index (SP5LVIT) and the MSCI USA Minimum Volatility Gross Total Return Index (M00IMV$T). Yet again, the unique combination of quintile ranking and optimization generated impressive outperformance during the same time frame, with higher absolute returns than both competitor indexes and comparable volatility.

	NQVMVUST	SP5LVIT	M00IMV$T
Cumulative Return	899%	589%	464%
Annualized Return	11.2%	9.3%	8.3%
Volatility	15%	15%	16%
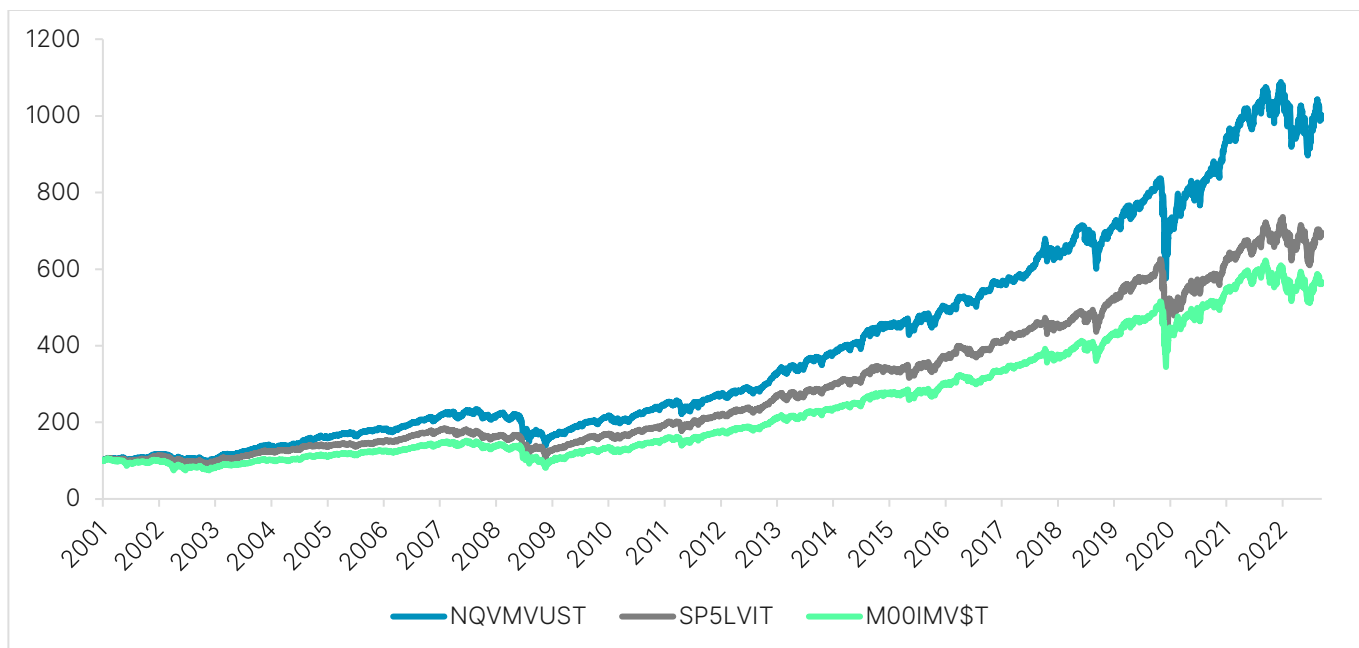
Conclusion:

The Nasdaq Victory US Multi-Factor Minimum Volatility Index was designed to improve upon existing low-volatility strategies in the marketplace. Rather than selecting and weighting securities based solely on their volatility or using a one-step volatility optimizer on the entire US equity market, the Index employs a two-step approach spelled out in the index name. In the first step, a multi-factor ranking process selects the highest-scoring securities in the US. In the second step, an optimization process determines weights that seek to minimize volatility while meeting other constraints that keep the index strongly correlated with the overall market. The graphics show that the multi-factor model produced a better performance with lower volatility than the S&P 500. After running the securities with their multi-factor composite scores through the optimizer, the historical results show how applying an optimization process allowed for even better performance while limiting volatility.

Market participants can gain exposure to this Index through the VictoryShares US Multi-Factor Minimum Volatility ETF (VSMV).