S&P Dow Jones Indices

A Division of S&P Global

Research

Factor Indices: A Simple Compendium

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INTRODUCTION

Passive management has become so prominent in the investing landscape that we sometimes forget that the entire history of index funds spans only 50 years. *Indices*, of course, have a more extensive pedigree[1] than index *funds*, having been developed initially simply as a means of summarizing the returns of a given stock market.[2] As such, it was natural for at least some observers to compare the returns of actively managed portfolios to index returns, thus using indices as *benchmarks* for portfolio management. It was the observation that many (nay, most) professional investment managers routinely underperformed index benchmarks that led to the creation of the first index funds, i.e., to the use of indices as *investment vehicles*.[3]

The first generation of index funds was designed to replicate an asset class; for example, the S&P 500® is the most common representative of large-capitalization U.S. stocks. But not all active managers can be usefully evaluated by comparing them to large-capitalization U.S. stocks; specialist mandates (perhaps emphasizing value, or small size, or low volatility) are common among investment managers, and indices have evolved in order to provide appropriate benchmarking. Factor indices—understanding a "factor" as an attribute with which excess returns are associated—are a prime example of this trend.

Factor indices can help the clients of specialist managers disentangle how much of the manager's performance is attributable simply to factor exposure, and how much is attributable to the manager's stock selection beyond the factor. Like their first-generation counterparts, factor indices can be used as both benchmarks and investment vehicles. In the latter use, we can speak of "indicizing" a factor or set of factors—i.e., delivering in passive form a strategy formerly available only via active management.[4]

[1] Preston, Hamish, "How Now the Dow?" S&P Dow Jones Indices, May 2021.

[2] Lazzara, Craig J., "Why Cap Weighting?" S&P Dow Jones Indices, November 2020.

[3] Ganti, Anu R. and Craig J. Lazzara, "Shooting the Messenger," S&P Dow Jones Indices, December 2017.

[4] Lazzara, Craig, "Coming Soon to a Dictionary Near You," S&P Dow Jones Indices, November 2013.

OUR DESIGN FOR THIS PAPER

The number of possible factor indices is limited mainly by the considerable creativity of their designers.

The number of possible factor indices is limited mainly by the considerable creativity of their designers.[5] We feel safe in opining that the number of genuine *factors*—attributes with which excess return is associated—is considerably lower than the number of factor *indices*. There are, after all, many ways in which a factor can be expressed. Consider an investor who wants exposure to the value factor (i.e., who wants to overweight cheap stocks). How might he measure value? Perhaps by the ratio of earnings to price, or by the ratio of book value to price, or with a dividend discount model. These are not three separate factors, but three aspects of the same factor.

In this paper, we provide brief descriptions of S&P DJI's approach to the following eight attributes:

In this paper, we provide brief descriptions of S&P DJI's approach to eight different attributes…

- Value
- Dividend Yield
- Growth
- Quality
- Momentum
- Size
- Low Volatility
- High Beta

Not all of these attributes can legitimately meet the academic definition of a factor; indeed, if low volatility is a factor, then high beta is almost certainly not, and so too for value and growth. None the less, all of these attributes have evoked considerable interest, and we hope that even those that fail the academic test might prove interesting and useful to our readers.

…not all of which meet the academic definition of a factor.

Our treatment of each factor will be relatively succinct. We use 30 years of historical data, starting in 1991. Each month, we sort the constituents of the S&P 500 in order by every factor. We then form equal-weighted quintiles from those sorted values, denoting Quintile 1 as the stocks with the highest exposure to the factor and Quintile 5 as the stocks with the lowest exposure. Ideally, the spread between the performance of Quintiles 1 and 5 will be positive; most academic work on factors focuses on the Quintile 1-Quintile 5 spread. Our approach will be more concerned with Quintile 1, which typically forms the base for our factor indices, and is consistent with most investors' long-only approach.[6]

[5] Harvey, Campbell R., Yan Liu, and Heqing Zhu, "… and the Cross-Section of Expected Returns," *The Review of Financial Studies*. 29.1, 5-68, January 2016.

[6] For a general, almost philosophical, overview of some problems in evaluating factor indices, see Lazzara, Craig J., "The Limits of History," S&P Dow Jones Indices, January 2013.

VALUE

Background

Value investing is based on the principle that "cheap" stocks tend to outperform "expensive" stocks in the long run.

Value investing is one of the oldest and best-known investing styles and is based on the principle that "cheap" stocks tend to outperform "expensive" stocks in the long run.[7] Value investors seek stocks that are undervalued in either absolute or relative terms, often using valuation ratios such as book-to-price ratio to assess relative value across companies.

Our view is that combining several metrics is better than using a single indicator to assess relative value, as this gives a more holistic view of a company's valuation. Indices such as the S&P 500 Value, S&P 500 Pure Value, and S&P 500 Enhanced Value Index use three fundamental measures.

We measure value stocks using three factors: the ratios of book value to price, earnings to price, and sales to price.

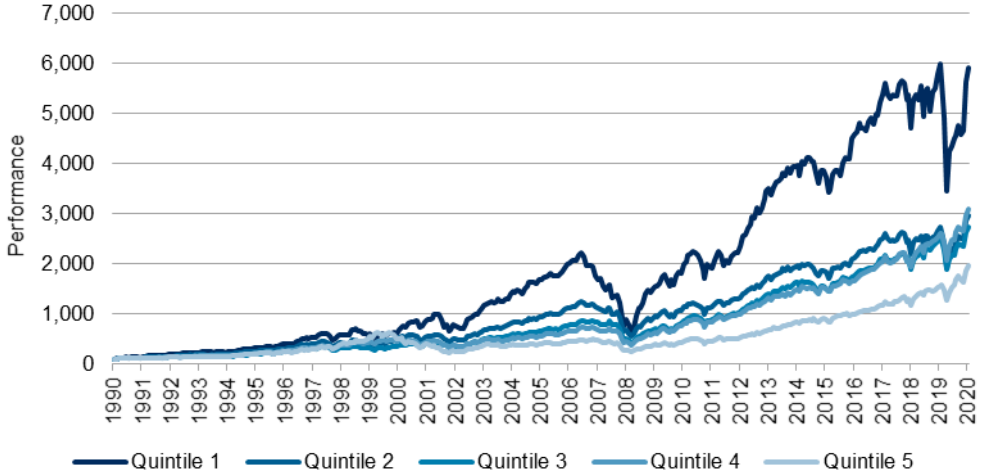
- **Book-to-price:** Calculated as a company's latest book value per share divided by price.
- **Earnings-to-price:** Calculated as a company's latest earnings per share divided by price.
- **Sales-to-price:** Calculated as a company's latest sales per share divided by price.

Observations

Exhibit V1 shows that the cheapest quintile of stocks handily outperformed the others over time. Quintiles 2-4 are relatively bunched, with Quintile 5 trailing.

Exhibit V1: Top Value Quintile Outperformed

Value Quintile 1 handily outperformed the others over time.



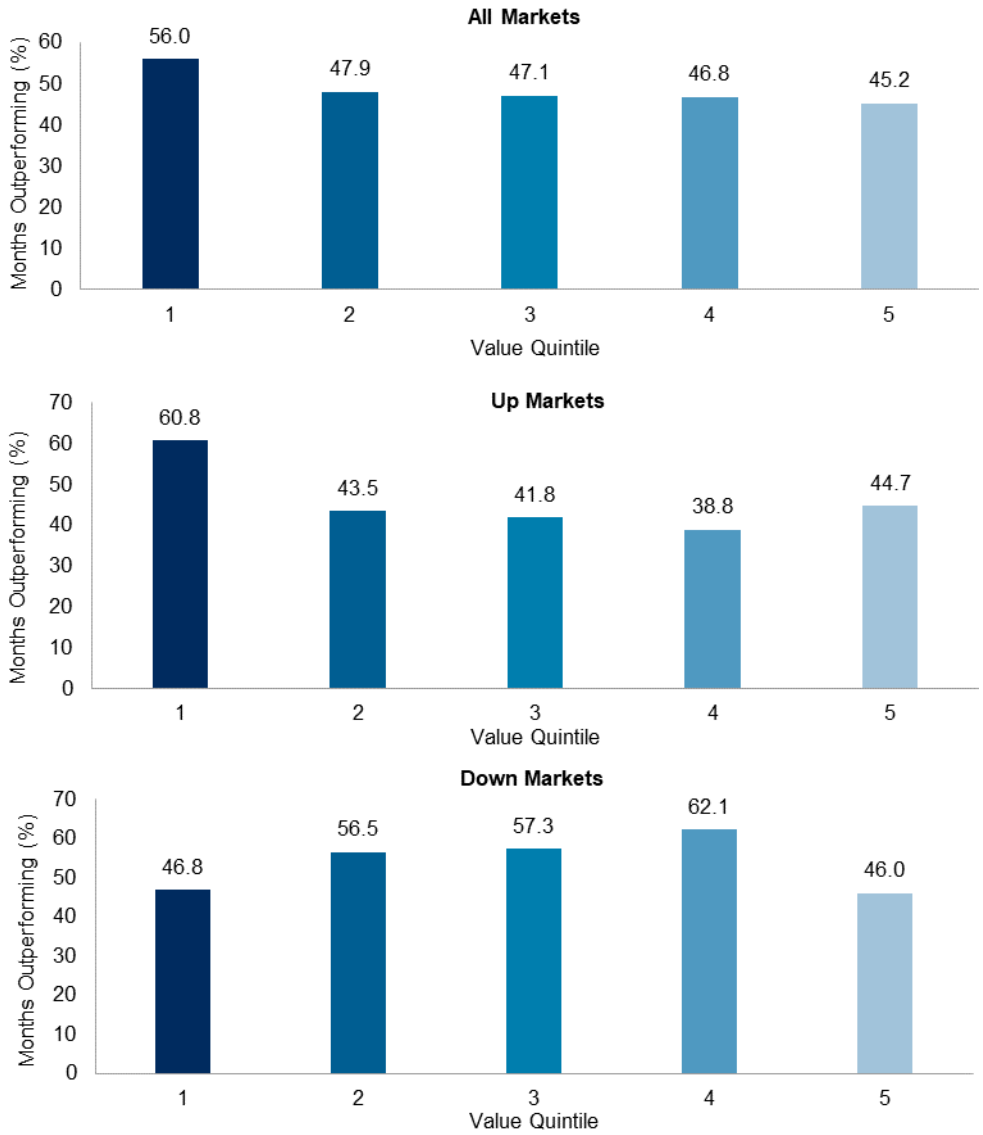
Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

[7] Fama, Eugene F. and Kenneth R. French, "Multifactor Explanations of Asset Pricing Anomalies," *Journal of Finance,* 51, 55-84, 1996.

The good performance of Quintile 1 did not accrue steadily…

Exhibit V2 shows that the good performance of Quintile 1 did not accrue steadily but rather had a strong relationship with the overall market environment. The cheapest quintile was much more likely to outperform in months when the market rose than when it declined. It was easily the most consistent quintile in rising markets and among the worst when the market fell.

Exhibit V2: Value Did Better in Rising Markets



…but rather had a strong relationship with the overall market environment.

It was easily the best quintile in rising markets and among the worst when the market fell.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

Finally, Exhibit V3 lets us make a number of other observations about the value factor.

Although Quintile 1 had the best returns, it was also the most volatile.

- Although Quintile 1 had the best returns, it was also the most volatile. Sharpe ratios showed relatively little variance across quintiles.
- The advantage of Quintile 1 survived adjustment for tracking error; Quintile 1 was the only quintile with a positive information ratio.
- There was a clear relationship between value and company size. Quintile 1 companies had the smallest average capitalization and Quintile 5 the largest.

There was a clear relationship between value and company size.

Exhibit V3: Key Value Statistics[8]

STATISTIC	VALUE QUINTILE				
	1	2	3	4	5
Quintile Return (%)	1.14	0.94	0.92	0.95	0.82
Standard Deviation Return (%)	6.34	4.81	4.52	4.43	5.13
Sharpe Ratio	0.18	0.20	0.20	0.21	0.16
Excess versus Universe	0.17	-0.03	-0.05	-0.02	-0.15
Tracking Error (Annualized, %)	8.44	4.21	3.55	3.88	8.33
Information Ratio	0.21	-0.07	-0.15	-0.05	-0.18
Average Market Cap (USD Millions)	15,918	20,523	23,655	28,180	33,558

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

DIVIDEND YIELD

Background

High-yield strategies seek to identify stocks that have demonstrated a consistent ability to pay dividends. In low-rate environments and times of market uncertainty, dividend strategies have been favored by retail and institutional investors seeking attractive yields and potential outperformance, since dividends can be a reliable source of income. Indeed, the potential power of dividend yields to forecast stock returns has been a topic of exploration for many studies.[9]

[8] The universe is a custom version of the benchmark, the S&P 500, and excludes secondary listings. The quintile and universe returns are the geometric mean of the period equal weight returns. Standard Deviation is the square root of the variance of returns acro ss periods. Sharpe Ratio is the (quintile return – risk free rate) divided by the standard deviation of return. Excess Return versus Universe is the difference in quintile and universe returns. Tracking Error is the standard deviation of excess return over the universe. Information Ratio is the ratio of annualized residual alpha (excess return versus universe) divided by annualized residual risk (tracking error).

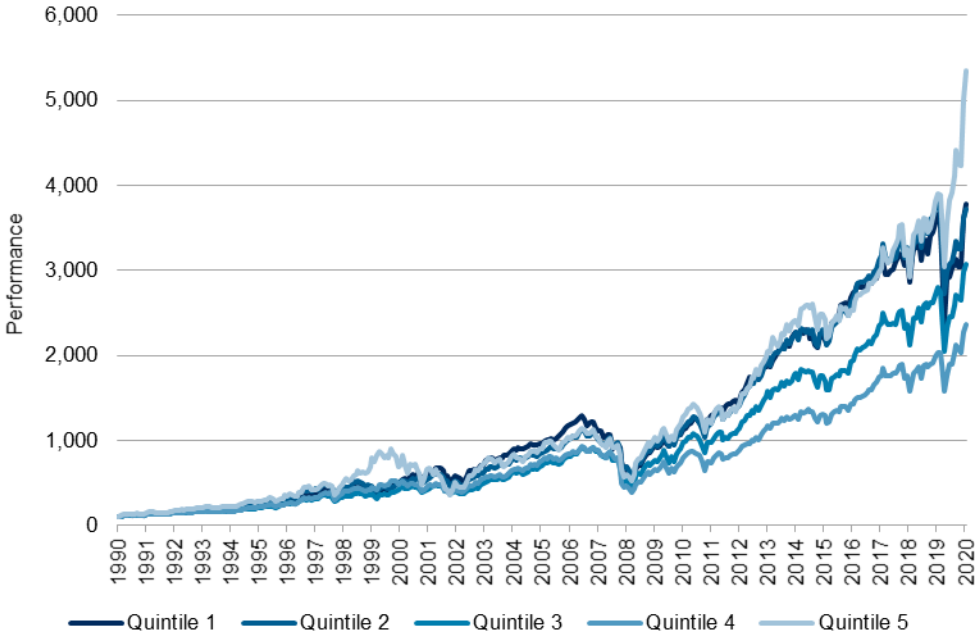
[9] Fama, Eugene F. and Kenneth R. French, "Dividend yields and expected stock returns." *Journal of Financial Economics*, 22.1, 3-25, 1988.

Observations

High-yield strategies seek to identify stocks that have demonstrated a consistent ability to pay dividends.

In Exhibit DY1, non-dividend payers are assigned to Quintile 5, while the remaining companies are split evenly among Quintiles 1-4. There is an inconsistent relationship between dividend yield and long-term performance. The best performer is Quintile 5, the non-payers. The other quintiles sort out monotonically, with Quintiles 1 and 2 relatively close together, while Quintiles 3 and 4 trail behind.

Exhibit DY1: High Yield and No Yield Outperformed Low Yield

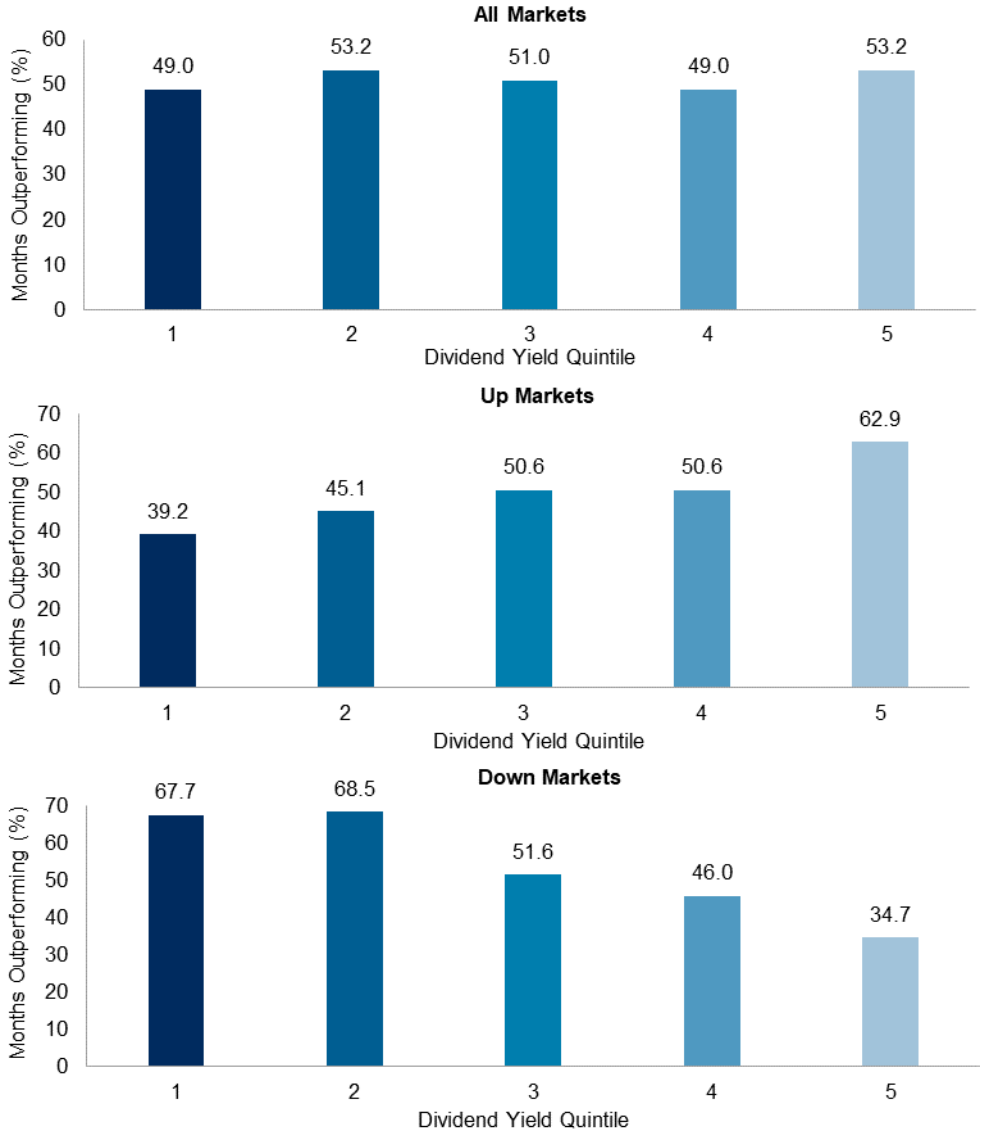


There is an inconsistent relationship between dividend yield and long-term performance.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

Exhibit DY2 shows that yield (unsurprisingly) had a strong defensive bias. Quintiles 1 and 2 outperformed the benchmark in more than two-thirds of the down months. The down market hit rate declines as we move to lower-yield quintiles. Contrariwise, yield seekers should recognize that they tend to underperform in rising markets.

Exhibit DY2: Yield Demonstrated a Defensive Bias



Quintiles 1 and 2 outperformed the benchmark in more than two-thirds of the down months.

While Quintile 5 had the best absolute returns, it was also substantially more volatile than the other quintiles.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

From Exhibit DY3, we make a few further observations.

- While Quintile 5 had the best absolute returns, it was also substantially more volatile than the other quintiles.
- On a risk-adjusted basis, Quintile 5 was the worst performer, with the returns of Quintile 1-3 bunched together and coming out on top.
- The average non-dividend payer was slightly smaller than dividend paying companies. Quintile 5 companies had the smallest average market capitalization, while the other quintiles had roughly the same average capitalization.

Sometimes seen as the opposite of the value factor, growth has been one of the best-known and most-popular investment styles for several decades.

Exhibit DY3: Key Dividend Yield Statistics

STATISTIC	DIVIDEND YIELD QUINTILE				
	1	2	3	4	5
Quintile Return (%)	1.02	1.00	0.95	0.87	1.11
Standard Deviation Return (%)	4.91	4.43	4.67	4.90	6.48
Sharpe Ratio	0.21	0.23	0.20	0.18	0.17
Excess versus Universe	0.02	0.01	-0.04	-0.13	0.11
Tracking Error (Annualized, %)	7.81	5.01	4.39	4.87	10.52
Information Ratio	0.02	0.02	-0.10	-0.26	0.10
Average Market Cap (USD Millions)	24,516	27,741	25,703	24,485	20,889

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

GROWTH

Background

Growth is an attribute of a company; a company can have strong growth prospects regardless of its stock's valuation.

Sometimes seen as the opposite of the value factor, growth has been one of the best-known and most-popular investment styles for several decades. An important subtlety is that investors typically think of value as an attribute of a *stock*; a value stock is cheap relative to its underlying business prospects. In contrast, growth is an attribute of a *company*; a company can have strong growth prospects regardless of its stock's valuation. Of course, strong growth prospects may deserve a rich valuation, but ideally there should be more to defining growth than simply the absence of value.

For a systematic growth factor strategy, the challenge is to develop a consistent and effective model for capturing growth over time. Additionally, while it is common for stocks to be classified as either growth or value, the two styles are not mutually exclusive, and some stocks might not fit neatly into either category. S&P DJI uses three metrics to measure growth.

S&P DJI uses earnings growth, sales growth, and price momentum to measure growth.

- **Earnings growth:** Calculated as a company's three-year net change in earnings per share (excluding extra items) over current price.
- **Sales growth:** Calculated as a company's three-year per share growth rate.
- **Price momentum:** Calculated as a company's 12-month percentage price change.

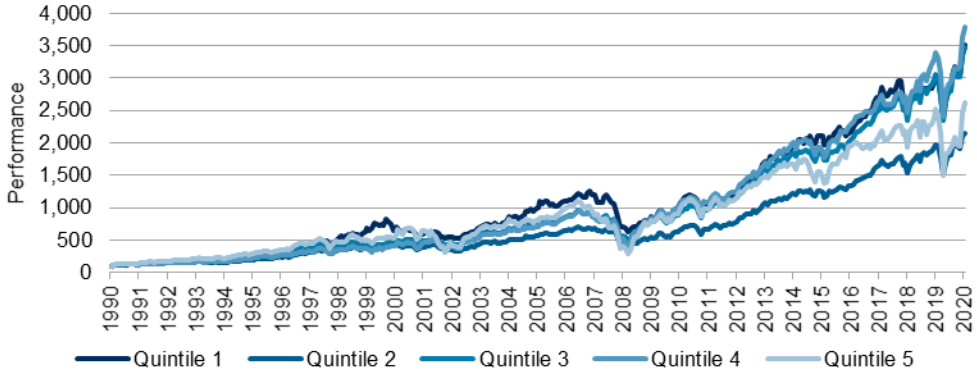
Observations

In terms of performance, it is hard to identify a clear pattern across the quintiles in Exhibit G1. Quintiles 1, 3, and 4 were quite closely bunched, while Quintile 5 lost ground over the past decade, and Quintile 2 lagged, albeit with less volatility. The lack of clear separation across growth quintiles is as good an explanation as any of why growth is not generally

considered to be a factor in the same sense as value. As noted, if value is a factor, growth probably cannot be.

In terms of performance, it is hard to identify a clear pattern across the growth quintiles.

Exhibit G1: Growth Performance Was Inconsistent



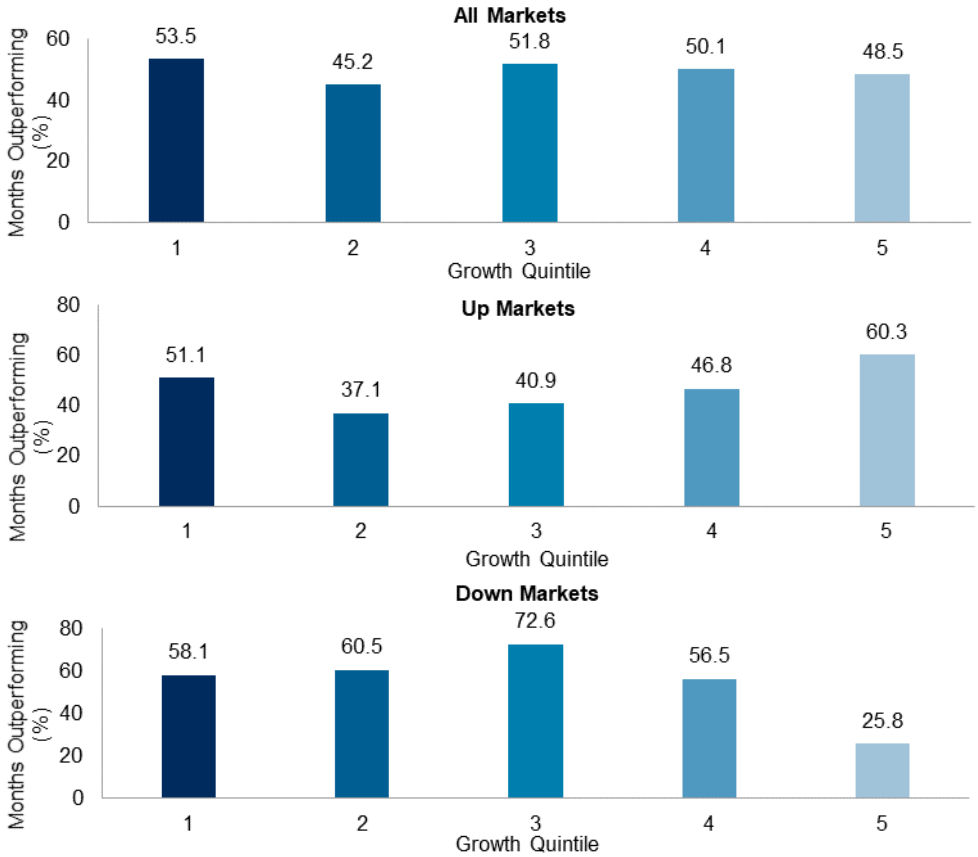
Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

The lack of clear separation across growth quintiles is a good explanation for why growth is not generally considered to be a factor in the same sense as value.

Exhibit G2 shows that Quintile 1 was the most likely to outperform across all market environments. It was not the leader in either up markets or down markets but was the only quintile with a hit rate above 50% regardless of the market's direction.

Exhibit G2: Top Growth Quintile Slightly Outperformed across All Markets

Quintile 1 was the most likely to outperform across all market environments, but it was not the leader in either up or down markets.



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

On a risk-adjusted basis, Quintiles 1-4 were quite closely clustered…

Exhibit G3 allows us to make a few additional observations.

- On a risk-adjusted basis, Quintiles 1-4 were quite closely clustered, while Quintile 5 clearly underperformed, primarily due to its significantly higher volatility.
- Quintile 1 had the highest average market cap, which decreases with each subsequent quintile. (The opposite holds true for value.)
- Quintiles 1 and 5 had the highest tracking error (same for value).

Exhibit G3: Key Growth Statistics

STATISTIC	GROWTH QUINTILE				
	1	2	3	4	5
Quintile Return (%)	0.99	0.85	0.98	1.01	0.91
Standard Deviation Return (%)	4.59	4.13	4.30	5.12	7.14
Sharpe Ratio	0.22	0.21	0.23	0.20	0.13
Excess versus Universe	0.02	-0.12	0.02	0.04	-0.06
Tracking Error (Annualized, %)	8.19	4.94	3.63	4.50	10.69
Information Ratio	0.03	-0.24	0.04	0.10	-0.06
Average Market Cap (USD Millions)	30,791	27,191	24,762	22,378	16,707

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

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QUALITY

Background

Unlike some other well-known factors such as size or momentum, there is limited consensus on the definition of quality.

Unlike some other well-known factors such as size or momentum, there is more limited consensus on the definition of quality. Practitioners typically relate quality to some measure of profitability, sometimes including metrics such as cash flow generation, earnings growth and stability, and financial robustness. Like growth, it is helpful to think of quality as a *company* characteristic rather than a *stock* characteristic.

Regardless of the method used, the aim of any quality measure should be to aid in identifying companies with relatively high profitability and relatively low balance sheet leverage. In general, high-quality companies seek to adopt a conservative and effective capital framework that promotes steady growth alongside higher revenue and cash.

Quality can sometimes seem difficult to capture objectively.[10] Considering this, we believe that using datapoints across a firm's financial statements provides a robust and comprehensive definition. S&P DJI uses a three-pronged approach to determining quality in a systematic manner.

[10] Ung, Daniel, Priscilla Luk, and Xiaowei Kang, "Quality: A Distinct Equity Factor?" S&P Dow Jones Indices, July 2014.

While quality can seem difficult to capture objectively, S&P DJI uses ROE, BSA, and financial leverage ratio to determine quality in a systematic manner.

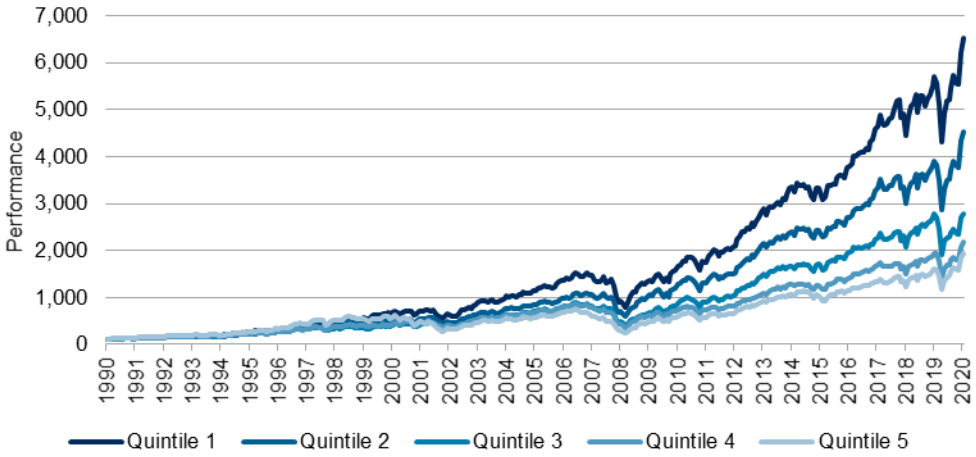
- **Return on equity (ROE):** Calculated as a company's trailing 12-month earnings per share divided by its latest book value per share.
- **Balance sheet accruals ratio (BSA):** Used to measure earnings quality,[11] this is defined as the change of a company's net operating assets over the past year divided by its average net operating assets over the past two years. All else equal, the higher the BSA, the lower the company's earnings quality.[12]
- **Financial leverage ratio:** Calculated as a company's latest total debt divided by its book value.

Observations

Exhibit Q1 suggests that investors have historically been compensated for holding high-quality stocks. Over the long term, the highest-quality quintile of stocks outperformed the others, with subsequent quintiles performing progressively less attractively.

Over the long term, the highest-quality quintile of stocks outperformed the others…

Exhibit Q1: Top Quality Quintile Outperformed



…with subsequent quintiles performing progressively less attractively.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

Exhibit Q2 shows that while high-quality stocks were generally more likely to outperform the market than other quintiles, their outperformance during market declines was much more impressive. The top quintile of quality stocks outperformed the benchmark in 71% of the months when the S&P 500 declined. During rising markets, Quintile 1 still did slightly better than the other quintiles but lost out to the bottom quintile of low-quality stocks. Overall, the asymmetric performance of top and bottom quintiles in rising and declining markets suggests quality stocks may be sensitive to market

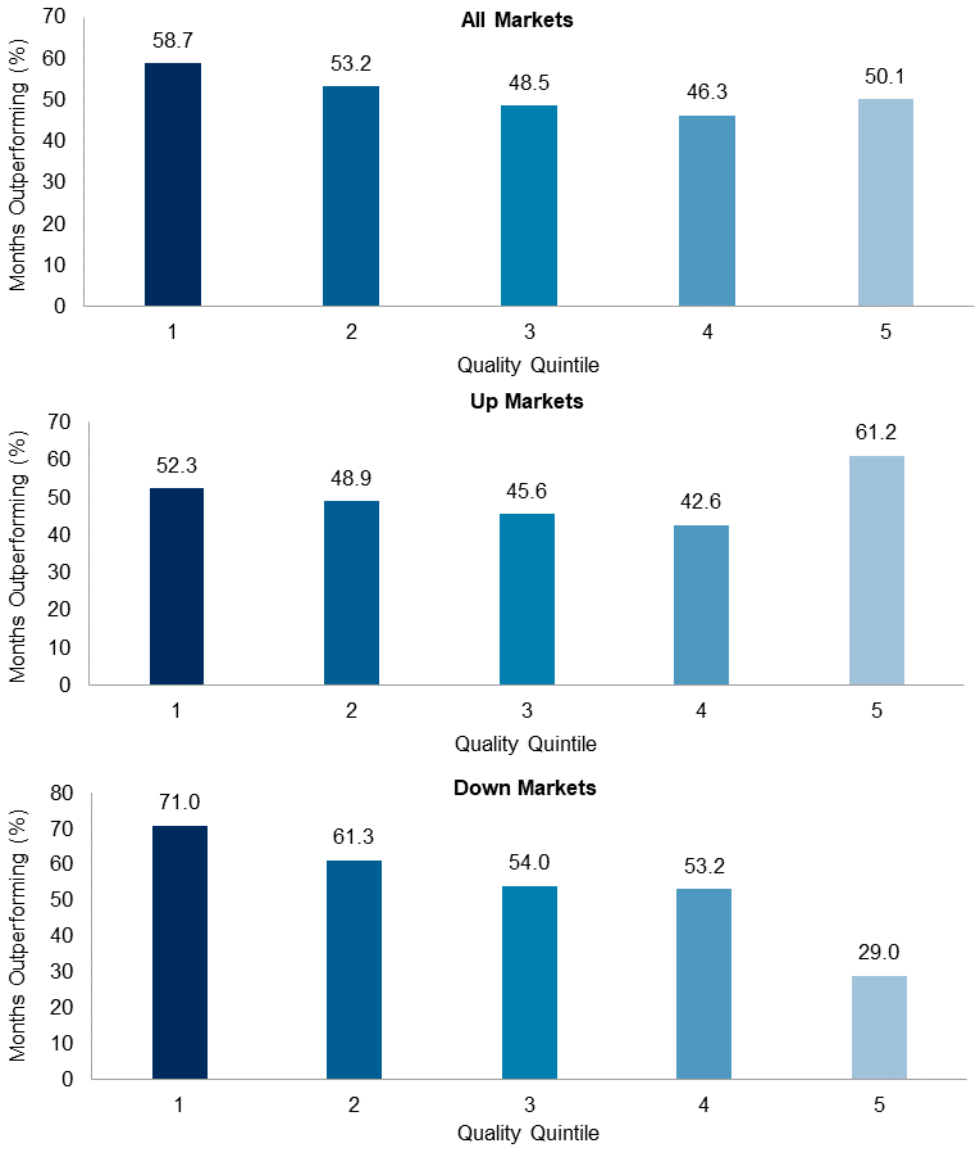
[11] Richardson, Scott A., Richard G. Sloan, Mark T. Soliman, and A. Irem Tuna, "Accrual Reliability, Earnings Persistence and Stock Prices," *Journal of Accounting & Economics*, Vol. 39, No. 3, 2005.

[12] Hao, Bill, "Measuring Earnings Quality – Balance Sheet Accruals Ratio Versus Earnings Variability," S&P Dow Jones Indices, October 2018.

conditions and tend to deliver more significant excess returns in down markets.

While high-quality stocks were more likely to outperform the market…

Exhibit Q2: Quality Had Asymmetric Performance in Rising and Declining Markets



…their outperformance during market declines was much more impressive.

Overall, the asymmetric performance of top and bottom quintiles in rising and declining markets suggests quality stocks may be sensitive to market conditions.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

From Exhibit Q3, we make a few further observations on the quality factor.

- The performance advantage of higher-quality stocks persisted after risk adjustment, with Quintile 1 earning a Sharpe ratio nearly twice as high as that of Quintile 5. Quintile 1 also had the highest information ratio over time.

- High-quality companies tend to have the largest average market capitalization, while other quintiles show relatively less variance across size.

The performance advantage of higher quality stocks persisted after risk adjustment…

Exhibit Q3: Key Quality Statistics

STATISTIC	QUALITY QUINTILE				
	1	2	3	4	5
Quintile Return (%)	1.16	1.06	0.92	0.85	0.82
Standard Deviation Return (%)	4.42	4.57	4.73	4.80	5.90
Sharpe Ratio	0.26	0.23	0.19	0.18	0.14
Excess versus Universe	0.19	0.09	-0.05	-0.12	-0.15
Tracking Error (Annualized, %)	3.64	3.38	3.12	3.05	6.01
Information Ratio	0.53	0.27	-0.16	-0.38	-0.25
Average Market Cap (USD Millions)	29,305	24,847	23,207	20,962	23,773

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

…with Quintile 1 earning a Sharpe ratio nearly twice as high as that of Quintile 5.

MOMENTUM

Background

Momentum investors seek to purchase stocks that have recently performed relatively well and to avoid those that have underperformed. Unlike value and growth, for example, which have relatively well-established pedigrees, momentum is a newer addition to the factor universe.[13] Momentum strategies have become increasingly popular in the past several decades, and the S&P 500 Momentum Index has performed better than the S&P 500 over the long term.

Momentum investors seek to purchase stocks that have recently performed relatively well, avoiding those that have underperformed.

We calculate momentum using 12 months of data beginning 13 months prior, avoiding the one-month reversal effect.[14] The momentum scores for each security are adjusted for risk.

Observations

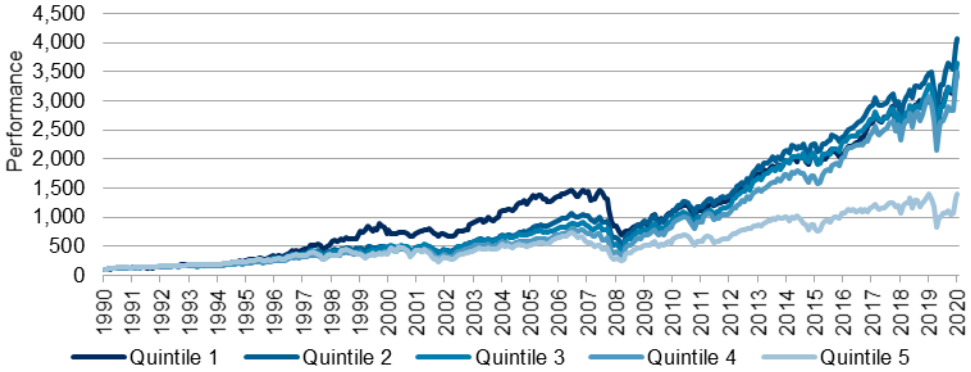
The quintile analysis for momentum (Exhibit M1) supports an exclusionary approach to portfolio construction. We immediately notice that the returns of Quintiles 1-4 are clustered together, while Quintile 5 underperformed significantly. Avoiding the lowest-momentum stocks is much more important than trying to concentrate on the highest-momentum stocks.

[13] Carhart, Mark M., "On Persistence in Mutual Fund Performance," *Journal of Finance* 52: 57-82, 1997.

[14] Jegadeesh, Narasimhan, "Evidence of predictable behavior of security returns," *Journal of Finance (1990)*: 881-898.

Avoiding the lowest-momentum stocks is much more important than trying to concentrate only on the highest-momentum stocks.

Exhibit M1: Bottom Momentum Quintile Underperformed Significantly



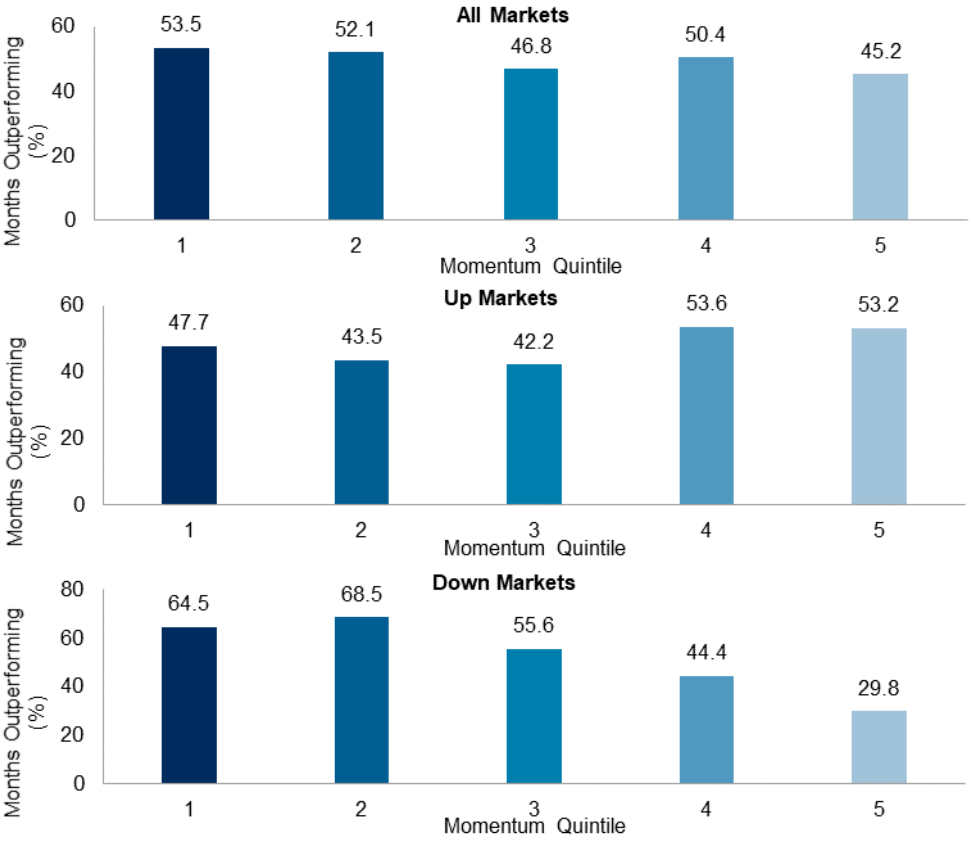
Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes

Momentum's top quintiles had defensive characteristics when examined across different market environments.

Exhibit M2 shows that momentum's top quintiles appear to have defensive characteristics when we examine performance relative to the benchmark during different market environments. Quintiles 1 and 2 tend to do best in months when the benchmark return was negative, historically outperforming 65% and 69% of the time, respectively. Meanwhile, Quintiles 4 and 5 tend to do better during rising markets, outperforming 54% and 53% of the time, respectively.

Exhibit M2: Momentum Did Better during Down Markets

Quintiles 1 and 2 did best in months when the benchmark return was negative, while Quintiles 4 and 5 did the opposite.



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

Exhibit M3 lets us make a few other observations about the momentum factor.

Momentum Quintiles 1-4 generated excess returns over the universe.

- Quintiles 1-4 generated excess returns over the universe.
- Quintile 5 lagged the universe and also had the highest tracking error, and therefore the lowest information ratio. This is unsurprising, as the stocks in Quintile 5 are by definition those that have performed relatively poorly.
- Average market capitalization was the highest in Quintile 1 and declined monotonically for each subsequent quintile.

Average market capitalization was the highest in Quintile 1 and declined monotonically for each subsequent quintile.

Exhibit M3: Key Momentum Statistics

STATISTIC	MOMENTUM QUINTILE				
	1	2	3	4	5
Quintile Return (%)	0.99	1.03	1.00	0.98	0.74
Standard Deviation Return (%)	4.39	4.27	4.72	5.37	6.72
Sharpe Ratio	0.22	0.24	0.21	0.18	0.11
Excess versus Universe	0.02	0.06	0.03	0.02	-0.23
Tracking Error (Annualized, %)	9.43	4.67	3.23	4.65	9.90
Information Ratio	0.02	0.13	0.09	0.03	-0.23
Average Market Cap (USD Millions)	31,782	27,300	24,534	21,647	16,866

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

SIZE

Background

Size is one of the factors in the seminal Fama-French three-factor model, and its pedigree extends even further back in time.

Size is one of the factors in the seminal Fama-French three-factor model,[15] and its pedigree extends even further back in time.[16] Over the long term, smaller companies tend to outperform larger companies.

Observations

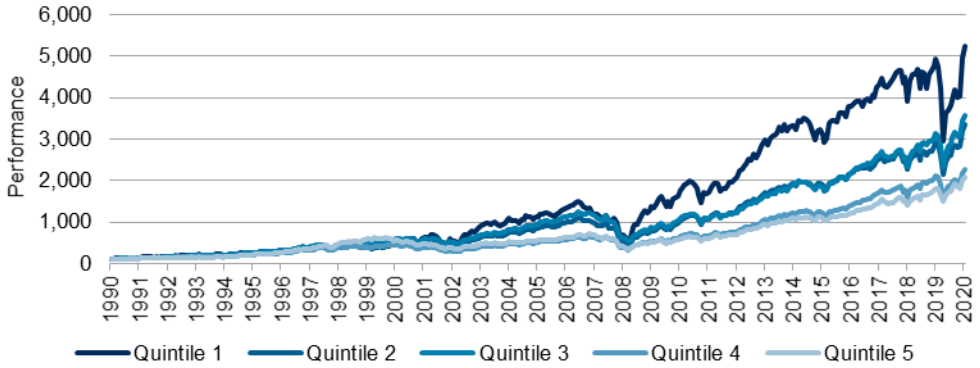
Exhibit S1 shows that the quintile analysis for size supports a top-quintile approach to factor construction, similar to what we saw for value.

[15] Fama, Eugene F. and Kenneth R. French, "The Cross-Section of Expected Stock Returns," *The Journal of Finance,* 47(1), March 1992, 427-465.

[16] Banz, Rolf W., "The Relationship between returns and market value of common stocks," *Journal of Financial Economics*, 9(1), 1981, 3-18. Reinganum, Marc R., "Misspecification of capital asset pricing: Empirical anomalies based on earnings' yields and market values," *Journal of Financial Economics,* 9, March 1981, 19-46.

The quintile analysis for size supports a top-quintile approach to factor construction, similar to what we saw for value.

Exhibit S1: Top Size Quintile Outperformed

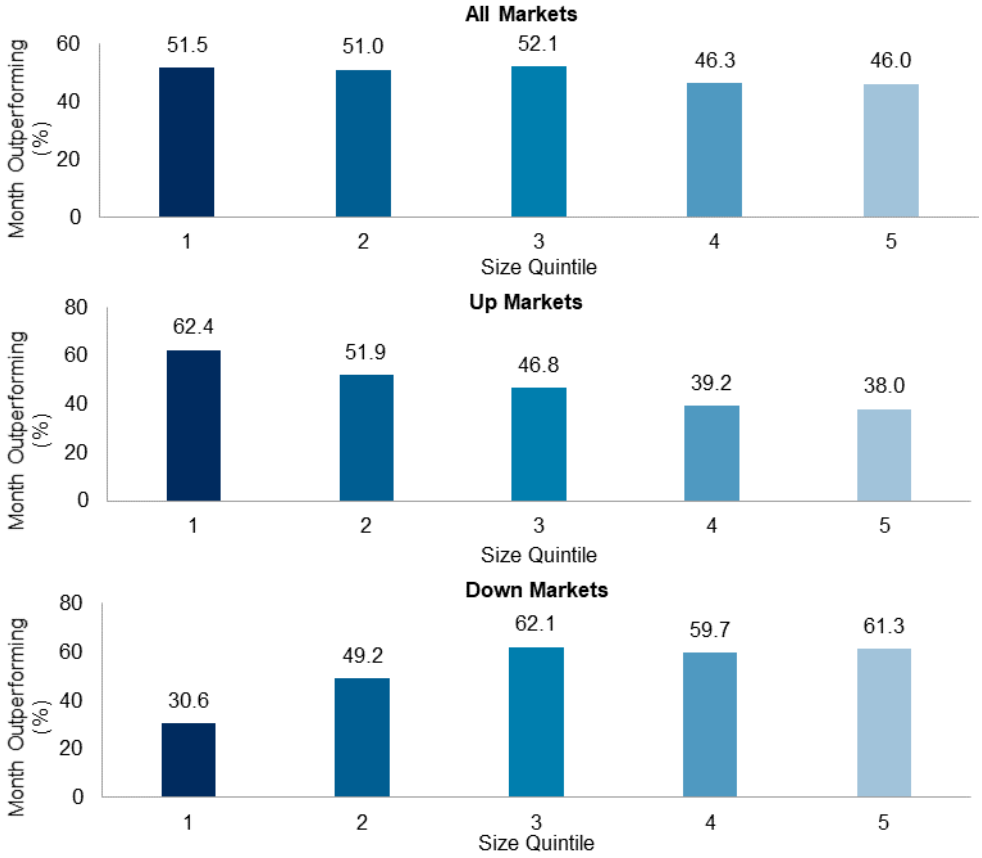


Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

Size's pro-cyclical nature, similar to value, is further evidenced in Exhibit S2 when examining Quintile 1's performance relative to the benchmark. Quintile 1 tended to do best in months when the benchmark return was positive, historically outperforming 62% of the time. Additionally, it was the least defensive, underperforming 69% of the time when the benchmark return was negative.

Size Quintile 1 tended to do best in months when the benchmark return was positive, historically outperforming 62% of the time…

Exhibit S2: Size Did Better in Rising Markets



…and it was the least defensive among the size quintiles.

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

Exhibit S3 lets us make some additional observations about the size factor.

Over the long term, only the smallest stocks generated significant excess returns over the universe across this analysis period.

- Over the long term, only Quintile 1 (the smallest stocks) generated significant excess returns over the universe across this analysis period. Quintile 1 had the highest return, with subsequent quintiles becoming less attractive.
- Quintile 1 also had the highest standard deviation of returns, consistent with the view that smaller stocks tend to be more volatile. Quintile 1's Sharpe ratio is penalized by this higher volatility. Its information ratio, on the other hand, was superior to those of the other quintiles.

Quintile 1 also had the highest standard deviation of returns, consistent with the view that smaller stocks tend to be more volatile.

Exhibit S3: Key Size Statistics

STATISTIC	SIZE QUINTILE				
	1	2	3	4	5
Quintile Return (%)	1.11	0.98	0.99	0.86	0.84
Standard Deviation Return (%)	6.67	5.01	4.53	4.38	4.18
Sharpe Ratio	0.17	0.19	0.22	0.20	0.20
Excess versus Universe	0.14	0.01	0.02	-0.10	-0.13
Tracking Error (Annualized, %)	8.84	3.44	3.51	3.81	6.16
Information Ratio	0.16	0.02	0.07	-0.27	-0.21
Average Market Cap (USD Millions)	3,613	6,772	11,042	19,592	80,761

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

LOW VOLATILITY

Background

The phenomenon of lower risk assets outperforming higher risk assets over time, dubbed the low volatility anomaly, was noted by academics almost half a century ago.

The phenomenon of lower risk assets outperforming higher risk assets over time was noted by academics almost half a century ago.[17] Flouting the conventional wisdom that risk and return go hand in hand, this phenomenon was dubbed the low volatility anomaly. The anomaly has been observed universally across different markets and asset classes.[18]

While the concept is far from new, low volatility gained mainstream popularity in the period following the trauma of the 2008 global financial crisis. The strategy seeks to reduce risk relative to the benchmark and, as such, tends to attenuate the returns of the market, typically underperforming in good markets and outperforming in bad markets.

[17] Jensen, Michael C., Fischer Black, and Myron S. Scholes, "The Capital Asset Pricing Model: Some Empirical Tests," *Studies in the Theory of Capital Markets*, Praeger Publishers Inc., 1972; see also: Fama, Eugene F. and James D. MacBeth, "Risk, Return, and Equilibrium: Empirical Tests," *The Journal of Political Economy*, Vol. 81, No. 3. (May-June 1973), pp. 607-636.

[18] Chan, Fei Mei and Craig J. Lazzara, "Is the Low Volatility Anomaly Universal?" S&P Dow Jones Indices, April 2019.

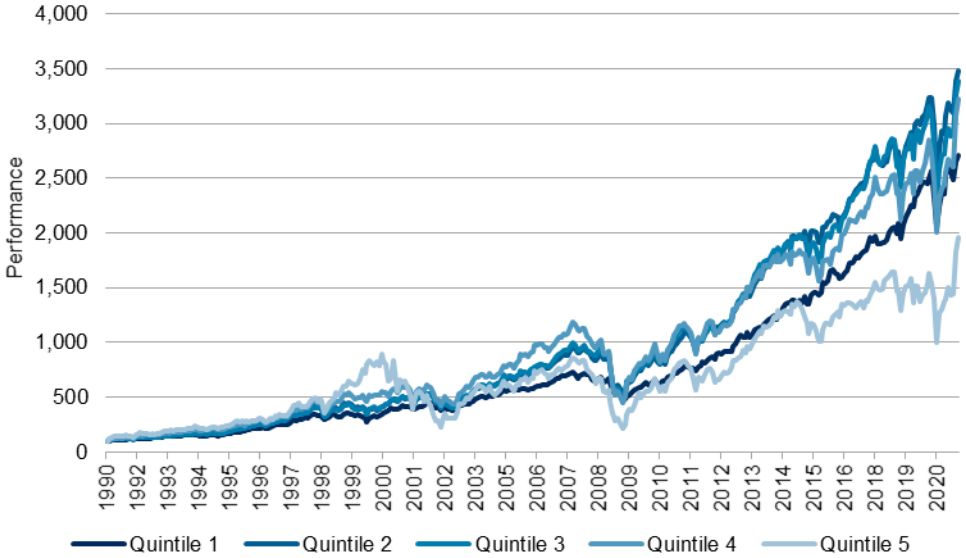
S&P DJI's rankings-based methodology sorts stocks into quintiles, measured by the trailing 12 months' daily volatility.

Observations

From a purely performance perspective, the most important thing is to avoid the highest volatility quintile.

From a performance perspective, Exhibit LV1 shows that the most important thing is to avoid Quintile 5 (the highest volatility quintile). The laggard by a wide margin, Quintile 5 was a star in the buildup to the 2000 technology bubble but fell just as dramatically following the bust. Quintile 2 was the overall best performer.

Exhibit LV1: The High Volatility Quintile Significantly Underperformed



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

Quintile 2 was the overall best performer.

More than any other factors, volatility and beta strategies are explicitly tied to the performance of the overall market.

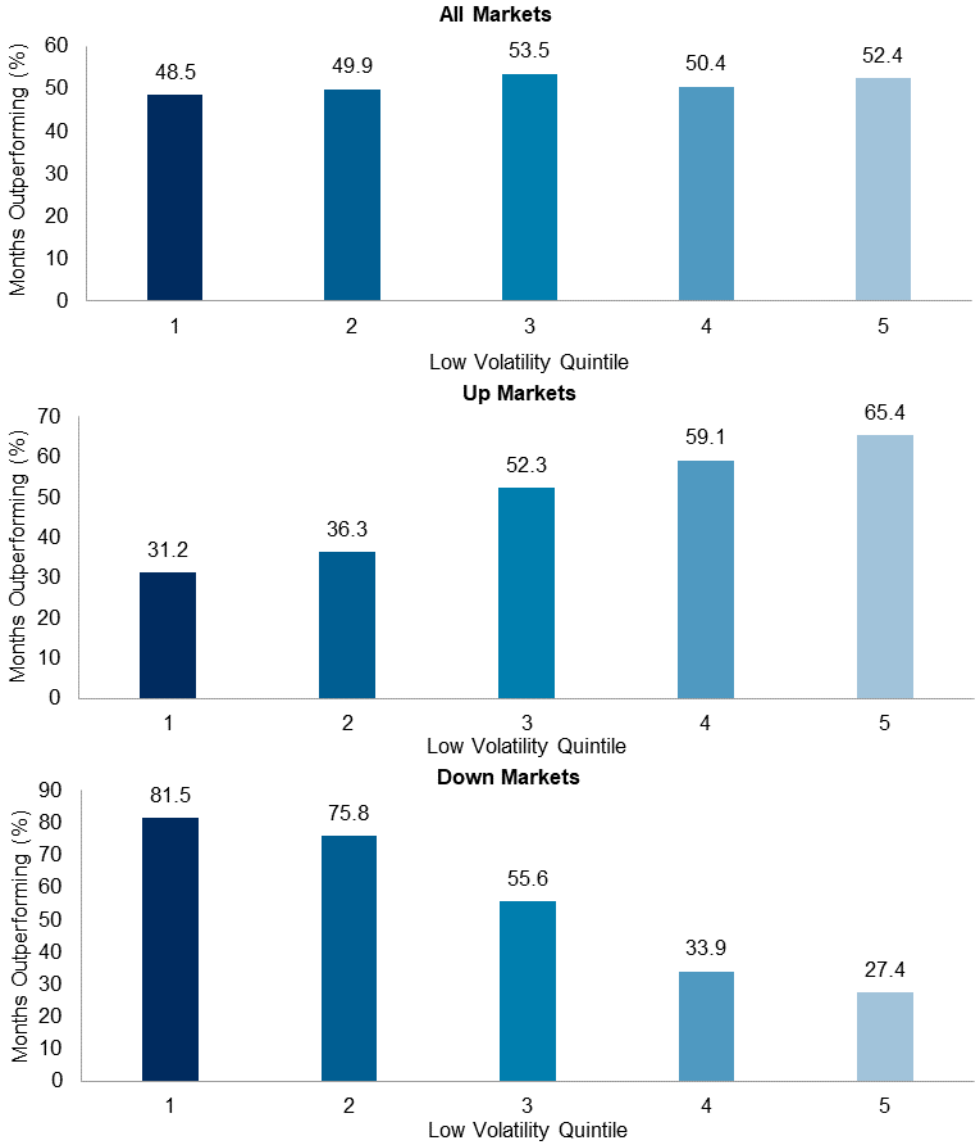
More than any other factors, volatility and beta strategies are explicitly tied to the performance of the overall market. The patterns in Exhibit LV2 are reassuring. In up markets, Quintile 5 had the highest hit rate, outperforming the benchmark in 65% of the months. The hit rates decline monotonically as we move down the quintiles, with Quintile 1 underperforming 69% of the time.

Not surprisingly, the pattern for down markets was the opposite. Quintile 5 *underperformed* most often, while Quintile 1 outperformed most often (in 82% of the months).

In up markets, the high volatility quintile had the highest hit rate, outperforming the benchmark in 65% of the months.

Not surprisingly, the pattern for down markets was the opposite, with the lowest volatility quintile outperforming in 82% of the months.

Exhibit LV2: Volatility Strategies Were Tied to the Overall Market



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

Exhibit LV3 lets us make a number of other observations about the low volatility factor.

- On a risk-adjusted basis, Quintile 1 delivered the best performance as it had the highest Sharpe ratio.
- Risk-adjusted performance declines monotonically across the quintiles.
- Tracking error was significantly higher in Quintiles 1 and 5 than in Quintiles 2-4.

On a risk-adjusted basis, Quintile 1 delivered the best performance as it had the highest Sharpe ratio.

Exhibit LV3: Key Low Volatility Statistics

STATISTIC	LOW VOLATILITY QUINTILE				
	1	2	3	4	5
Quintile Return (%)	0.91	0.98	0.98	0.97	0.83
Standard Deviation Return (%)	3.24	4.01	4.72	5.47	8.25
Sharpe Ratio	0.28	0.24	0.21	0.18	0.10
Excess versus Universe	-0.05	0.02	0.01	0.00	-0.14
Tracking Error (Annualized)	9.99	5.78	3.88	4.11	15.17
Information Ratio	-0.05	0.03	0.03	0.00	-0.09
Average Market Cap (USD Millions)	34,325	29,323	24,339	20,772	13,307

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

HIGH BETA

Background

A high beta strategy offers a way to increase exposure to market returns without explicitly taking on leverage.

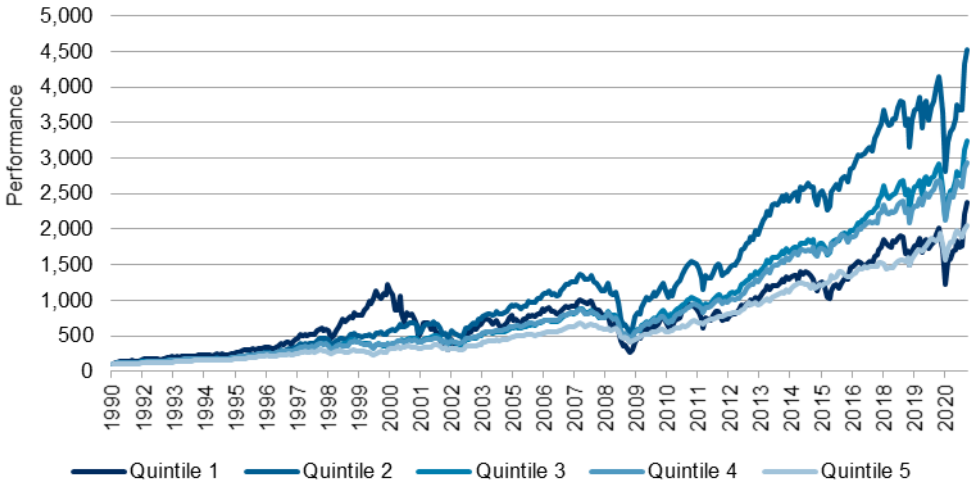
A high beta strategy offers a way to increase exposure to market returns without explicitly taking on leverage. Designed to amplify market returns, high beta should outperform when the market is up and underperform when the market is down. High beta strategies can deliver excess returns in short windows of rising markets but tend to underperform over the long term (the low volatility anomaly in reverse). S&P DJI estimates betas using 12 months' daily data.

Observations

High beta strategies can deliver excess returns in short windows of rising markets but tend to underperform over the long term.

Overall, Quintile 2 (the second highest beta quintile) was the best performer by a large margin. Quintile 5 was the worst performer.

Exhibit HB1: The Second Highest Beta Quintile Was the Best Performer



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Chart is provided for illustrative purposes.

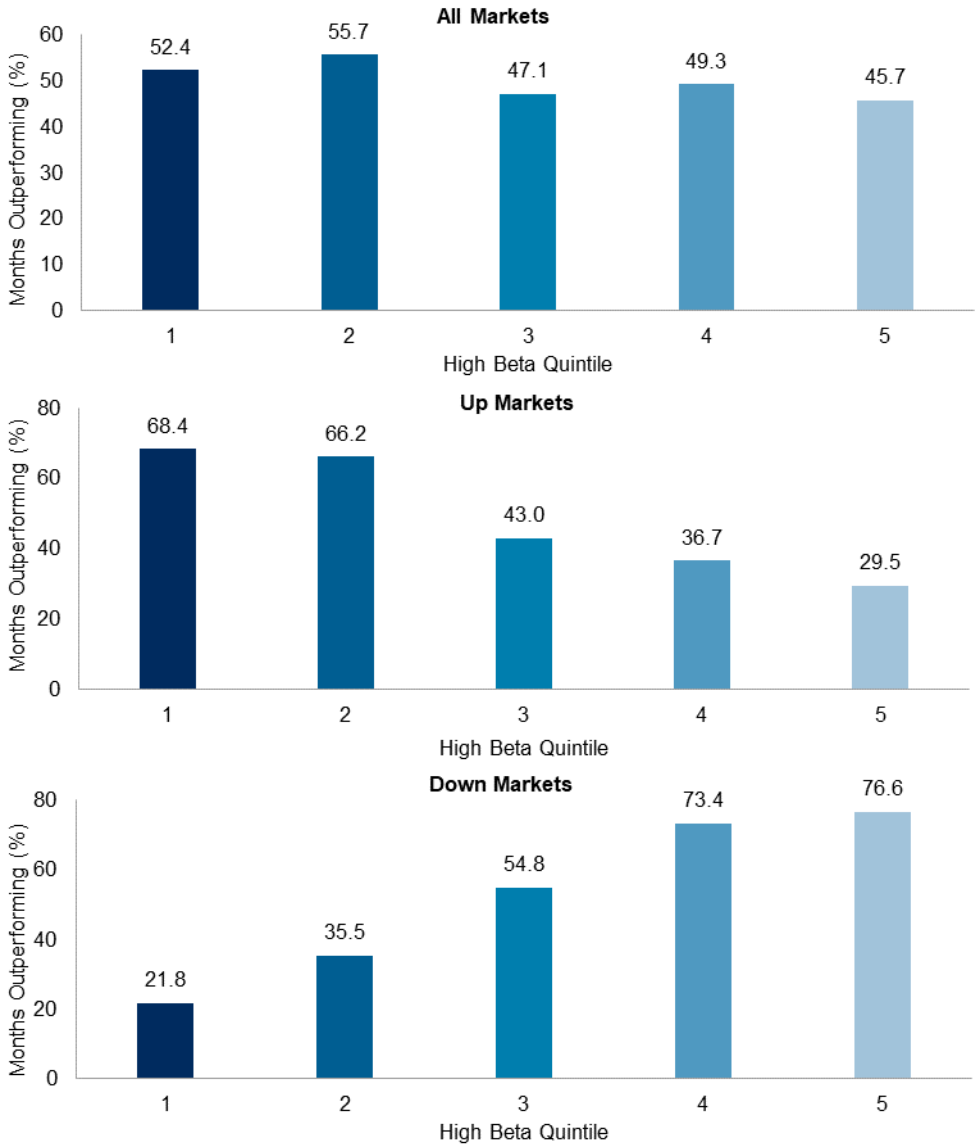
High beta, similar to low volatility, explicitly extracts a certain pattern of returns from the market but in the other direction.

High beta, similar to low volatility, explicitly extracts a certain pattern of returns from the market, but in the other direction. Since the strategy is almost the exact opposite of low volatility, it is not surprising to find that results were almost the mirror of those for low volatility. Each quintile outperformed the benchmark in roughly half of the monthly observations. However, in up markets, the highest beta quintile outperformed most often. The percentage of stocks outperforming the benchmark in this environment declined monotonically across the spectrum. The reverse was true in down markets.

In up markets, the highest beta quintile outperformed most often.

The reverse was true in down markets.

Exhibit HB2: High Beta Was the Opposite of Low Volatility



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Charts are provided for illustrative purposes.

Risk-adjusted return was highest for Quintile 5 and, not surprisingly, declined monotonically from there.

Exhibit HB3 lets us make a few additional observations about the high beta factor.

- Risk-adjusted return was highest for Quintile 5 and, not surprisingly, declined monotonically from there.
- Similar to low volatility, the tracking error was highest in Quintile 1 and 5 and by significant margins compared with those of Quintiles 2-4.
- Average market cap was similar across all five quintiles.

Average market cap was similar across all five quintiles.

Exhibit HB3: Key High Beta Statistics

STATISTIC	HIGH BETA QUINTILE				
	1	2	3	4	5
Quintile Return (%)	0.88	1.06	0.96	0.94	0.84
Standard Deviation Return (%)	8.07	5.66	4.66	4.05	3.37
Sharpe Ratio	0.11	0.19	0.21	0.23	0.25
Excess versus Universe	-0.09	0.09	0.00	-0.03	-0.13
Tracking Error (Annualized, %)	14.50	4.83	3.94	6.20	10.26
Information Ratio	-0.06	0.19	-0.01	-0.05	-0.13
Average Market Cap (USD Millions)	24,177	23,884	24,399	24,535	24,763

Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1990, through Dec. 31, 2020. Past performance is no guarantee of future results. Quintiles shown are hypothetical. Table is provided for illustrative purposes.

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