

Concentration within Sectors and Its Implications for Equal Weighting

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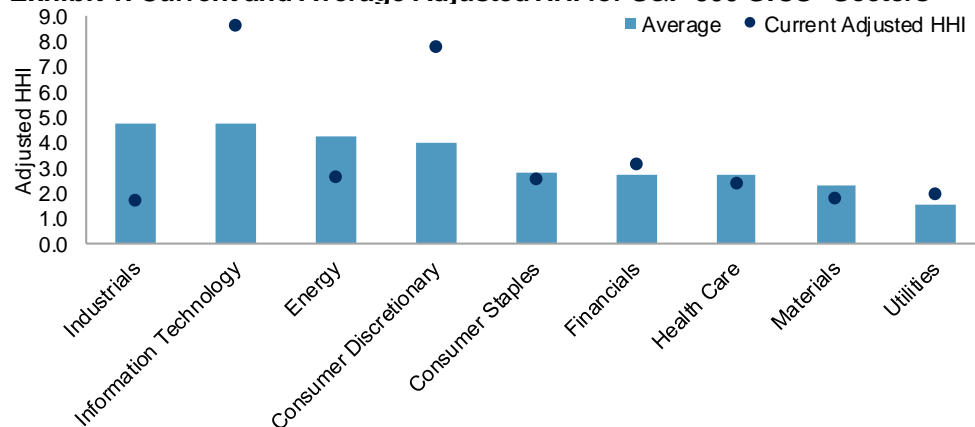
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EXECUTIVE SUMMARY

Concerns about the degree of concentration in cap-weighted indices like the [S&P 500®](#) seem to arise whenever performance is dominated by mega-cap names—as it has recently been. A simple way to measure market concentration is to add up the weight of the largest constituents in an index. Interestingly, after peaks in concentration—such as the aftermath of the technology bubble—the [S&P 500 Equal Weight Index](#) has typically outperformed its cap-weighted counterpart.

In this paper, we propose an alternative way to measure concentration. By adjusting the Herfindahl-Hirschman Index (HHI) to account for the number of names in a sector, we're able to make meaningful cross-sector comparisons. We show that **concentration tends to mean-revert in most sectors, which has important implications for the relative performance of equal weighting**. Exhibit 1 shows recent and average adjusted HHI levels across S&P 500 sectors.¹

Exhibit 1: Current and Average Adjusted HHI for S&P 500 GICS® Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

¹ We excluded Real Estate and Communication Services from this analysis, as those sectors underwent GICS changes in August 2016 and September 2018, respectively. Data points for the Financials sector reflect the inclusion of Real Estate companies through Aug. 31, 2016, and exclusion thereafter. Consumer Discretionary and Information Technology were affected as some stocks within these sectors moved to Communication Services.

A DIFFERENT WAY TO MEASURE CONCENTRATION

The HHI, defined as the sum of the squared index constituents' percentage weights, is a widely used concentration measure.

While looking at the weight of the top names is a simple way to assess market concentration, it's useful to have a more comprehensive method that incorporates all the constituents in an index. The HHI is a widely used concentration measure; it is defined as the sum of the squared index constituents' percentage weights.² For example, the HHI for an equally weighted 50-stock portfolio is 200 (50×2^2). The HHI for the S&P 500 Equal Weight Index, which comprises 500 stocks, is 20 (500×0.2^2).

Previous research has shown that the long-term performance advantage of equal weight over cap-weighted strategies is driven more by equal weighting *within* sectors than by equal weight's differential weighting *across* sectors.³ This may occur because of unique regulatory challenges faced by the largest stocks in each sector; interestingly, the HHI is used by the U.S. Department of Justice in evaluating the competitiveness of markets and in making decisions on antitrust concerns.

Other things equal, a higher HHI indicates increased concentration.

Other things equal, a higher HHI indicates increased concentration, but other things may not be equal: **even for completely unconcentrated equal weight portfolios, the HHI value is inversely related to the number of names.** As seen above, an equally weighted 50-stock index has a higher HHI than an equally weighted 500-stock index. If we want to use the HHI to examine the history of concentration within an index, we need to adjust for the number of names. We therefore define the *adjusted* HHI as the index's HHI divided by the HHI of an equally weighted portfolio with the same number of stocks.⁴ If there are n stocks in an index, the HHI for an equal-weighted portfolio is always $(10,000/n)$. Therefore, the adjustment factor for an n -stock index is $(n/10,000)$.

A higher adjusted HHI means that an index is becoming more concentrated, independent of the number of stocks it contains.

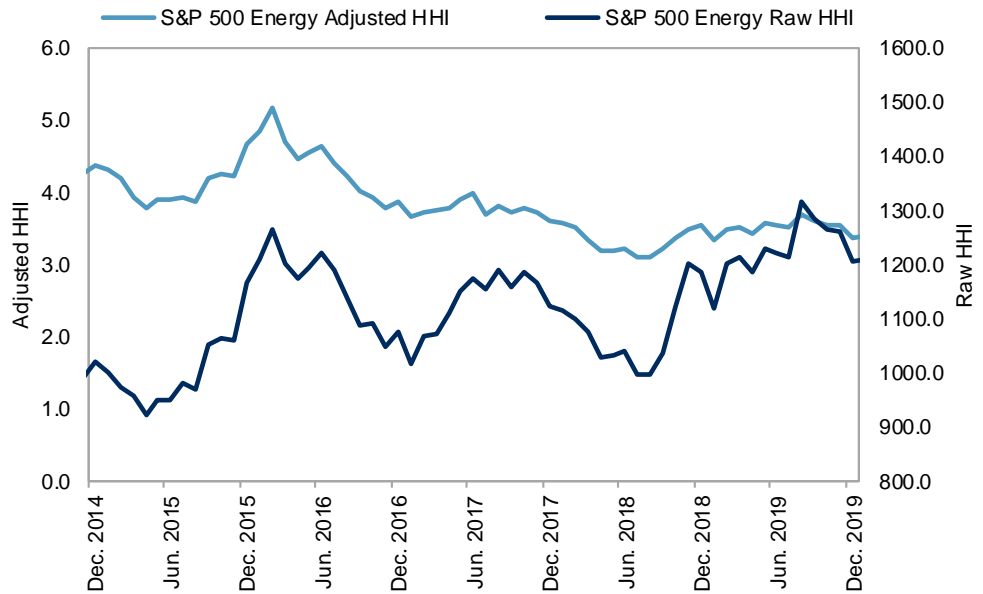
A higher adjusted HHI means that an index is becoming more concentrated, *independent of the number of stocks it contains.* We observe in Exhibit 2 that the *adjusted* HHI for the Energy sector decreased from 2014 to 2019, *in spite of* an increase in its raw HHI. This is because the number of constituents in the sector decreased from 43 in 2014 to 28 in 2019.

² Federal Reserve Bank of St. Louis, "[The Herfindahl-Hirschman Index](#)," March 1993; see also Hirschman, Albert O., "[The Paternity of an Index](#)," *American Economic Review*, Sept. 1964. Typically, individual constituent weights are stated as whole percentages; a stock with a 2% weight in an index is treated as 2.00, not 0.02. Thus, the maximum possible HHI (for a one-stock index) is 10,000.

³ Edwards, Tim, Craig J. Lazzara, Hamish Preston, and Oliver Pestalozzi, "[Outperformance in Equal-Weight Indices](#)," S&P Dow Jones Indices, January 2018.

⁴ The raw HHI for an index will always be between 0 and 10,000. There is no similar theoretical boundary for adjusted HHI, but empirically it seems to range between 1 and 16.

Exhibit 2: Historical Adjusted and Raw HHI for S&P 500 Energy Sector



Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 2014, through Dec. 31, 2019. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

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Since the number of names in the S&P 500 GICS sectors ranges from 21 to 76, we need to use the adjusted HHI to make meaningful cross-sector comparisons

Since the number of names in the 11 S&P 500 GICS sectors ranges from 21 (Energy) to 76 (Information Technology), we need to use the adjusted HHI to make meaningful cross-sector comparisons.

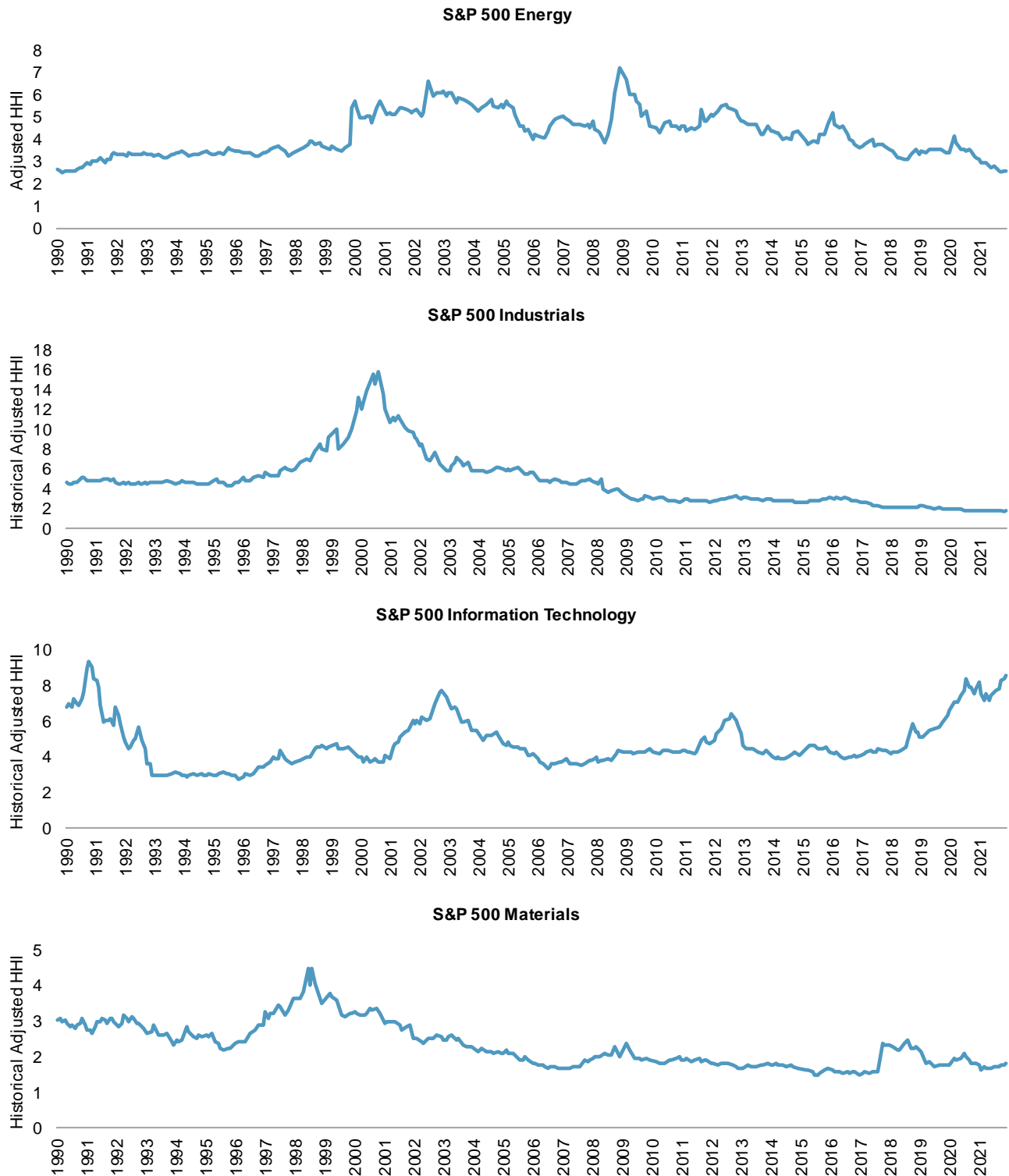
CONCENTRATION AND ITS REVERSION

Exhibit 3 shows a history of adjusted HHIs for a few key sectors since 1990.⁵ Concentration tends to mean-revert in most sectors; this is particularly noticeable in Energy, Industrials, Information Technology, and Materials. As a result, we can infer that when concentration is relatively high, as we see for Information Technology presently, it subsequently tends to decline. Meanwhile, when concentration is relatively low, as we see for Industrials, Energy, and Materials, it subsequently tends to increase.

Concentration tends to mean-revert in most sectors.

⁵ Please refer to the Appendix for the history of adjusted HHIs for the remaining sectors.

Exhibit 3: Historical Adjusted HHI across Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

The tendency of sector concentration to reverse has important implications for the performance of equal-weight strategies.

Another way to visualize the reversion of concentration is to divide our adjusted HHI data series into quartiles and track the movement within these quartiles⁶ over time. Exhibit 4 shows a transition matrix using a five-year window, as changes in concentration tend to occur very slowly. When a sector’s adjusted HHI was in quartile 1, the least concentrated quartile, the probability that its quartile ranking moved up in the subsequent five years was 71%, as concentration increased. Contrariwise, when a sector’s adjusted HHI was in quartile 4, the most concentrated quartile, the probability that its quartile ranking moved down was 82%, as concentration decreased.

Exhibit 4: Sector Concentration Tends to Reverse

ADJUSTED HHI RANKING	ADJUSTED HHI RANKING IN SUBSEQUENT 5 YEARS			
	1	2	3	4
1	29.3%	18.3%	22.2%	30.1%
2	40.3%	14.1%	15.7%	29.8%
3	45.7%	15.3%	12.3%	26.6%
4	49.1%	18.0%	14.6%	18.3%

Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

History suggests that there is a relationship between concentration and the relative performance of equal weighting...

The tendency of sector concentration to reverse has important implications for the performance of equal-weight strategies.

CONCENTRATION AND EQUAL-WEIGHT SECTOR PERFORMANCE

History suggests that there is a relationship between concentration and the relative performance of equal weighting: after peaks in S&P 500 concentration, the S&P 500 Equal Weight Index tended to outperform.⁷ Does this relationship also exist at the sector level?

...after peaks in S&P 500 concentration, the S&P 500 Equal Weight Index tended to outperform.

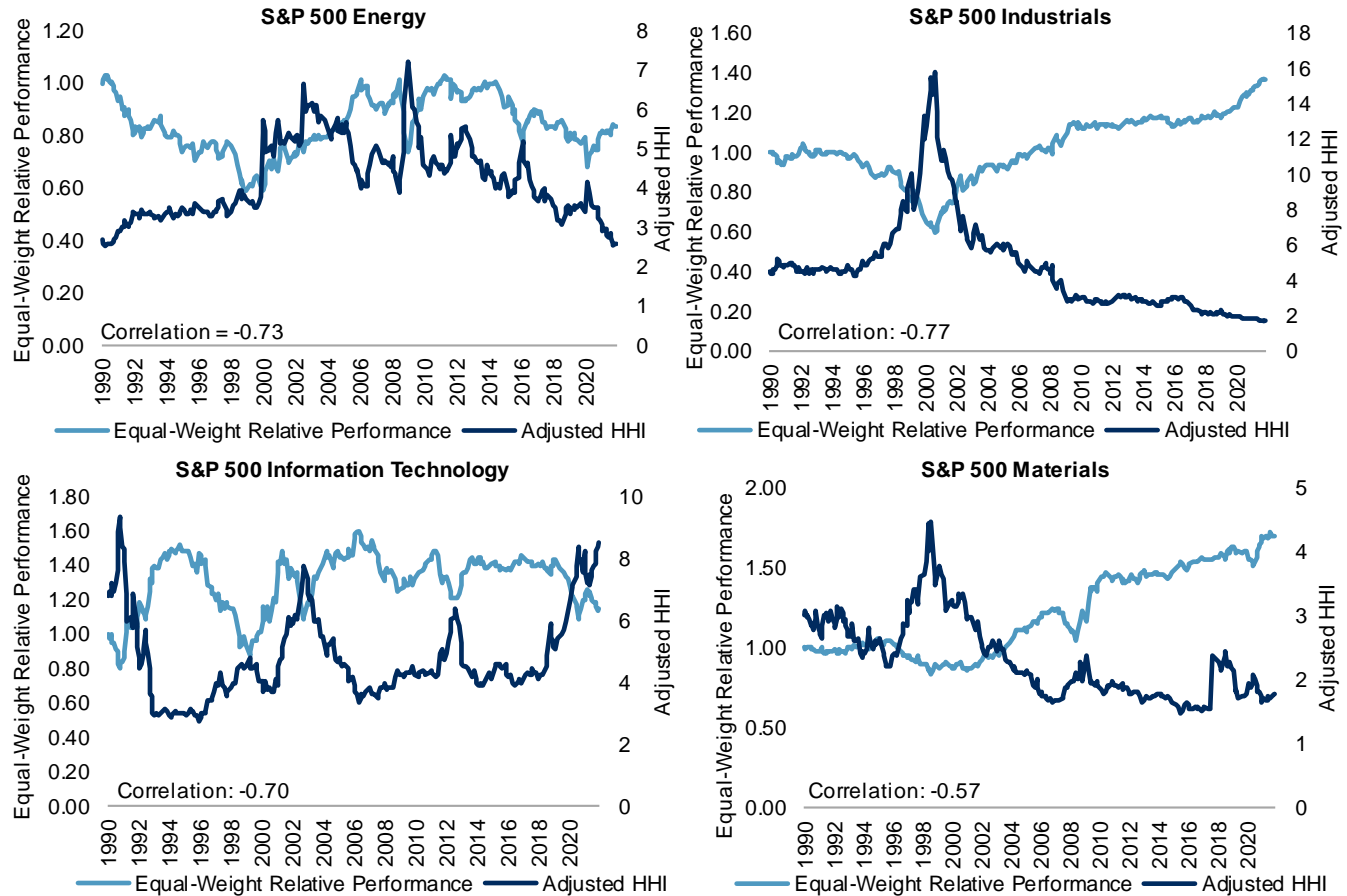
Exhibit 5 plots the historical adjusted HHI for a few key sectors along with the relative performance of the equal-weighted version of each sector. The exhibit also includes the correlation of contemporaneous monthly changes between the two time series since 1990.⁸ We again notice a trend: equal-weighted sectors tended to outperform after peaks in their sector concentration (and to underperform following troughs). This is particularly noticeable, for example, for Information Technology.

⁶ Quartile breakpoints calculated on a trailing 5-year basis at a monthly frequency.

⁷ Edwards, Tim, “[Higher Concentrations in the S&P 500 could lead to Equal Weight Outperformance](#),” S&P Dow Jones Indices, September 2018.

⁸ Please refer to the Appendix for the historical adjusted HHI along with the relative equal-weight performance for the remaining sectors.

Exhibit 5: Historical Adjusted HHI and Equal Weight Relative Performance across Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

These consistently negative correlations demonstrate that changes in equal-weight relative performance and changes in concentration **are not two separate things, but two aspects of the same thing**. That “thing” is the relative performance of large- versus small-cap stocks in each sector. If larger stocks outperform smaller ones, concentration will increase, and equal weight will underperform. Similarly, if smaller stocks outperform, concentration will decrease, and equal weight will outperform.

RECENT LEVELS OF CONCENTRATION

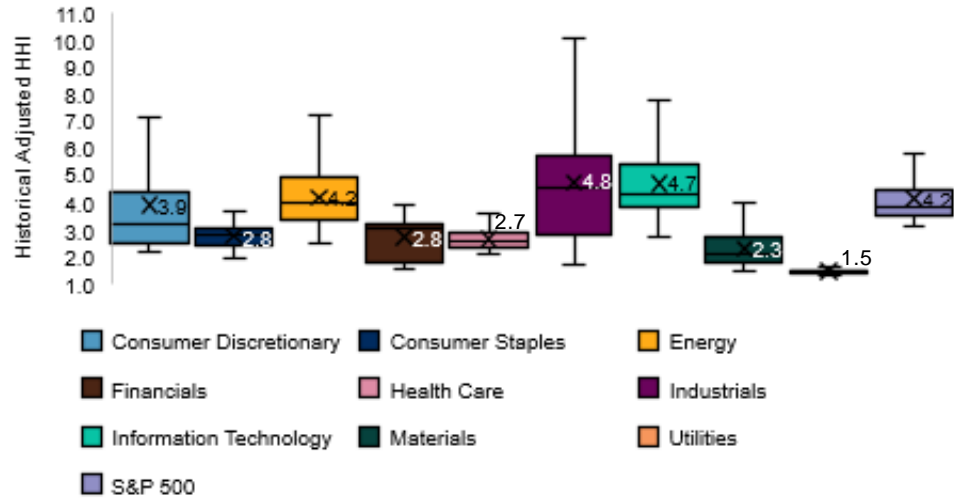
Exhibits 6 and 7 plot the historical range of the adjusted HHI for the S&P 500 and its sectors, along with a bar chart showing current levels. For each sector, the bottom line of the box plot is the minimum value, the horizontal line is the median, the shaded area is the interquartile range, the x indicates the mean, and the upper line is the largest (trimmed) value.⁹ Not only do the average HHIs vary across sectors, but their typical range is also sector-specific. Industrials had the widest adjusted HHI range among sectors, while Utilities had the narrowest range.

⁹ The upper line in Exhibit 5 is the largest value trimmed so that it's no greater than the third quartile breakpoint plus 1.5 times the interquartile range.

Adjusted HHIs for the Energy, Industrials, and Materials sectors have been at historically low levels.

Comparing Exhibits 6 and 7 confirms what we saw in Exhibit 1: adjusted HHIs for the Energy, Industrials, and Materials sectors have recently been at historically low levels. In contrast, for the Information Technology and Consumer Discretionary sectors, adjusted HHIs were recently very high compared to their historical ranges.

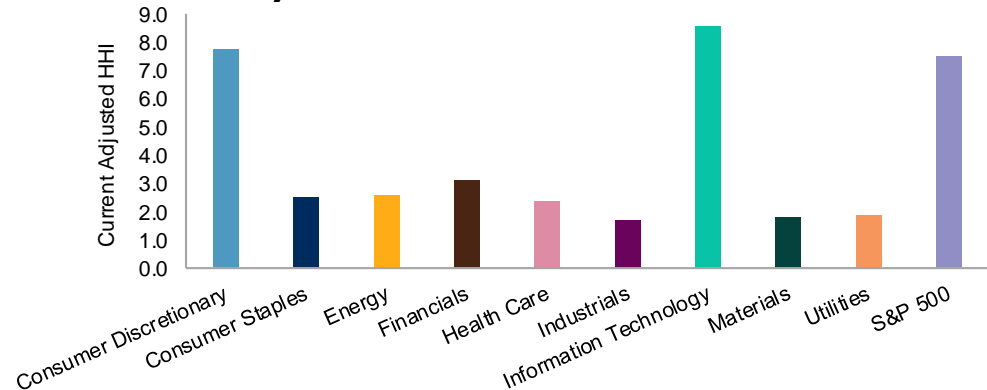
Exhibit 6: Historical Adjusted HHI across S&P 500 Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

In contrast, for the Information Technology and Consumer Discretionary sectors, adjusted HHIs were recently very high compared to their historical ranges.

Exhibit 7: Recent Adjusted HHI Across S&P 500 Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Some sectors, (e.g., Industrials) have a much wider range of historical concentration than others.

Thus, a small change in adjusted HHI means much more to Utilities than it does to Industrials.

The inverse relationship between concentration and equal weighting that we see at the index level exists across all sectors, although it is more pronounced for some sectors.

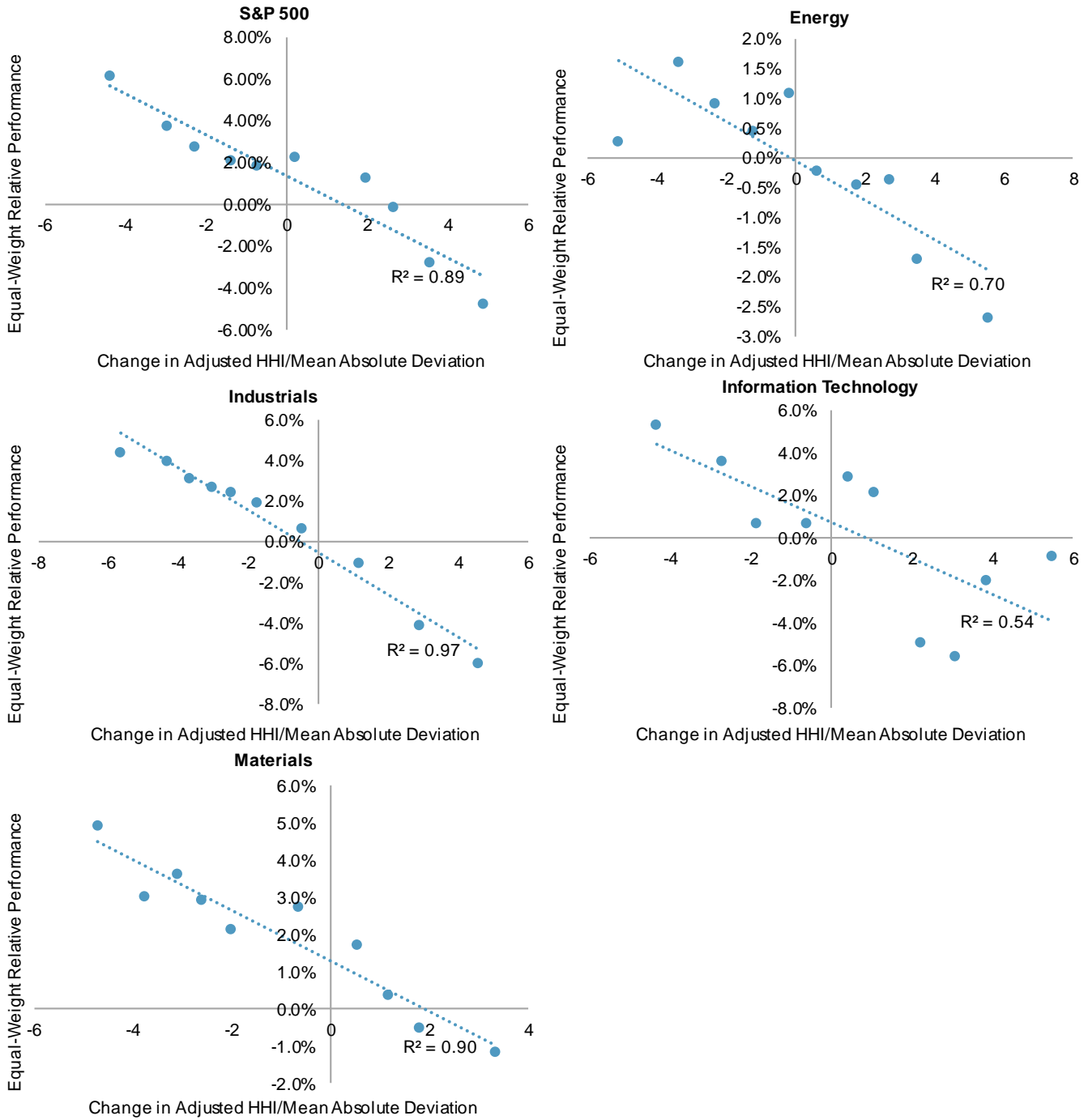
CHANGES IN CONCENTRATION AND EQUAL WEIGHT SECTOR PERFORMANCE

How might we further quantify the relationship between concentration and equal-weight performance at the sector level? In order to smooth out short-term fluctuations, we begin by calculating, for each sector, the five-year change in adjusted HHI at a monthly frequency. As Exhibit 6 demonstrates, some sectors, (e.g., Industrials) have a much wider range of historical concentration than others (e.g., Utilities). Thus, a small change in adjusted HHI means much more to Utilities than it does to Industrials. In order to make more meaningful comparisons, we make a second adjustment, dividing the five-year change in adjusted HHI for each sector by the five-year mean absolute deviation of that sector's adjusted HHI. *For each sector*, we then group these data points into deciles to reduce short-term noise.

Exhibit 8 summarizes this work for the S&P 500 and the same key sectors.¹⁰ On the horizontal axis, we plot the five-year change in adjusted HHI divided by five-year mean absolute deviation. On the vertical axis, we plot equal weight's contemporaneous five-year relative performance. Each point represents 10% of the observations for that sector. Because we divided each sector's periodic adjusted HHI change by its own mean absolute deviation, the horizontal axes are roughly comparable across sectors. Unsurprisingly, we observe a strong negative linear relationship across the board between changes in concentration and equal-weight relative performance. If concentration increased, equal weight's relative performance declined; if concentration decreased, equal weight's relative performance increased. We see particularly high R^2 s for Industrials and Materials, consistent with what we observed historically in Exhibit 5. We conclude that **the inverse relationship between concentration and equal weighting that we see at the index level for the S&P 500 exists across all sectors, although it is more pronounced for some sectors than for others.**

¹⁰ Please refer to the Appendix for the decile analysis for the remaining sectors.

Exhibit 8: Historical Adjusted HHI and Equal-Weight Relative Performance across S&P 500 and Sector Deciles



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Sector concentration has significant implications for index weighting decisions.

Understanding concentration from a sector perspective is critical to weighting exposures appropriately.

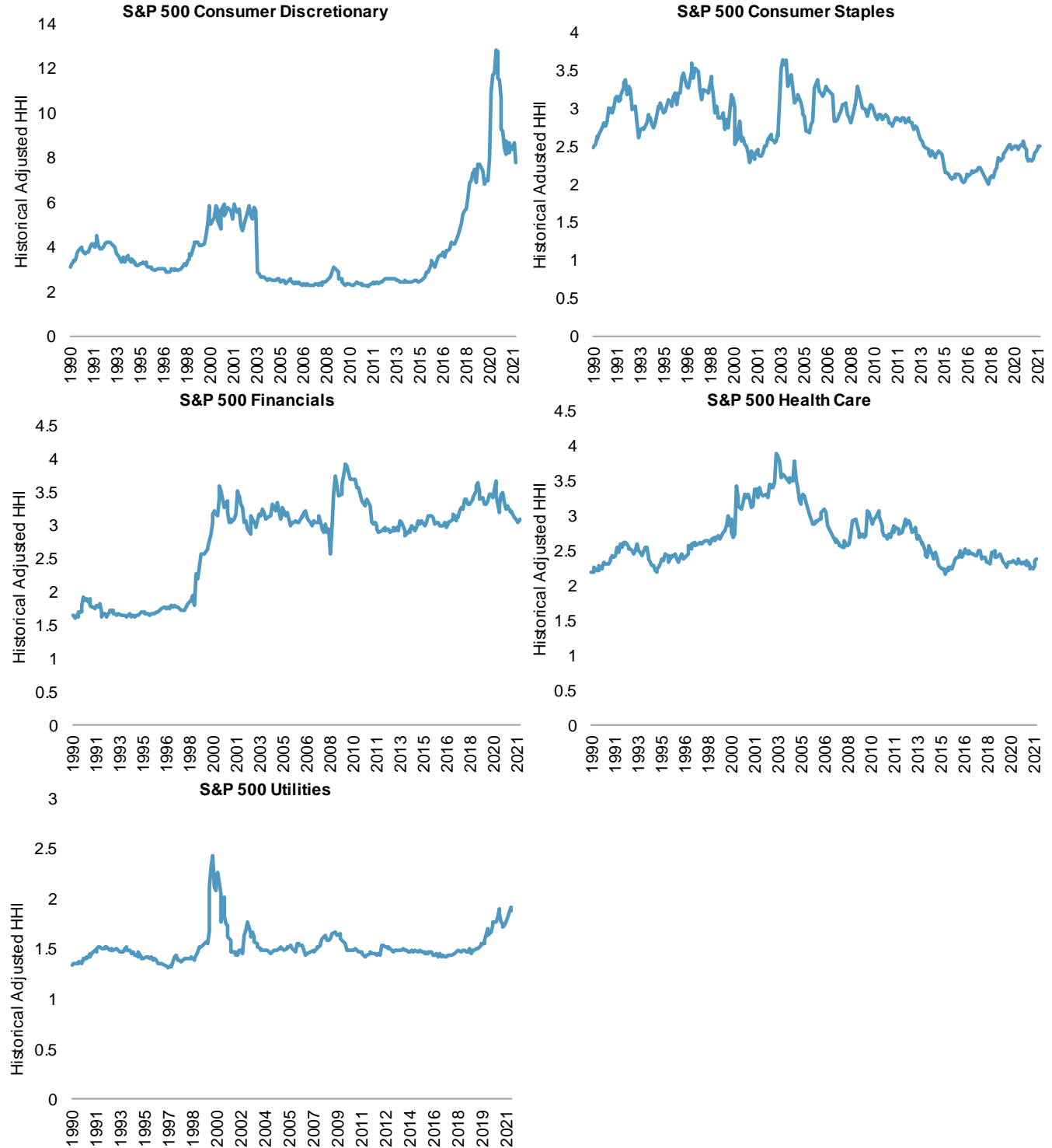
FINAL THOUGHTS

Sector concentration has significant implications for index weighting decisions. Since Information Technology and Consumer Discretionary adjusted HHIs are at historically high levels, equal weighting could be a logical option as concentration has tended to mean-revert historically. In contrast, Energy, Industrials, and Materials adjusted HHIs are at historically low levels. Assuming that the recent low concentration levels will move upwards, cap weighting could make sense. Regardless of current readings, understanding concentration from a sector perspective is critical to weighting exposures appropriately.

APPENDIX

Concentration and Its Reversion

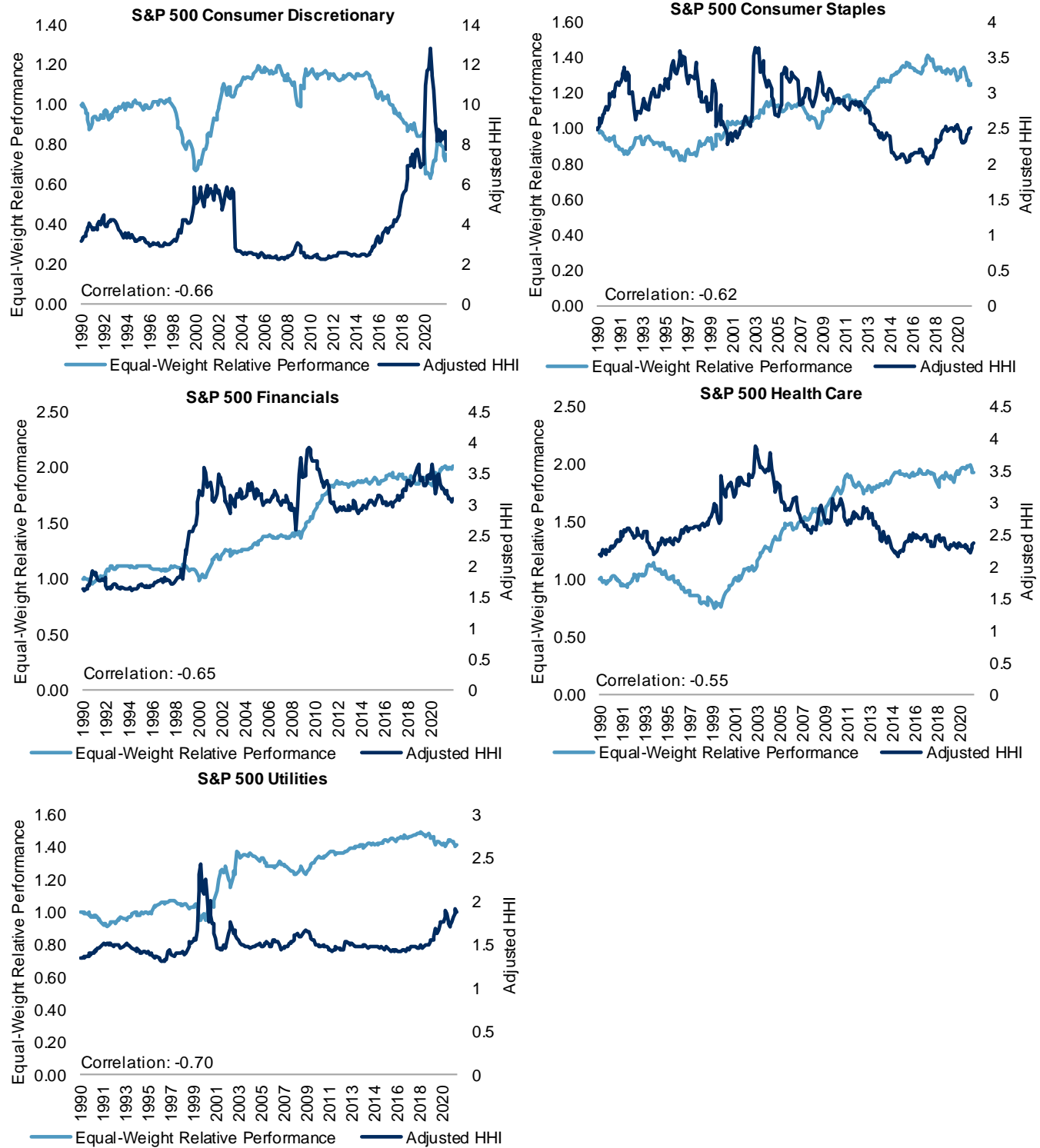
Exhibit 9: Historical Adjusted HHI across Remaining Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Concentration and Equal-Weight Sector Performance

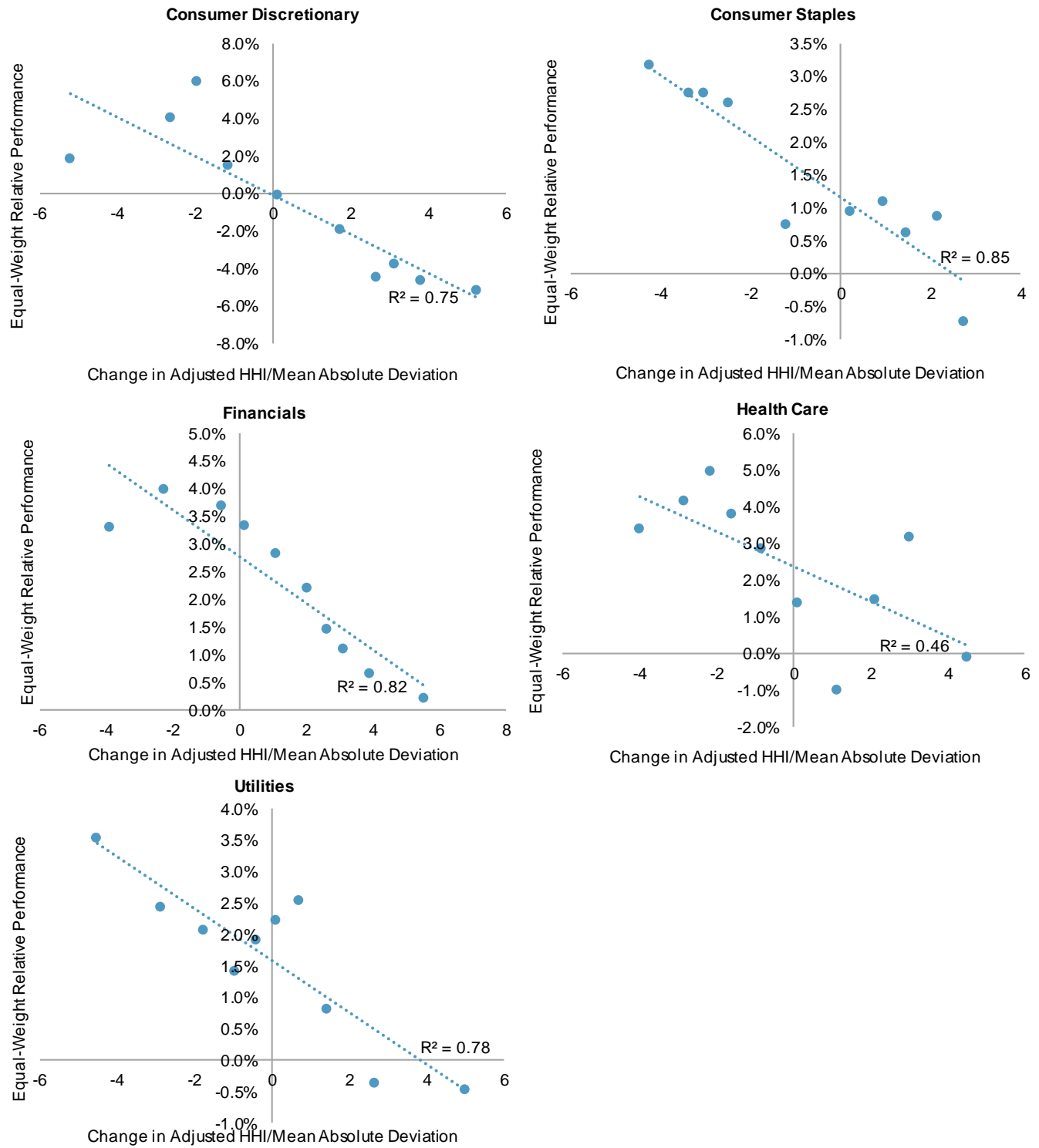
Exhibit 10: Historical Adjusted HHI and Equal-Weight Relative Performance across Remaining Sectors



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Changes in Concentration and Equal Weight Sector Performance

Exhibit 11: Historical Adjusted HHI and Equal-Weight Relative Performance across Remaining Sector Deciles



Source: S&P Dow Jones Indices LLC. Data from Jan. 31, 1990, through Dec. 31, 2021. Past performance is no guarantee of future results. Charts are provided for illustrative purposes and reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

PERFORMANCE DISCLOSURE/BACK-TESTED DATA

The S&P 500 Energy, S&P 500 Industrials, S&P 500 Information Technology, S&P 500 Materials, S&P 500 Consumer Discretionary, S&P 500 Consumer Staples, S&P 500 Financials, S&P 500 Health Care, S&P 500 Utilities were launched June 28, 1996. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Complete index methodology details are available at www.spglobal.com/spdji. Past performance of the Index is not an indication of future results. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results. Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations. Back-tested performance is for use with institutions only; not for use with retail investors.

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