CRSP® MARKET INDEXES

Market Cap   Value   Growth   Sector   ESG

Key Concepts

TABLE OF CONTENTS

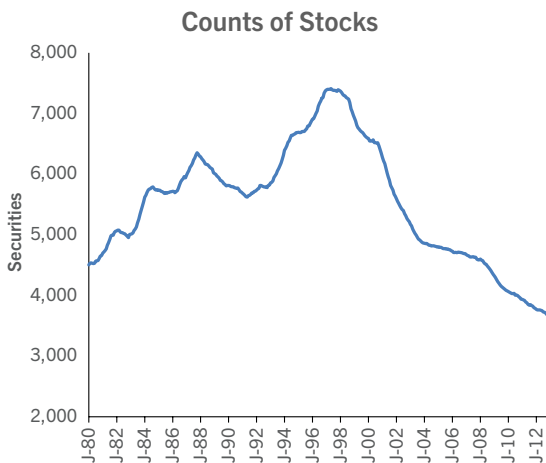**CRSP** | CENTER FOR RESEARCH IN SECURITY PRICES

Learn more at crsp.org
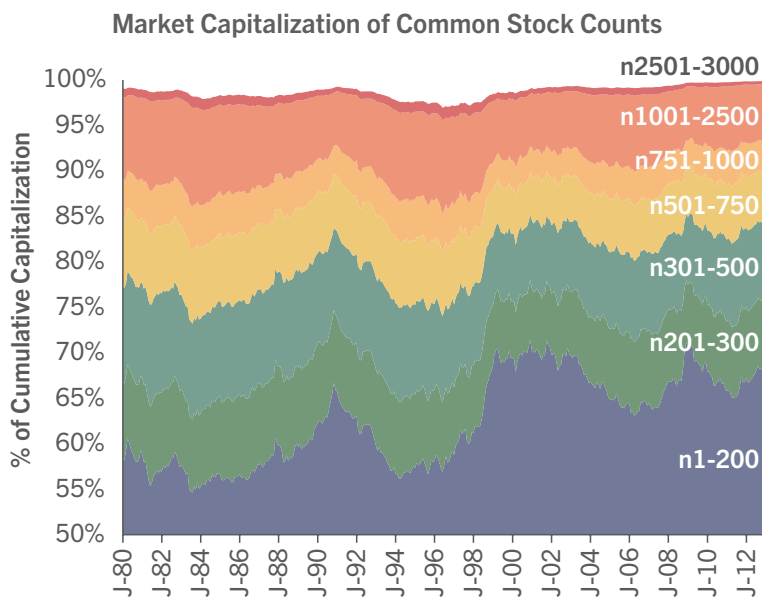
KEY CONCEPT ONE:
MARKET CAPITALIZATION BREAKPOINTS

Academic research has long noted that equities with different market capitalizations display significant differences in average returns. Further, the prices of small stocks (or large stocks), as a group, tend to move together, suggesting the presence of a common factor that can be identified by sorting stocks by market capitalization. CRSP's capitalization-based indexes were designed to capture these differences in returns in a systematic and transparent fashion.

While clear differences in returns exist between small and large market capitalization stocks, academic research into capitalization finds no distinct statistical "breakpoints". In fact, CRSP's research shows that an index provider's breakpoint decision is often a reflection of industry practice. Index providers have frequently made these decisions in an ad hoc fashion by using counts of securities as proxies for market capitalization (e.g., a Large Cap Index may be defined as the largest 1000 stocks and a Small Cap Index may include stocks ranked 1001-3000).

Count-based indexes introduce some problems. CRSP observed that the number of listed stocks changes significantly over time, as does the percentage of market capitalization represented by a portfolio with any fixed number of stocks.

Counts of Stocks

As a result, the market risk represented by a portfolio with a fixed number of stocks also varies over time.

Market Capitalization of Common Stock Counts

As can be seen above, a mega cap index of the top 200 stocks jumped from around 57% of capitalization in the mid-1990's to almost 70% five years later.

Count-based benchmarks are therefore not ideal for performance evaluation or for the construction of "policy portfolios" in asset allocation.

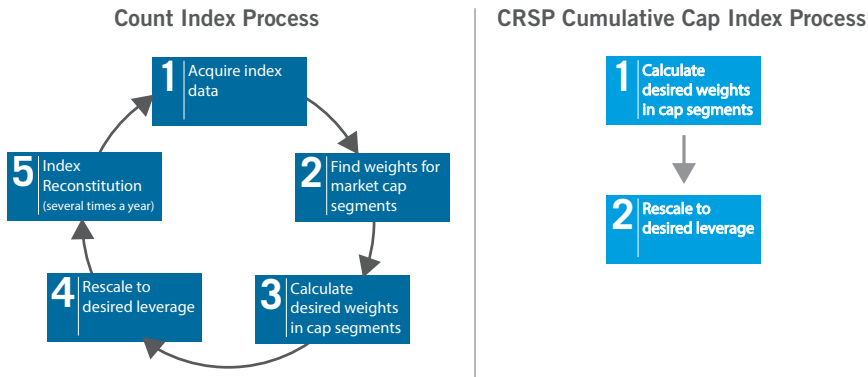| CRSP MARKETINDEXES	Cap-Based Index Breakpoints
Mega	**0 - 70%**
Mid	**70 - 85%**
Small	**85 - 98%**

Large 0 - 85%

CRSP's solution was to base its indexes on cumulative market capitalization — a practice that parallels industry convention in international markets. CRSP set its breakpoints at levels that should look familiar to practitioners.

This choice of a cumulative capitalization method has a distinct advantage: it delivers consistent exposure to "size" without any sensitivity to a specific time or market. The resulting indexes are much more suitable for use in policy portfolios and contribute to ease of use for the asset allocator.

PORTFOLIO CONSTRUCTION MADE EASY

Individual and other non-institutional investors may be particularly interested in the inherent simplicity and precision that a cumulative capitalization-based index brings to their asset allocation decisions. This is a direct result of the fact that investors care about asset weights in portfolio construction rather than counts of securities. Using a count-based index, the investor must acquire index data and determine the weights of the different capitalization segments in that index before determining the weight desired in his/her portfolio; when such an index is reconstituted, these weights must be found anew. Cumulative capitalization-based indexes, in contrast, have cap segment weights that are known, fixed values.

The following example illustrates the ease with which an investor can maintain a cap-tilted portfolio using products based on CRSP's cumulative capitalization indexes instead of traditional count-based indexes.

Count Index Process

1 Acquire index data
2 Find weights for market cap segments
3 Calculate desired weights in cap segments
4 Rescale to desired leverage
5 Index Reconstitution (several times a year)

CRSP Cumulative Cap Index Process

1 Calculate desired weights in cap segments
2 Rescale to desired leverage

KEY CONCEPT TWO:
MULTI-FACTOR STYLE MODEL

The investing community has long used "value" and "growth" to describe distinct investment "styles". Looking at the mutual fund universe, it is clear that managers, too, self-identify and align their products along style lines. Value managers describe their process as one that involves trying to buy assets or cash flows at inexpensive prices by looking at "scaled price ratios" (think P/E, B/M or other ratios of market value to variations on intrinsic accounting value). Growth managers, on the other hand, often describe their process as one that involves determining which firms will grow (sales, earnings, cash flows, etc.) most quickly.

In the academic world, the past 20+ years have seen many journals filled with articles exploring the differences in returns between stocks (called the "cross-section of stock returns"). Seminal work by Fama and French, among others, noted stocks that are lower priced than their peers using a scaled price ratio tend to have higher future returns. Using terms similar to practitioners, academics noted that these cheap "value" stocks tend to move together, as do stocks at the opposite end of the spectrum, the "growth" stocks (so called because valuation methods dictate that investors, rationally or not, believe they will experience higher future cash flows). For academics, this indicated the presence of a common explanatory "value" factor.

$$\frac{P}{CF} = \frac{1}{r - g}$$

Value investor's concern

Growth investor's concern

Shuffling the Gordon model so that there is a scaled price ratio (Price / Cash Flow) on the left shows a clear relationship with the discount rate and expected growth.

If not yet clear, the similarity between investor practice and academics seems to start and end with terms. For example, if we run an experiment and compare the returns that would have been generated by owning a portfolio of value stocks to one composed of growth stocks (using typical academic style definitions) we see that there is far less correlation between the two series than we observe when we compare the returns of portfolios of funds managed by investors that identify as value or growth investors. In other words, value investors do not appear to simply be the opposite of growth investors. Accordingly, benchmarks that treat the two styles as opposites may not provide as rich a description of manager performance.

CRSP, in its index design, has sought to develop a series of more applicable benchmarks for industry, bridging the gap between industry practice and current academic thinking.
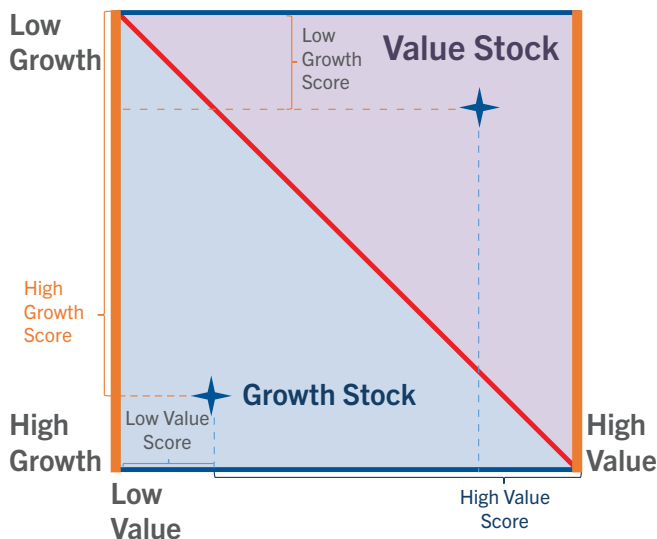
THE CRSP MULTI-FACTOR MODEL

CRSP believes that investment managers possess information beyond that contained in simple scaled price ratios and growth statistics. The decisions these investors make are shaped by this unobservable information. The importance of this philosophical consideration cannot be overstated: the CRSP US Value and Growth Style Indexes are designed to be a cost-effective approximation of the process actual value and growth managers use to invest rather than an ad hoc style definition.

A notable feature of the CRSP Market Indexes that allows for a better fit to industry behavior is the separation of value and growth into two distinct dimensions.

The value and growth dimensions are defined using multiple factors for each security. The use of multiple factors follows current academic thought and manager behavior (managers look at multiple data points simultaneously when generating their investment ideas). This ultimately allows for better estimation of the true, unobservable "value" or "growth" of a firm.

The factors used result from a combination of common industry practice and recent work in empirical finance. CRSP is the first index provider to include investment rate and return on assets ("ROA") as growth factors. Empirical analysis shows that firms that invest more tend to grow faster, as do firms that are more profitable. In addition, economic theory links both investment and ROA to expected stock returns.
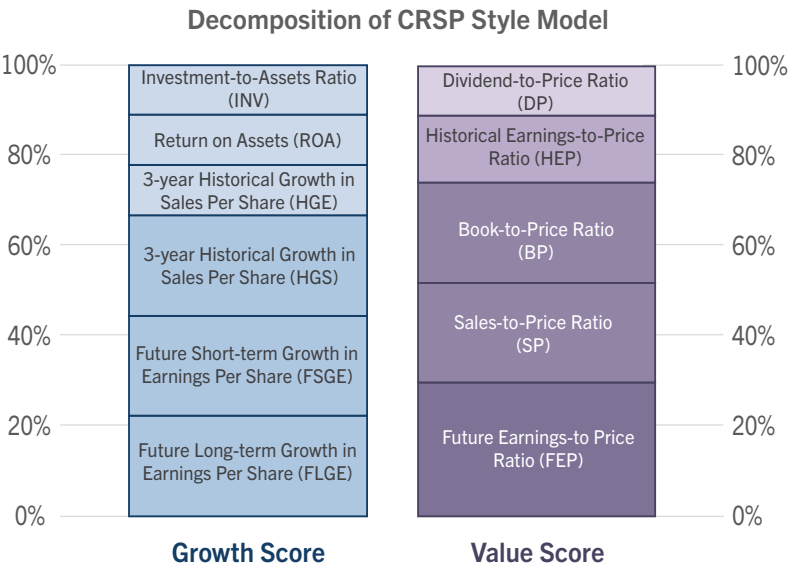
CRSP and its faculty advisors place a premium on independent analysis. As such, CRSP validated each factor individually and in concert with other factors using common econometric techniques. The five value factors, individually, have predictive power in the cross section of stock returns. A composite of the five value factors produces even more consistent results. Similarly, while the six growth factors individually predict growth, together they prove more effective.

The weights selected for each individual factor are the result of a process designed to select investments that behave like those value and growth managers would choose, while limiting portfolio turnover (where obvious transaction costs are incurred). Using a combination of cluster analysis, regression and rank tests, CRSP assessed almost 2600 candidate models before determining a set of final factor weights. In contrast to many existing index providers, CRSP found that not all factors are created equal. On the value side, earnings metrics have a plurality of the weight. For growth, historical sales trends and analyst estimates proved most important.

To build the value and growth portfolios, stocks are ranked in cumulative market capitalization order first by a composite value score and then by a composite growth score. This means that along the value dimension, stocks can be in either the top or bottom half of market capitalization ranked value (the same goes for growth).

Here, CRSP introduces two novel features:

1. Value and growth scores are determined solely within the market cap segment evaluated, making scores statements of relative value and growth.

2. CRSP simply averages the value and growth ranks scores to determine security placement, rather than coercing half of an index's market cap to be value and the other growth.

Decomposition of CRSP Style Model

Growth Score	Value Score
Investment-to-Assets Ratio (INV)	Dividend-to-Price Ratio (DP)
Return on Assets (ROA)	Historical Earnings-to-Price Ratio (HEP)
3-year Historical Growth in Sales Per Share (HGE)	Book-to-Price Ratio (BP)
3-year Historical Growth in Sales Per Share (HGS)	Sales-to-Price Ratio (SP)
Future Short-term Growth in Earnings Per Share (FSGE)	Future Earnings-to Price Ratio (FEP)
Future Long-term Growth in Earnings Per Share (FLGE)	

Investors should be able to immediately recognize how both decisions make the CRSP Market Indexes better measures of manager style performance. For example, CRSP understands that a Large Cap Value manager may only choose securities that look like value stocks within his or her universe; the use of a relative value score specific to the Large Cap universe better represents his or her opportunity set. It also means that the same security may have a different style assignment in the CRSP Mid Cap or Mega Cap portfolios, which use their own relative scores (representing the opportunities restricted to those universes). The second decision, to resist coercing half the market into value and the other into growth, reflects an idea introduced earlier: value and growth styles, as practiced by investors, are not opposites; instead, they are best thought of as separate, though related, processes.
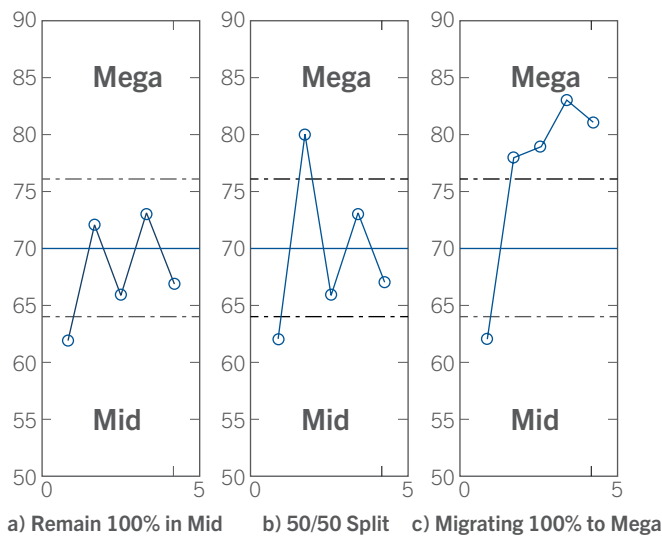
KEY CONCEPT THREE:
BANDING & MIGRATION

Indexes are designed to best represent designated segments of the market. Related index series such as capitalization-based indexes and value and growth style indexes, are usually separated by 'breakpoints'. However, in reality, the styles and sizes of securities at or near breakpoints are often not clear. Consequently, enforcing investment rules strictly based on breakpoints may both coerce securities into categories when they do not show strong characteristics and cause additional transaction costs introduced by the traffic across the breakpoints. Thus, we maintain that indexes constructed with rigid breakpoints are less representative of a market and can be costly to track. We mitigate these problems through our innovative banding and migration features.

CRSP acknowledges that in practice, fund managers may have different preferences with respect to securities and styles. The same security could be Small Cap to one manager but Mid Cap to another. And, a particular security might be considered value by certain managers, but growth by others. CRSP's methodology helps capture this 'grey' area by allowing a security to split 50/50 between adjacent indexes. Those securities that remain split between the adjacent indexes are ambiguous and should defy categorization until demonstrating a more stable and dominant style or size characteristic. Allowing companies to split better represents market opinion about the opportunity set.

As mentioned in a prior piece, CRSP's capitalization-based index breakpoints are based on cumulative capitalization while the value and growth style indexes have a breakpoint defined by average rank (AR) of value and growth scores. Banding and migration respect both these breakpoints and 'threshold bands' defined around breakpoints. Only when a security's AR or capitalization moves beyond its outer band can the security begin migrating to an adjacent index. CRSP handles migration with the concept of 'packeting'. Migrating securities are broken into two packets, each 50% of a company's holdings. The first packet migrates when the threshold band is crossed during a ranking day, the second moves if the security stays beyond the threshold in a successive quarter.

The figure below shows three simple scenarios to illustrate our banding and migration rules using the breakpoint and bands between mega- and Mid Cap Indexes. Plot a) shows a case where a security moves across the breakpoint but not the bands, and remains 100% allocated in the original, Mid Cap Index. Plot b) shows a case where a security crosses the threshold bands once but falls back into the bands afterwards. This security would remain split 50/50 between the adjacent indexes until its cap rank score emerges from a band on either side of the breakpoint. Plot c) shows a case where the security migrates 100% from the Mid Cap Index to the Mega Cap Index over two rank periods.

Banding and Migration: A Simple Illustration in Cap Indexes

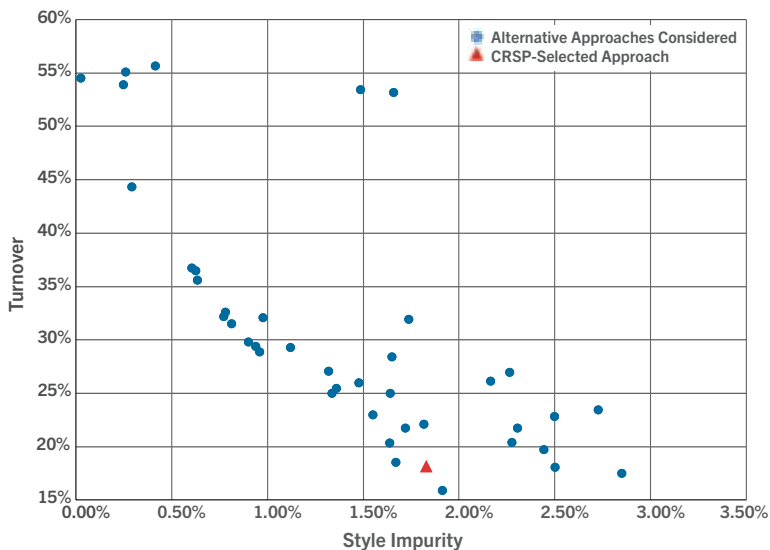a) Remain 100% in Mid   b) 50/50 Split   c) Migrating 100% to Mega

CRSP maintains that an index is more useful when it better represents the designated market and is cheaper to track. Banding and migration smooth the migration process by filtering out smaller fuzzy noises and focusing on clearer signals. For scenarios illustrated in figures a) and b) above, banding and migration rules eliminate any unnecessary transaction costs associated with transitory fluctuations in security characteristics (whether it is cap size or value/growth score); the rules also reduce the impact and, at the same time, better represent securities that had not shown persistently dominating characteristics.

BANDING & MIGRATION IN CAP INDEXES

For Market Cap indexes, the size of a company can range from several hundred millions to several hundred billions. An appropriate bandwidth between Mid and Small Cap Indexes would create too much migrating activities for Mega Cap securities but stagnancy for Micro Cap ones. Thus, we do not apply a 'one-size-fits-all' approach in choosing band width. Based on the test results, CRSP assigns different band sizes around breakpoints for its Mega, Mid, Small and Micro Cap Indexes. As one would expect, we have a wider band around the breakpoint between Mega and Mid Cap Indexes than for Small and Micro Cap Indexes.

CRSP considered the impact of different banding and migration strategies in terms of turnover, bad turnover (turnover that create trades more than 10% of the average daily volume) and tracking errors. In the search for the best strategy, CRSP ran more than 40 combinations of band size, packeting variations, and migration paths. The figure below serves as an example showing how different banding and migration strategies influenced turnover and tracking error (labeled as 'Style Impurity') for Mid Cap securities. It depicts a clear 'efficient frontier' showing the general tradeoff between turnover and tracking error. CRSP performed the same test for Mega, Large, Small and Micro Cap securities. CRSP-Selected approach achieves the highest average ranking based on measures of turnovers, bad turnovers and tracking errors.
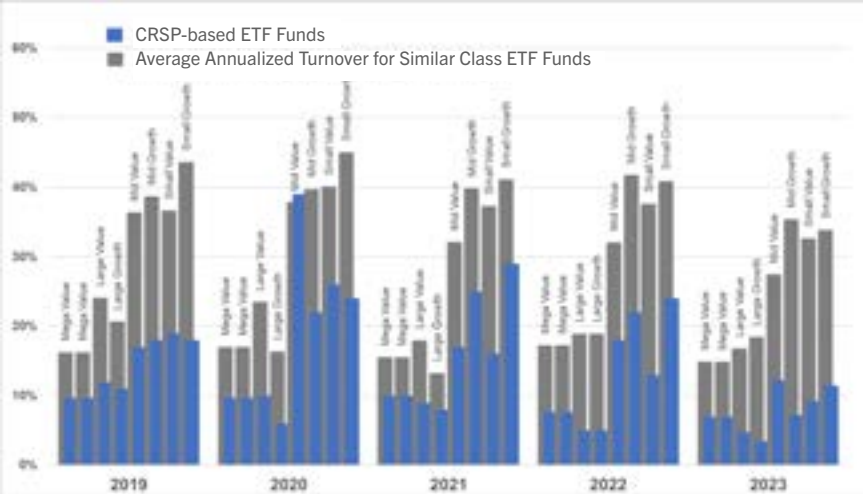
BANDING & MIGRATION IN VALUE & GROWTH INDEXES

Banding and migration for CRSP value and growth style indexes inherited the same concepts as for the cap-based indexes. However, CRSP acknowledged that value and growth styles are more difficult to measure than market cap. To incorporate possible additional information that had not been incorporated by our model, we also calibrate the bandwidth comparing tracking errors with Morningstar and Lipper value and growth managed funds. We evaluated bandwidth between 2% and 40% around the value and growth style average rank score breakpoint. A bandwidth of 33% accommodated maximized purity and minimized turnover without compromising either. Shown in the figure on the following page, bandwidth of 33% also best represents the industry practice in value and growth style investing.

CRSP Value/Growth Indexes Average Turnover and Tracking Error vs. Average Performance of Lipper and Morningstar Value/Growth Managed Funds.

EFFECTIVENESS

Our efforts in reducing turnover while maintaining style characteristics through banding and migration technique pays off by creating a low-cost investable index that represents the market. The figure below shows the comparison of turnover between Vanguard's value and growth ETF product and the backtested CRSP value and growth indexes. CRSP's investable indexes would have potentially generated considerable savings in transaction costs.
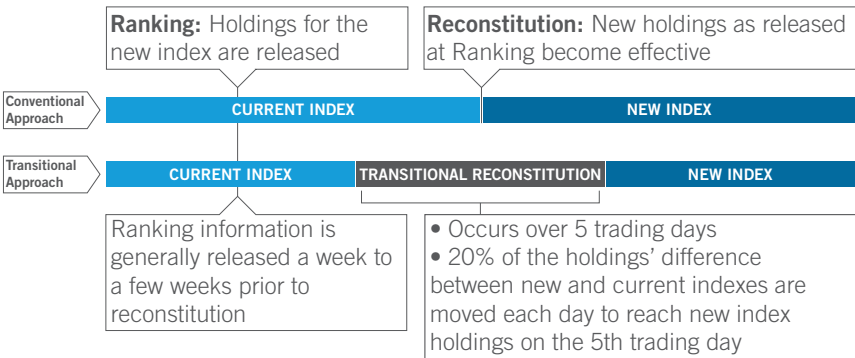

Note: 2023 Data as of 08/31/23.

TRANSITIONAL RECONSTITUTION

CRSP recognizes that active managers usually don't change portfolio positions over a single day. Rather, it is common for active managers to gradually adjust their holdings to mediate market impact by lowering the daily trading volume. To better align index methodology with the investment community's best practices, CRSP introduced a five-day transitional reconstitution that moves 20% of the change in holdings each day from the current index to the new target index's holdings as computed on ranking day.

The following illustration demonstrates the difference between the conventional and transitional reconstitution.

Ranking: Holdings for the new index are released

Reconstitution: New holdings as released at Ranking become effective

Conventional Approach

CURRENT INDEX

NEW INDEX

Transitional Approach

CURRENT INDEX

TRANSITIONAL RECONSTITUTION

NEW INDEX

Ranking information is generally released a week to a few weeks prior to reconstitution

• Occurs over 5 trading days
• 20% of the holdings' difference between new and current indexes are moved each day to reach new index holdings on the 5th trading day

KEY CONCEPT FOUR:
THE CRSP APPROACH TO COMBINING SIZE BENCHMARKS

In the indexing world there are two different approaches to combining Market Cap benchmarks:

1. **Two-Tier: Large Cap** + **Small Cap**

   Historically, many investors have followed the lead of Russell and Standard & Poor's as they split the universe of stocks into large stocks and small stocks. Russell offers the Russell 1000 which includes 90% of the total cap market, and the Russell 3000 which includes the total market.

   Similarly, Standard & Poor's uses the flagship S&P 500 Index for large and the S&P Completion Index for small exposure.
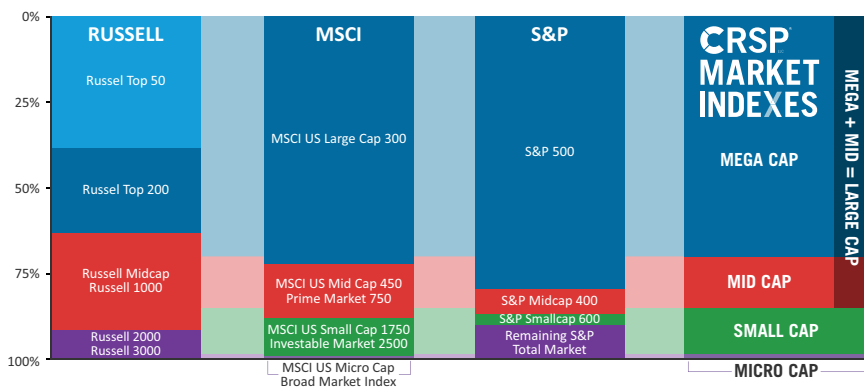
2. **Three-Tier: Large Cap** + **Mid Cap** + **Small Cap**

   On the other hand, many index providers offer a second approach that carves out Mid Cap securities as a distinct asset class. In this paradigm, three indexes are used to capture the full Market Cap spectrum (MSCI Large + Mid + Small and S&P 500 + S&P 400 + S&P 600). This strategy aligns nicely with Morningstar's nine-box approach to mutual fund classification.

COMBINED LOGIC

The combined-size approach constructs indexes that function effectively in both building block scenarios. For the two-tier approach, an investor can combine CRSP Large Cap + CRSP Small Cap, or if a three-tier approach is preferred, the investor can use CRSP Mega Cap + CRSP Mid Cap + CRSP Small Cap.

The one potential point of caution: If investors combine CRSP Large Cap + CRSP Mid Cap + CRSP Small Cap, they have an overweight position in Mid Cap stocks since large is already made up of Mega Cap+ Mid Cap.

	RUSSELL	MSCI	S&P	CRSP MARKET INDEXES	MEGA + MID = LARGE CAP

RUSSELL
- Russel Top 50
- Russel Top 200
- Russell Midcap / Russell 1000
- Russell 2000 / Russell 3000

MSCI
- MSCI US Large Cap 300
- MSCI US Mid Cap 450 / Prime Market 750
- MSCI US Small Cap 1750 / Investable Market 2500
- MSCI US Micro Cap / Broad Market Index

S&P
- S&P 500
- S&P Midcap 400
- S&P Smallcap 600
- Remaining S&P / Total Market

CRSP MARKET INDEXES
- MEGA CAP
- MID CAP
- SMALL CAP
- MICRO CAP

MEGA + MID = LARGE CAP

Scale: 0% · 25% · 50% · 75% · 100%

CRSP Market Indexes are used by asset owners, fund sponsors and other financial institutions to measure the performance of the overall US equity market and various market segments (market cap, style, sector, ESG).

Currently **nearly $3 trillion** of fund assets are linked to CRSP Market Indexes.

Learn more at **crsp.org**