# Targeting risk with smart beta indexes

Risk-based indexes are an important category of smart beta—they target different objectives and are commonly used to complement allocations to traditional capitalization-weighted approaches. In this article, we explore the most popular types of risk-based indexes and summarize their objectives. We distinguish between methodologies aimed at reducing overall index volatility and those that target the low volatility factor premium. Finally, we show some of the ways investors are currently using risk-based indexes.

## Capitalization-weighted indexes represent the market

Capitalization-weighted indexes reflect the market opportunity set in its entirety. These indexes are liquid, transparent, and easily replicated. However, during market up turns, the capitalization-weighted indexes may be influenced by a small number of large-cap stocks.

A snapshot of constituent weightings in the capitalization-weighted FTSE 100 Index at the end of June 2014 is given in Exhibit 1. At that date, the largest ten constituents of the index by market capitalization contributed 44% of the FTSE 100's overall market value. The largest 25 stocks by market capitalization contributed over 70% of the index's value and the largest 50 stocks by market capitalization nearly 90% of its value.
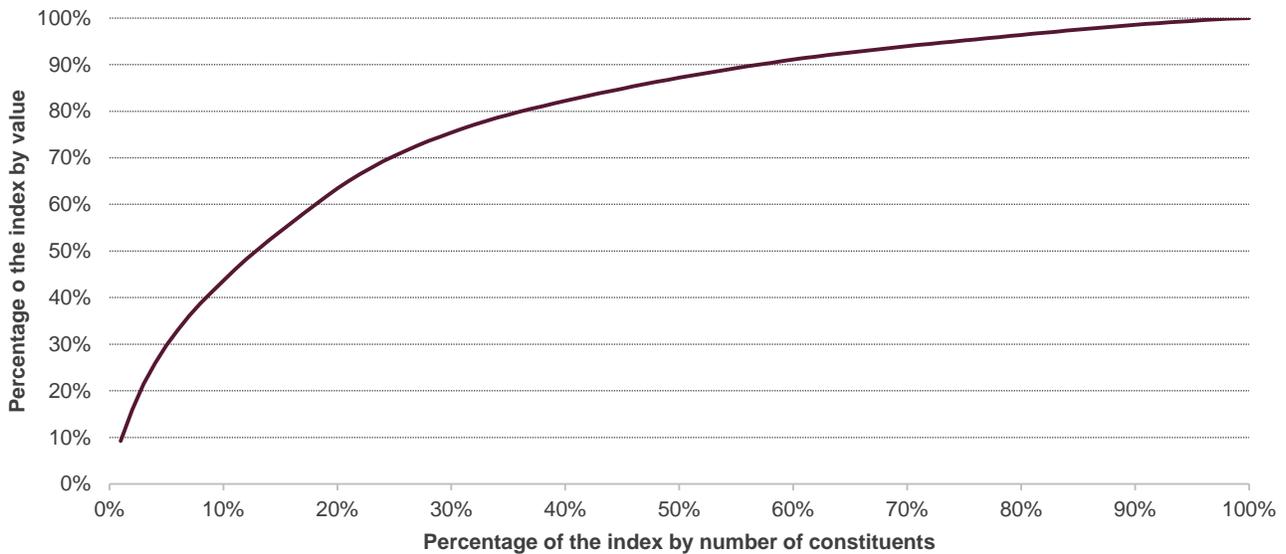
**Exhibit 1. FTSE 100 constituent weightings**
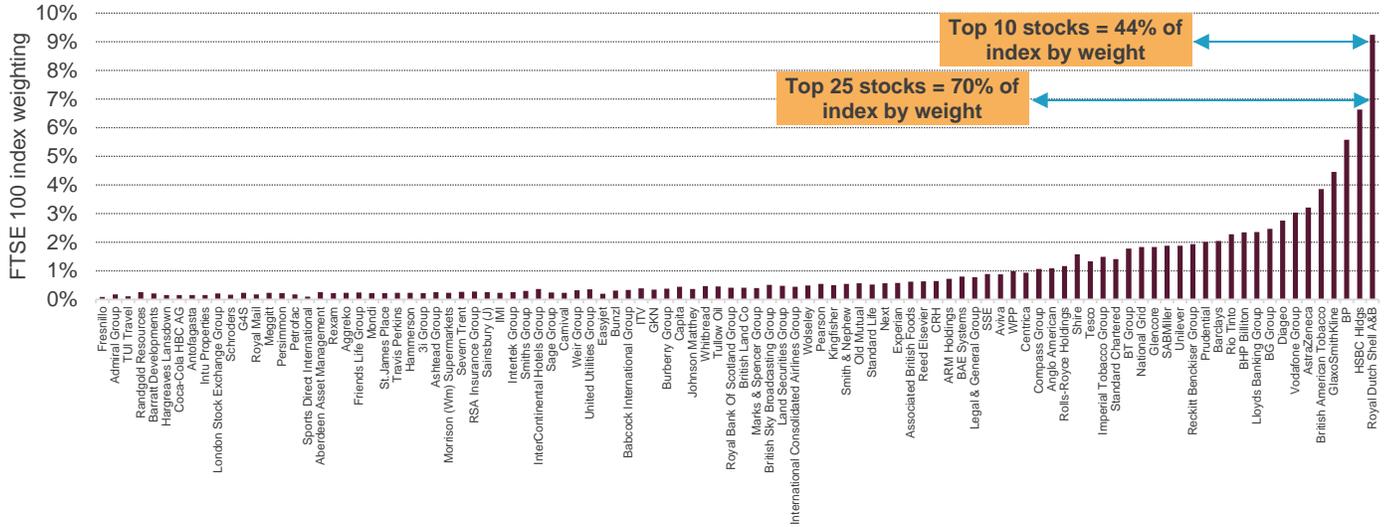


Source: FTSE Russell, data as at June 30, 2014. Royal Dutch Shell A and B are considered to be one FTSE 100 Index constituent. Index concentration levels vary over time.

The concentration of an index can be measured mathematically by means of a so-called Lorenz curve. This shows the cumulative weighting (in percent) of the first X percent (by number) of index stocks. A Lorenz curve for the FTSE 100 Index as at the end of June 2014 is shown in Exhibit 2.

# Index concentration measured by the Lorenz curve

**Exhibit 2. Lorenz Curve: FTSE 100**



Source: FTSE Russell, data as at June 30, 2014. Royal Dutch Shell A and B are considered to be one FTSE 100 Index constituent. Index concentration levels vary over time.

During the internet bubble of 1999/2000, for example, many capitalization-weighted indexes became heavily concentrated in stocks from the technology, media and telecommunications sectors, which subsequently suffered heavy price falls. Risk-based indexes aim to improve the level of diversification of standard capitalization-weighted indexes via an alternative weighting methodology and in some cases may help mitigate the index drawdown experienced due to a market correction.

## Improving diversification by alternative weighting

Several alternative index weighting methodologies aim, in one way or another, to address concentration risk:

- **Equal-weighted indexes** weight constituents equally and their primary objective is to improve levels of diversification. Equal-weighted indexes' construction is easy to understand and they offer a full representation of the stocks from the starting universe. Their potential drawbacks are sensitivity to the choice of starting universe, increased rebalancing costs and typically a bias towards relatively smaller-cap stocks.

- **Equal risk contribution (ERC) indexes** weight constituents such that each contributes equally to index risk, providing an effective means of risk diversification. They maintain full representation of stocks from the starting index universe, while ensuring that risk concentration is minimized. The potential drawbacks of this approach are a more complex construction methodology and typically relatively small reductions in volatility.

- **Minimum variance indexes** select stocks whose volatilities and correlations minimize index-level risk. This approach ensures volatility reduction by taking into account both past risk levels and correlations. The potential drawbacks of the minimum variance approach are greater complexity in construction, high sensitivity to inputs and estimation errors, and concentration risks.

- **Maximum diversification indexes** select stocks which maximize the index's diversification level. This approach to diversification is achieved by maximizing the ratio of the weighted average of index constituents' volatilities to index volatility. The indexes are also designed to achieve a reduction in index volatility, while the primary drawback is the complexity of design.

- **Maximum Sharpe ratio (risk-efficient) indexes** select and weight stocks to maximize the index's Sharpe (return to risk) ratio.

Although they share a common principle, these indexes vary in their design and their objectives. In the remainder of this section, we focus on three popular risk-based index methodologies.

**Equal-weighted indexes** are conceptually simple: they equalize constituents' index weightings at regular rebalancing points. So, for example, the equally weighted version of the FTSE 100 Index allocates a 1% weighting to each of the index's 100 stocks each time the index is rebalanced.

This methodology has the net effect of allocating a significantly smaller weighting to the larger stocks that tend to dominate capitalization-weighted indexes, while simultaneously granting a comparatively larger weighting to the smaller companies within the starting universe.

**Equal risk contribution (ERC) indexes** have the aim of equalizing their constituents' contribution to the risk of a benchmark, but do so in a sophisticated way. Rather than setting index weightings equally, ERC indexes recognize that stocks have varying levels of volatility and that some index constituents may therefore have a greater impact on index-level risk than others. And recognizing that individual stocks' behavior may be closely related to that of other stocks, ERC indexes also take into account correlation.

Exhibits 3 and 4 contrasts the Lorenz curves for equal-weighted and ERC indexes with those of the capitalization-weighted index: first on the basis of stock weightings, second on the basis of risk contributions. When the Lorenz curve is calculated on the basis of weightings, the equal-weighted index is the most diversified index (signified by the flat Lorenz curve). When the Lorenz curve is calculated on the basis of risk contributions, the ERC index is the most diversified.

**Exhibit 3. Cumulative Weight Lorenz curves for equal-weighted and ERC indexes**

**Stock Weights**



ERC — Equal Weight — Cap Weight
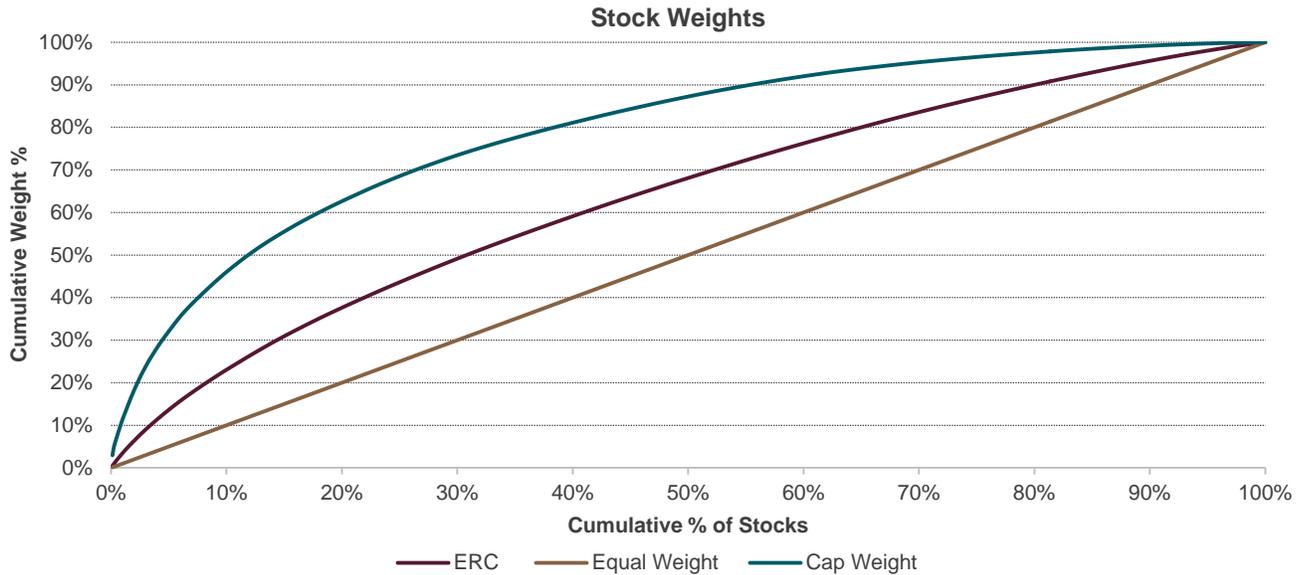
**Exhibit 4. Cumulative Risk Contribution Lorenz curves for equal-weighted and ERC indexes**

**Risk Contribution**



ERC — Equal Weight — Cap Weight
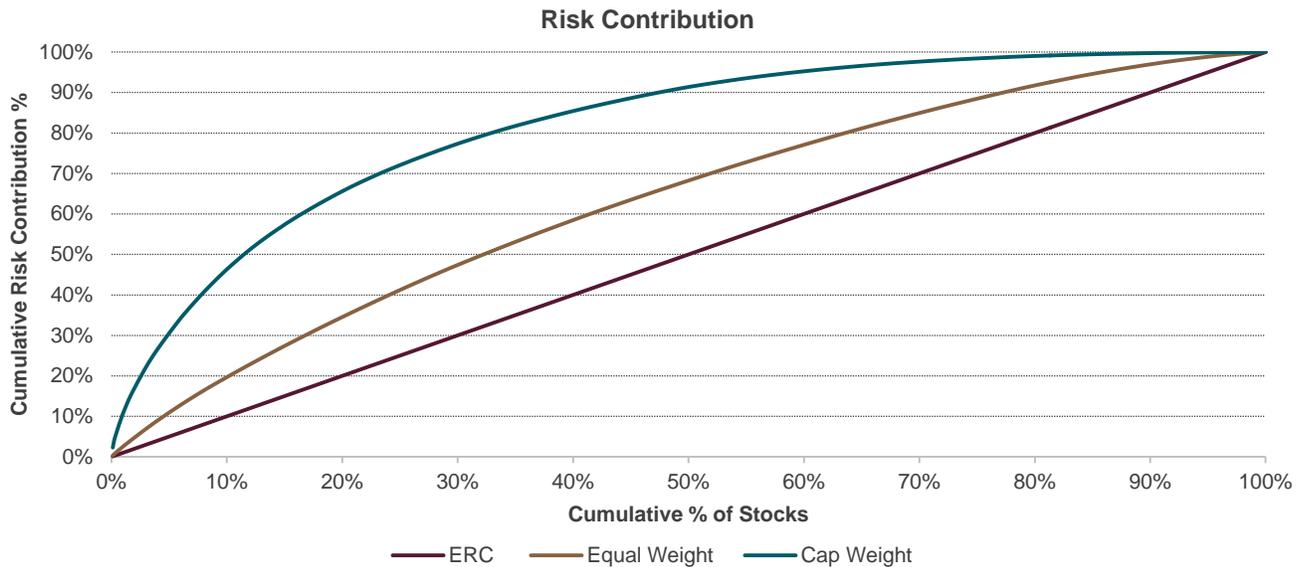
Charts and graphs are provided for illustrative purposes only.

Like ERC indexes, minimum variance indexes also use stocks' volatilities and correlations as inputs. But these two indexes have different objectives. Whereas ERC indexes aim to equalize constituents' contributions to index risk, minimum variance indexes seek to minimize the risk of the index as a whole (i.e., they seek the combination of stocks and stock weightings that produces the lowest possible index volatility). The minimum variance index is arrived at by means of a mathematical optimization (an algorithm that produces the optimal outcome for a given set of inputs).

The optimization used to determine the components of the minimum variance index is usually performed subject to a number of constraints, such as caps on stock and sector weightings and a minimum number of holdings. By limiting concentration, these constraints help to ensure that the minimum variance index is suitable for practical uses in portfolio construction and benchmarking.

# What are the return objectives of risk-based indexes?

Risk-based indexes do not generally have explicit return objectives. Instead, they seek to target specific risk objectives–for example, enhanced diversification (whether measured in terms of stock weightings or risk contributions), risk efficiency or minimum index volatility.

Nevertheless, the alternative weighting methodologies of risk-based indexes produce index return outcomes that are, inevitably, distinct from those of the capitalization-weighted index. There is significant interest among market participants in understanding the sources of those return differences.

For example, based on back tested data, the FTSE 100 Equally Weighted Index produced a hypothetical average annual total return of 6.9% over the ten year period from 2006-2015, whereas the capitalization-weighted FTSE 100 Index produced an average annual total return of 4.8% over the same period.

The long-term return premium exhibited by many equal-weighted indexes (by comparison with their capitalization-weighted equivalents) is attributed by some academics to equal-weighted indexes' exposure to certain systematic risks (such as the small-cap and value effects).[1]

Similarly, ERC indexes, which have a naturally defensive tilt (measurable by means of the index beta, which is typically below one) and a bias towards small-cap stocks, have also exhibited a return premium over long-term periods, when measured against the capitalization-weighted index. This return premium may also be attributable to exposure to systematic (factor) risks.[2]

# Implicit and explicit factor objectives

The factor exposures of risk-based indexes are implicit in the indexes' design; in contrast, factor indexes have the explicit objective of targeting specific factor return premia.

This subtle distinction can be understood by contrasting a minimum variance index and a low volatility factor index.

In the case of the minimum variance index, whose objective is to minimize index risk, factor exposures (such as size) are a secondary outcome of the index design.[3]

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[1] See, for example, "Why Does an Equal-Weighted Portfolio Outperform Value- and Price-Weighted Portfolios?", Plyakha, Uppal and Vilkov, 2012.
2 See "Factor Exposures of Smart Beta Indexes", FTSE Russell, 2015.
3 Ibid.

A low volatility factor index, by contrast, is designed to provide consistent exposure to the (low) volatility factor. It is designed to exhibit persistently greater exposure to the factor of interest than the comparable alternatively weighted index (minimum variance).

## How investors are using risk-based indexes

According to the 2016 FTSE Russell smart beta survey, 40-50% of the investors surveyed (depending on the size segment) said they were considering smart beta strategies for the purposes of risk reduction. Improved diversification was cited as a key objective for larger asset owners (those with $10 billion-plus under management) considering smart beta.

**Exhibit 5. Risk considerations central to interest in smart beta**

|  | <$1B | $1-$10B | $10B+ |
|---|---|---|---|
| Return enhancement | 56% | 51% | 63% |
| *Risk reduction* | *44%* | *43%* | *50%* |
| Provide specific factor exposure | 16% | 25% | 47% |
| Cost savings | 22% | 19% | 34% |
| *Improve diversification* | *47%* | *35%* | *34%* |
| Other | 0% | 7% | 6% |
| Income generation | 3% | 7% | 3% |

Source: FTSE Russell, "Smart beta: 2016 global survey findings from asset owners," Investors were asked "What investment objective initiated the evaluation of smart beta strategies?".

Improved risk outcomes are therefore central to the rising investor interest in smart beta, together with a desire to achieve enhanced returns and reduce costs.

## Conclusion

Risk-based indexes are an important category of smart beta index and are commonly used to address concerns over concentration risk.

Risk-based indexes include some of the most popular forms of smart beta index, ranging from the conceptually simple (equal weighted) to the mathematically sophisticated (equal risk contribution, maximum diversification, maximum Sharpe ratio).

Our recent survey results show rapidly increasing interest in this form of smart beta index, driven by a desire amongst institutional investors to achieve improved risk outcomes, together with an appetite for return enhancement and cost reduction.

## For more information about our indexes, please visit ftserussell.com.

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