FTSE
Russell

Leveraging factors without using leverage
FTSE Russell Multi-factor Indexes

Key points:

- The debate goes on about the best way to construct a multi-factor index: a "mixed" composite of individual factors versus an "integrated," bottom-up approach of simultaneous factor exposures.

- In this Insights, we empirically show that the FTSE Russell "tilt-tilt" integrated methodology is more capital efficient in delivering exposures than a mixed composite methodology.

- We show that the capital efficiency of the tilt-tilt methodology is equivalent to using leverage in a composite approach.

There has been a lively debate amongst practitioners about the most capital efficient method of building a multi-factor portfolio. By "capital efficient," we mean the most cost effective way to achieve a given level of factor exposures and the factor premiums accessed by those exposures. Achieving a level of factor exposures for less means that more capital can be allocated to other targeted strategies or provide a better allocation of the fee budget. The debate centers on comparing a top-down composite mix of individual factors versus a bottom-up fully integrated portfolio of stocks that are simultaneously exposed to the target factors.

In this paper we use index data dating back to 1997 to demonstrate the capital efficiency of the tilt-tilt methodology. The example indexes all use the same methodology for constructing individual factors, which eliminates one confounding issue caused by comparing indexes from different providers who calculate single factors differently from one another. By focusing on the delivery of factor exposures, not returns, the additional confounding issue of individual factor return cycles is also eliminated as exposures tend to be more stable over time than factor returns.

A simple comparison

Let's do a little math to illustrate our multi-factor methodology and contrast it with a composite approach. Then we'll bring in some empirical evidence. To keep it simple we'll just look at a two-factor example. A simple equal-weighted composite ("mixed") index of the value and quality factors would be:

$$Composite\_0.5 = 0.5 * Value * Mkt + 0.5 * Quality * Mkt$$

Here Mkt is the market cap weight while Value and Quality are factor scores ranging from 0 to 1. An equally simple version of the FR tilt-tilt ("integrated") methodology would be:

$$Tilt\_0.5 = Mkt * Value^{0.5} * Quality^{0.5}$$

The tilt-tilt approach takes the products of factors and weights by exponents.[1] These two simple indexes are apples-to-apples comparisons in the sense that if we replace Quality with Value in each we will get:

$$0.5 * Value * Mkt + 0.5 * Value * Mkt = Mkt * Value^{0.5} * Value^{0.5} = Mkt * Value$$

Now let's compare the active exposures of these two indexes. By "active," we mean the exposure of the Value and Quality factors in the indexes minus whatever exposure occurs in the underlying benchmark, which in this case is the cap-weighted Russell 1000® Index.

Figure 1 shows the active factor exposures measured in z-score units.[2] We can see that the active value exposure is about the same for both and the quality exposure and is a bit stronger for the Tilt_0.5. Excess returns for the Composite_0.5 and Tilt_0.5 are 0.86% and 0.91% respectively.[3] If this was all there was to it one would probably conclude that there is not a big difference between the two methods of constructing indexes. But this is definitely not all there is to it as the next section will show.

Figure 1. Active exposure of value-quality indexes. Composite 0.5 versus tilt 0.5
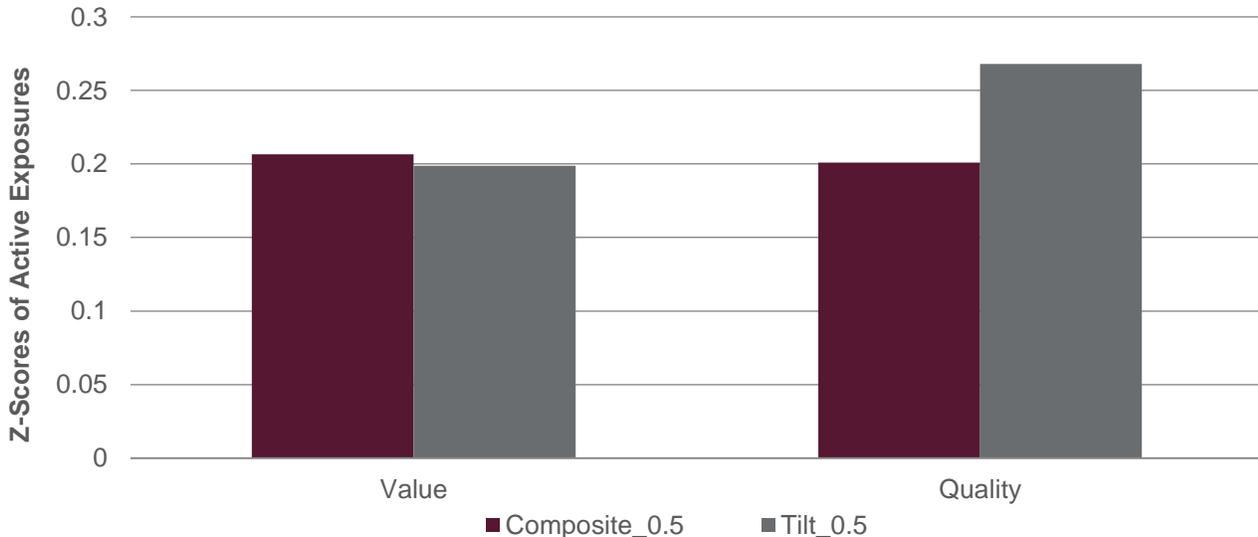
Source: FTSE Russell. Data from December 1997 to December 2016. Past performance is no guarantee of future results. Exposures shown may reflect hypothetical historical data. Please see the disclaimer for important legal disclosures.

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[1] For a detailed description of the methodology, including how individual factors are constructed, see *The Power of Tilting*, FTSE Russell 2016.

[2] The z-scores are in units of standard deviation from zero, zero being the average. A factor z-score of 1 would be a stock or index that has one standard deviation greater exposure than the average exposure for that factor. This way of measuring exposures allows for apples-to-apples comparisons across different factors.

[3] Dec 1997 through Dec 2016. Returns may reflect hypothetical data. Past performance is no guarantee of future returns.

What does leverage have to do with it?

The Tilt_0.5 index example above produces an index that is not FR's standard methodology for two factors. Instead, the standard methodology looks like this:

$$Tilt\_1.0 = Mkt * Value * Quality$$

There is an implicit exponent of 1.0 on each of the factor scores. This, of course, sharply increases the active exposures to the factors, as Figure 2 shows.

Figure 2. Active exposures of value-quality indexes. Composite_0.5, Tilt_0.5 and Tilt_1.0.
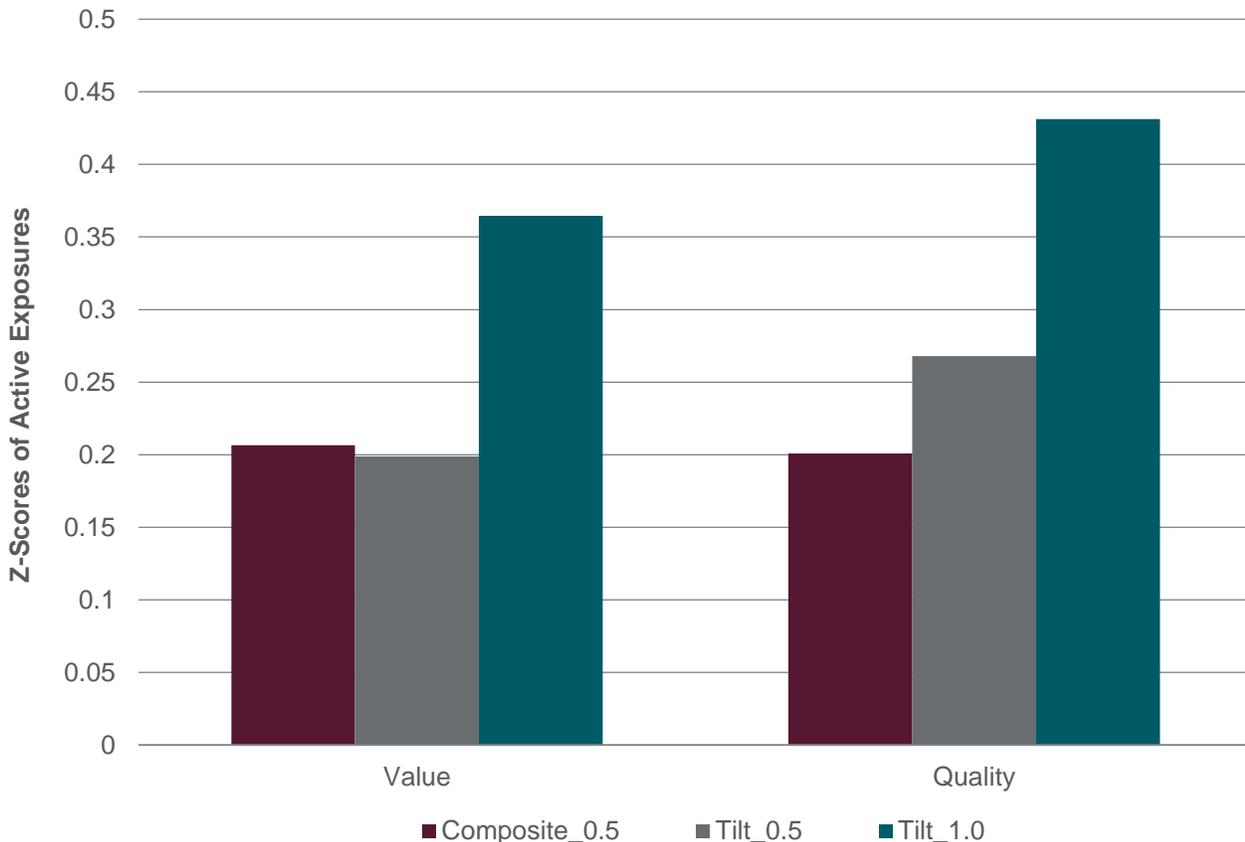
Source: FTSE Russell. Data from December 1997 to December 2016. Past performance is no guarantee of future results. Exposures shown may reflect hypothetical historical data. Please see the disclaimer for important legal disclosures.

Comparing a Composite_0.5 with a Tilt_1.0 may appear to be an unfair comparison because it is no longer apples-to-apples. How can we get composite index exposures up to the level of the Tilt_1.0 index? The obvious solution is a Composite_1.0 index:

$$Composite\_1.0 = 1.0 * Value * Mkt + 1.0 * Quality * Mkt$$

Figure 3 show that the Composite_1.0 does indeed bring active exposures close to the Tilt_1.0 index. There is just one problem: the Composite_1.0 represents twice more capital than was originally allocated. To see this, repeat the exercise we did above by hypothetically replacing Quality with Value:

$$1.0 * Value * Mkt + 1.0 * Value * Mkt = 2.0 * Value * Mkt$$

While for the Tilt_1.0:

$$Mkt * Value^1 * Value^1 = Mkt * Value^2$$

The additive nature of a composite index means that one has to effectively double the allocation to achieve the same level of active exposures as the standard Tilt_1.0 methodology. This can be achieved one of two ways. If the allocation is a sleeve of a larger portfolio, then one can double the allocation of capital. If the index is stand-alone however, then one must lever up the Composite_0.5 at 2x to achieve the same exposures as the Tilt_1.0.

The multiplicative nature of the tilt-tilt methodology results in an index that exponentially raises the intensity in the factors without having to increase capital allocations or explicitly employ leverage. The methodology "leverages" factor exposures without actually using leverage. Many market participants are either averse to using leverage or are prohibited from it altogether. This is the basis for our claim that the FR tilt-tilt methodology is more capital efficient.

Figure 3. Active exposures of value-quality indexes. Composite_0.5, Tilt_0.5 and Tilt_1.0.
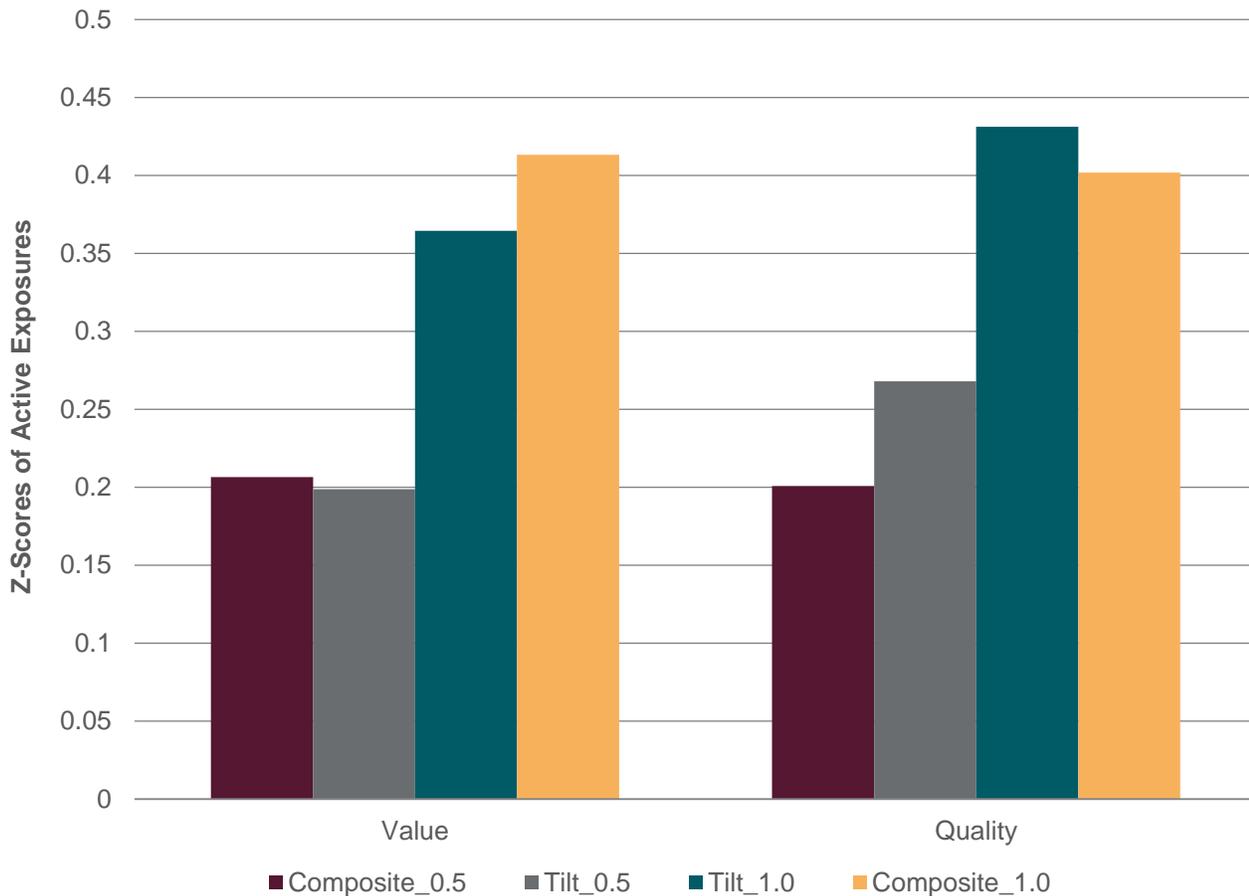
Source: FTSE Russell. Data from December 1997 to December 2016. Past performance is no guarantee of future results. Exposures shown may reflect hypothetical historical data. Please see the disclaimer for important legal disclosures.

Extension to five factors

The leveraging effect of the tilt-tilt methodology increases with the number of factors. Figure 4 shows the active exposures of indexes with five factors: quality, momentum, value, size and volatility. An equally-weighted composite index must be weighted at 0.2 to avoid explicit leverage:

$$Composite\_0.2 = 0.2 * Mkt * (Quality + Momentum + Value + Size + Volatility)$$

The tilt-tilt methodology requires no such constraint:

$$Tilt\_1.0 = Mkt * Quality * Momentum * Value * Size * Volatility$$

Figure 4 shows that active exposures for each factor are substantially larger with the Tilt_1.0 index. The average ratio of the active exposures is around 3, suggesting that a market participant would either have to explicitly lever at 3x or have to allocate three times more capital to achieve the same active factor exposures.

Table 1 shows the index performance comparison of applying these different methodologies. Targeting exposures in the capital efficient tilt-tilt way would have helped the index harness historical factor risk premia more effectively over the long term than a composite. The Sharpe ratios indicate tilt-tilt would have delivered higher risk-adjusted index returns as well.

Figure 4. Active exposures of five factor indexes. Composite_0.2 versus Tilt_1.0.
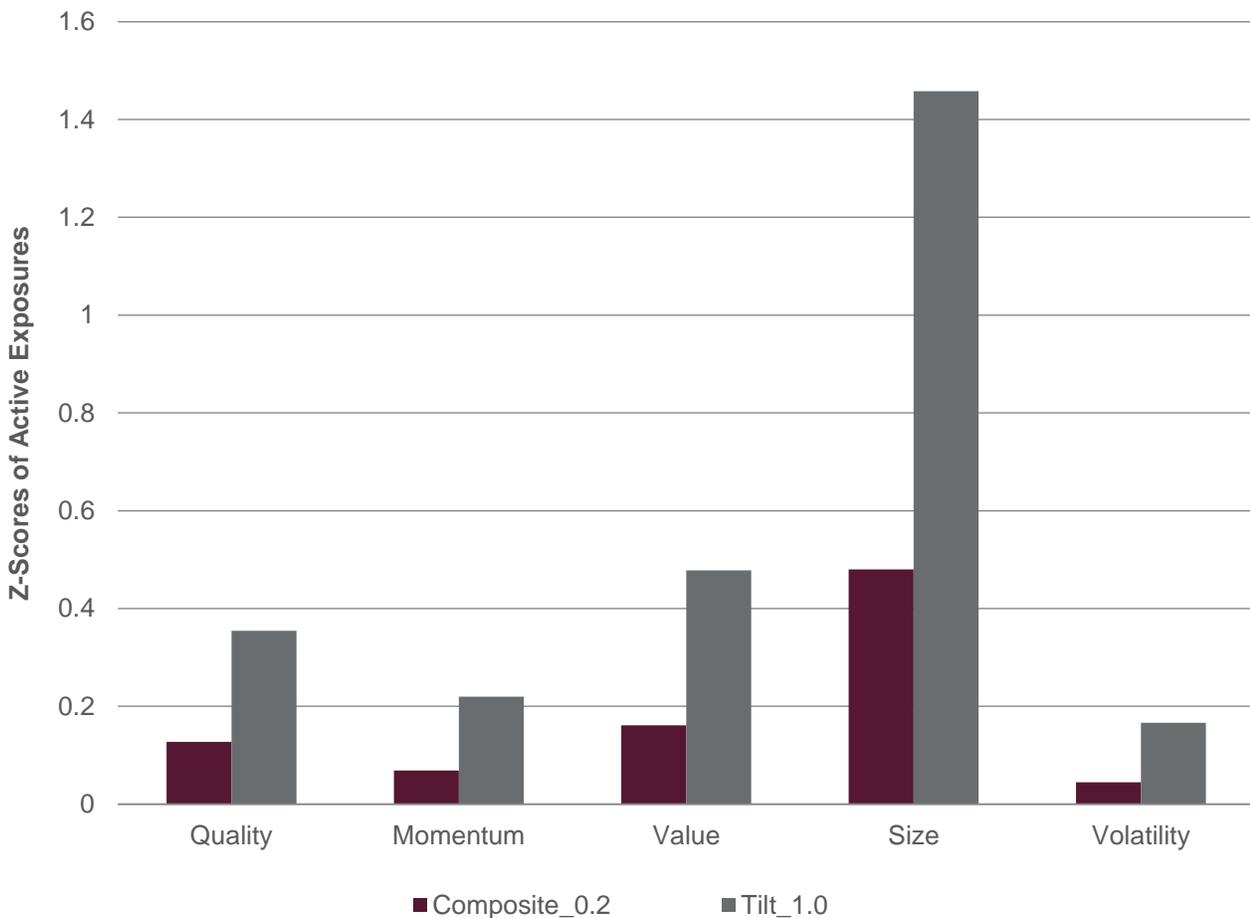
Source: FTSE Russell. Data from December 1997 to December 2016. Past performance is no guarantee of future results. Exposures shown may reflect hypothetical historical data. Please see the disclaimer for important legal disclosures.

Table 1. Performance- December 1997 – December 2016.

Performance Dec 1997 – Dec 2016	Russell 1000	Five Factor Tilt	Five Factor Composite
Geo. Return	6.87%	11.57%	8.04%
Volatility	17.71%	16.90%	17.49%
Sharpe Ratio	0.47	0.74	0.54
Geo. Excess Return		4.39%	1.09%
Tracking Error		6.94%	1.62%

Source: FTSE Russell. Data from December 1997 to December 2016. Past performance is no guarantee of future results. Returns shown may reflect hypothetical historical data. Please see the disclaimer for important legal disclosures.

Final observations

We have shown how the multiplicative tilt-tilt methodology more efficiently uses capital allocated for factor exposures. But a related issue is often brought up: multiplying by factor scores means that any stock with a close-to-zero score in any one factor will necessarily have a zero or extremely small weight in the final index. The concern is that a stock that has a very high score on one factor will be eliminated if even one score on another factor is zero or close to it.

This is entirely accurate but we consider this strength, not a weakness, of our methodology. One can think of a five factor index as a pentathlon. An athlete might have a world's record in one of the events, but if he is weak in one or two other events he will not be a winner. Neither Usain Bolt nor Michael Phelps would get a gold medal in the pentathlon. The gold goes to the athlete that is simultaneously strong and competitive in all five events, even though he might not be a world's record holder in any one of the events. The stocks in a five factor tilt-tilt index are pentathletes that deliver strength in all five factors simultaneously. This contributes substantially to the capital efficiency of the tilt-tilt methodology. It is not only an interesting theoretical argument; it is supported by data, as we have shown.

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

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