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SHANE D. SHEPHERD

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SHANE D. SHEPHERD is a vice president and head of fixed income research at Research Affiliates, LLC, in Newport Beach, CA, and adjunct professor at UCLA Anderson School of Management in Los Angeles, CA.
shepherd@rallc.com

In the five years since the launching of Fundamental Index® strategies as live portfolios, the effectiveness of the strategy and source of its outperformance have been strenuously debated. The initial research by Arnott, Hsu, and Moore [2005] presented the concept as a simple quantitative way to sidestep a crucial shortcoming of cap-weighted indexing. Capitalization-weight traditionalists, in step with the efficient markets hypothesis, believe that excess returns for any strategy must be compensation for the assumption of extra risk. In their minds, a Fundamental Index approach outperforms merely due to exposure to a size and/or value premium. (See Asness [2006], Blitz and Swinkels [2008], and Perold [2007].) Opposing the EMH adherents are proponents of a noise-in-price model, who believe that an ability to systematically take advantage of a mispricing effect drives the excess returns. In this article, we examine the characteristics of price returns in the Fundamental Index fixed income strategies and show evidence that supports the noise-in-price model. A fixed income portfolio that earns higher return due to a risk premium should show a higher yield and typically a higher income return at the expense of greater defaults and lower price return. However, a noise-in-price model suggests that outperformance will come about from systematic rebalancing and contra-trading against noisy price movements, which manifest as a high price return. Our findings show the excess returns to Fundamental Index fixed income portfolios are due *entirely* to price corrections and not due to exposure to higher risk factors. This supports a noise-in-price model as the driver of excess returns rather than exposure to higher amounts of risk.

THE FUNDAMENTAL INDEX APPROACH

The Fundamental Index idea was first presented by Arnott, Hsu, and Moore [2005], who noted that, in the absence of efficient markets, a cap-weighted portfolio will suffer from a return drag due to a systematic overweighting of overvalued securities and underweighting of undervalued securities. They estimate this return drag at 2% per year in the United States equity market. Theoretical models of noisy markets that delve into the mathematics behind this effect are shown in various applications by Blume and Stambaugh [1983], Roll [1983], Hsu [2006], Arnott, Hsu, Liu, and Markowitz [2011], and Brennan and Wang [2010]. At their core, these models show that with some amount of noise embedded in market prices and mean reversion over time, security prices with high recent returns are more likely to become overvalued and therefore experience lower future returns. A capitalization-weighted portfolio will increase weights to these securities along with their

upward price movements, resulting in a portfolio with high weights to securities more likely to be overvalued and low weights to those more likely to be undervalued. As prices mean-revert towards fair valuation, this weighting results in a return drag (relative to the opportunity set).

A Fundamental Index approach attempts to remove this return drag by eliminating the correlation between the pricing errors and the portfolio weights. The selection and weighting scheme detailed by Arnott, Hsu, and Moore uses a combination of four accounting variables to determine portfolio weights: five-year averages of cash flow, sales, dividends paid, and book value. These metrics select and weight constituents based on their economic scale while removing any connection with pricing errors. As a result, the portfolio preserves high levels of liquidity, capacity, and representativeness of the broad economy while removing the return drag associated with a cap-weighted portfolio.

FIXED INCOME FUNDAMENTAL INDEXES

The noise-in-price models are quite general and not specific to equities. Therefore, a cap-weighted portfolio in the fixed income markets should suffer the same source of return drag as that documented in the equity markets. The application of Fundamental Index strategies in the fixed income markets was first presented by Arnott, Hsu, Li, and Shepherd [2010]. They show that a fixed income portfolio selected and weighted by cash flow, sales, dividends, and book value of assets has outperformed its cap-weighted benchmark by 260 basis points annually in the United States high-yield corporate debt market, and by 40 basis points annually in the U.S. investment-grade corporate debt market.[1] Nor is this outperformance restricted to the United States markets. A portfolio of emerging markets sovereign USD-denominated bonds that is weighted by country factors (population, area, GDP, and energy consumption) outperforms its cap-weighted counterpart by 140 bps annually. Additional research by Hsu and Shepherd [2011] extends this concept to show outperformance in the developed world sovereign debt markets, emerging markets local currency bonds, global investment-grade and high-yield corporate bonds, and emerging markets corporate bonds.

We base the research in this article upon the RAFI® US Corporate Fundamental Bond Index series.[2] We examine four of the primary indexes in this series: the RAFI Investment Grade Master 1-30 Year Index, the RAFI Investment Grade 1-10 Year Maturity Index, the RAFI High Yield Master 1-30 Year Index, and the RAFI High Yield 1-10 Year Maturity Index.

These indexes are constructed by weighting companies according to economic size rather than the amount of their debt issuance. We gather historical information on cash flow, sales, dividends paid, and book value of assets. Weights are calculated as the trailing five-year average of each of these metrics to the aggregate five-year average across all corporations for each year. The composite RAFI weights are an equally weighted average of the cash flow, sales, dividends, and book value portfolios. To qualify for inclusion in the index, bonds must have a minimum amount outstanding of $500 million for the investment-grade index and $350 million for the high-yield index. Bonds rated AAA to BBB by both S&P and Moody's are placed in the investment-grade index, and those rated BB or B are placed in the high-yield index. Bonds with a split rating of BBB by one agency but rated high yield by the other are included in the high-yield index. Bonds rated CCC or below by either agency are excluded. The RAFI weight for each corporation is distributed among all bonds issued by that corporation according to relative face value. The Master index includes all outstanding bonds that qualify for inclusion. To ensure liquidity and investability, the 1–10 year maturity bin indexes include a maximum of two bonds from each issuer; the largest qualifying bond in the 1–5 year maturity bin and the largest qualifying bond from the 6–10 year bin are placed into the index.

We compare the RAFI Indexes to the broad-based cap-weighted counterparts computed by Merrill Lynch. These are the US Corporate Master (Bloomberg ticker C0A0); the US Corporate Master 1-10 Year (C5A0); the US High Yield Master II, BB-B Rated (H0A4); and the US High Yield Master II, BB-B Rated, 1-10 Year (H5A4). We use the BB-B rated benchmarks in the high-yield space as they better match the credit spectrum covered by the RAFI Index, thus ensuring that our results are not generated by a persistent credit bias due to index rules.

Exhibit 1 summarizes the risk and return characteristics of these indexes and their benchmarks. As expected, we see that the strategy works well in the U.S. fixed income markets. The Fundamental Index portfolios show outperformance and strong risk-adjusted alphas (based upon a market model) over their cap-weight benchmarks, and three of the four alphas are highly significant. In all but one case, the Sharpe ratios are significantly superior to those for the benchmarks.

EXHIBIT 1

Return and Risk Characteristics for RAFI Portfolios and Merrill Lynch Cap-Weighted Benchmarks, January 2000–December 2010

	Total Return	Standard Deviation	Sharpe Ratio	Duration	Credit Rating	Excess Return	Alpha	Alpha t-Stat
RAFI Investment Grade Master	7.07%	5.88%	0.78	5.67	A2/A3	0.24%	0.43%	1.11
Merrill Investment Grade Master	6.83%	5.05%	0.86	5.93	A3			
RAFI Investment Grade 1-10	7.03%	4.92%	0.93	4.56	A2/A3	0.51%	0.63%	2.01
Merrill Investment Grade 1-10	6.52%	5.01%	0.81	4.22	A3			
RAFI High Yield Master	10.03%	10.82%	0.70	4.62	BB2/BB3	3.40%	3.17%	2.59
Merrill High Yield Master (BB-B rated)	6.63%	9.84%	0.42	4.46	BB3/B1			
RAFI High Yield 1-10	8.92%	9.37%	0.69	4.71	BB2/BB3	2.80%	2.86%	3.53
Merrill High Yield 1-10 (BB-B rated)	6.12%	9.64%	0.38	3.92	BB3/B1			

Notes: Duration and credit ratings are the average of these values for each index over the sample period. Alphas are calculated by regressing the monthly RAFI index returns minus the risk-free rate on the respective Merrill Lynch benchmark returns less the risk-free rate. Both alphas and excess returns are annualized figures.

One natural possibility for these superior performance metrics could be due to higher yields resulting from excess interest rate risk exposure or credit risk exposure. However, the risk metrics presence in the exhibit casts serious doubt upon this explanation.[3] With the exception of the High Yield 1-10 Index, the duration risk has not been significantly higher or lower on average than the benchmark portfolios. Nor can credit risk explain the superior returns. The investment-grade rated portfolios rank a half-grade better than the benchmarks, and the high-yield portfolios score a full grade better. This should come as no surprise; by selecting and weighting on companies with high sales, cash flow, book value of assets, and dividends, the portfolio will be tilted more towards those companies with a stronger ability to make good on their debts. Therefore, we see these excess returns *despite* taking on significantly less credit risk.

EXAMINING THE PRICE RETURNS

Since risk-based factors cannot readily explain the excess returns, perhaps we should consider whether a noise-in-price model can provide some assistance. In a noisy marketplace, our theory suggests that some bonds will be underpriced (trading with too high an estimation of default risk) while others will be overpriced (trading with not enough default risk priced in). A cap-weighted portfolio will assign lower-than-optimal weights to those bonds which are trading cheap, relative to their default probability, and high weights, relative to fair value, to those for which the market has yet to realize the full risk. The first group typically includes historically strong companies that may have fallen on harder times; the second group would include those companies with high debt loads relative to their economic size. (In fact, the cap-weight portfolio assigns the highest weights to those companies with the highest levels of bond issuance!)

Using the Fundamental Index methodology, the economic size of a company serves as a stable anchor that allows the index to contra-trade against the imperfect judgments of the markets. Regular rebalancing requires taking profits from those bonds that have increased in price and are thus more likely to be overvalued and investing the proceeds in those that have fallen in price and are more likely to be undervalued. Excess returns are achieved via a systematic strategy of buying low and selling high.

Under the noise-in-price theory, we expect to see the majority of the outperformance come as a result of price movements in the portfolio. Note that this implication stands in stark contrast to the efficient market's risk-based hypothesis, which states that higher returns would manifest as a higher yield on the portfolio (witnessed primarily through a higher income return) to compensate an investor for taking on additional risk. Certainly, higher returns can often be achieved through seeking out higher yields. But stretching one's portfolio to find higher yields does indeed carry significant risk, as many investors learned the hard way during the market meltdown of 2008!

With this in mind, an examination of the outperformance due to price return versus income return should be quite illuminating. These results are summarized in Exhibit 2. In every case, we see dramatically stronger price return performance for the Fundamental Index portfolio. The RAFI Investment Grade Master Index produces 56 bps more in price return annually; the RAFI Investment Grade 1-10 Index generates 61 bps higher; the RAFI High Yield Master Index generates an incredible 3.34% higher return due to price movements; and the RAFI High Yield 1-10 Index generates 2.85% higher price return annually. Not only do the price returns strongly validate the noise-in-price hypothesis, they account for *virtually all* the outperformance of a Fundamental Index portfolio! On the other hand, the income returns are indistinguishable from the benchmark indexes, with the exception of the RAFI Investment Grade Master Index where the benchmark collects an additional 32 bps annually.

EXHIBIT 2

Price Returns versus Income Returns for RAFI Portfolios and Merrill Lynch Benchmarks, January 2000–December 2010

	Total Return	Income Return	Price Return	Yield to Worst
RAFI Investment Grade Master	7.07%	6.07%	1.00%	5.40%
Merrill Investment Grade Master	6.83%	6.39%	0.44%	5.98%
RAFI Investment Grade 1-10	7.03%	6.25%	0.96%	5.27%
Merrill Investment Grade 1-10	6.52%	6.18%	0.35%	5.68%
RAFI High Yield Master	10.03%	8.65%	1.38%	9.10%
Merrill High Yield Master (BB-B rated)	6.63%	8.60%	-1.96%	9.20%
RAFI High Yield 1-10	8.92%	8.48%	0.44%	8.51%
Merrill High Yield 1-10 (BB-B rated)	6.12%	8.53%	-2.41%	9.23%

Note: Yield to Worst is calculated as the average Yield to Worst over the sample period.

Let's take the analysis one step further. Contrary to the norm, the RAFI High Yield Fundamental Index strategies have actually generated a *positive* price return (with the help of falling yields over our time span, of course). Most high-yield investors expect a negative price return resulting from the inevitable defaults that occur. This is precisely what cap-weighted high-yield investors have received, losing about 2% to 2.5% annually in price movements. But by taking advantage of the noisy price movements in the high-yield space and regularly rebalancing back to a target weight, Fundamental Index investors have been able to turn that expectation on its head entirely.

It is also interesting to compare the stated yield to worst for each portfolio. We see that, if yields were taken on their face, the benchmark portfolio investors have been *promised*, on average, a much better return—from 40 to 60 bps from investment-grade bonds and 10 to 70 bps from high-yield bonds. This illustrates precisely the dangers of relying upon stated yields to guide investment decisions. What matters in the end is total return, of which price return, particularly in the high-yield market, can be a substantial component that investors cannot afford to ignore.

RELATING VOLATILITY TO PRICE RETURN

Intuitively, we can see that the amount of return drag to a cap-weighted portfolio must correlate strongly with the level of noise in a market. At one extreme, with no noise at all, the markets would indeed be efficient and a cap-weighted portfolio would become optimal. As the level of noise grows, the amount of return drag must also grow. In fact, Hsu [2006] develops a model that shows that the return drag will grow at two times the *variance* of the mispricing.

One straightforward implication of this extension is that in markets with greater mispricing, we expect to see a greater excess return as well as price return advan-

EXHIBIT 3

Incremental Price Return Related to Volatility, January 2000 to December 2010

	Overall Price Difference	High Vol Periods	Low Vol Periods	t-Test
Investment Grade Master	0.56%	0.50%	0.59%	-0.25
Investment Grade 1-10	0.60%	0.82%	0.38%	1.57
High Yield Master	3.45%	5.56%	1.33%	3.84
High Yield 1-10	2.84%	5.10%	0.58%	5.98

Note: All returns are average annual price returns for the RAFI index minus the respective benchmark.

tage. There should be little doubt that, whatever the level of mispricing, it will surely be larger in the corporate high-yield market than the corporate investment-grade market. Defaults are relatively rare in the investment-grade area, where most bonds are issued at par and pay off at par. But with much greater uncertainty about default risk and drastically higher volatility, the high-yield market allows much more room for pricing error and opportunity to profit from those movements. Therefore, we see much larger relative price advantage in the high-yield market. While investment-grade bonds allow for a Fundamental Index strategy to recapture 55–60 basis points of value that are lost due to the return drag of cap weighting, high-yield bonds have provided opportunity to recapture 2.8% to 3.5% annually of value lost to the return drag. This result shows additional support for the noise-in-price model.

Another implication is that, within a single market, the times of greatest volatility will afford the greatest opportunities. Volatility can be thought of as consisting of two components: a part due to mispricing and a part due to fundamental uncertainty or risk. We cannot separate these two components but can make the reasonable assumption that the level of mispricing is positively correlated with aggregate volatility. We estimate volatility as the standard deviation of returns on each benchmark portfolio for the 24 months around the return month. We then examine separately the *excess* price return (price return for the Fundamental Index strategy minus price return for the cap-weighted benchmark portfolio) during periods of high volatility and periods of low volatility. High volatility periods are considered those with volatility above the sample median, and low volatility periods are those below the sample median. This study requires forward-looking information—knowledge of the full sample volatility and relative ranking for each month—and thus it would not be implementable in real time. That, however, is not our purpose here. We merely want to show that, as predicted by theory, periods of high volatility generate larger levels of mispricing and greater outperformance.

Exhibit 3 shows that the periods of high volatility do indeed provide the greatest opportunities and drive the majority of the excess price performance in the high-yield markets. The RAFI High Yield Master Index has price outperformance over the benchmark index of 3.45% annualized across all periods; that includes a 5.56% outperformance during the high volatility periods and 1.33% annualized during the lower volatility periods. The RAFI High Yield 1-10 Index shows outperformance of 5.10% and 0.58% during the higher and lower volatility periods, respectively. We use an unpaired two-sample t-test to validate the statistical significance of these differences and find extremely high levels of confidence. However, splitting the sample into periods of higher and lower volatility is uninformative on the investment-grade returns. The Investment Grade Master returns are essentially identical for the two indexes across the two periods, and while the RAFI Investment Grade 1-10 Index shows enough difference to be economically important (0.82% outperformance during periods of high volatility and 0.38% outperformance during low volatility periods), it does not show sufficient power to claim statistical significance in our t-test. However, we are reassured by the extremely strong results in the much more volatile high-yield market where the results should be stronger and easier to detect.

CONCLUSION

The Fundamental Index concept was launched in the equity markets over five years ago and greeted with

everything from novel appreciation to vociferous attacks. The most persistent of those objections settled upon the claim that efficient markets dictate that any outperformance must be due to a repackaging of the size and value risk factors, and no true alpha should be attributed to the strategy. However, no size or value premiums exist in the fixed income markets and standard risk factors (credit risk and interest rate risk) do not explain the observed excess returns. To the contrary, we have shown that the predictions from a noise-in-price model describe much better the characteristics of returns to a fundamentally weighted fixed income portfolio. Rather than exhibiting higher risk exposures and correspondingly higher yields, we see that Fundamental Index strategies typically show *lower* risk exposures and *lower* yields. The excess return comes entirely from taking advantage of price volatility and regularly rebalancing back to a fundamental target weight. This effect is greatly pronounced when comparing the more volatile and noise-prone high-yield markets to the relatively efficient investment-grade credit market. We also see much greater outperformance across the time series, with much higher excess price returns observed during periods of high market volatility when noise and opportunities to take advantage of mispricings are greatest. This strong support for the noise-in-price model should, we feel, also lend strong credence to the alpha-generating process of fundamentally weighted equity indexes.

ENDNOTES

[1]Based on simulated data from 1997 through 2009.

[2]The four Fundamental Index strategies are calculated in conjunction with Ryan ALM, Inc., using the methodology described in Arnott, Hsu, Li, and Shepherd [2010].

[3]Arnott, Hsu, Li, and Shepherd [2010] also show via regression-based tests and dynamic attribution tests that risk exposures fail to explain the excess returns to a group of fundamentally indexed fixed income portfolios.

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