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Valuation-indifferent weighting has gained significant interest as a strategy for creating alternative indices or quasi-indices. The weighting scheme has empirical support from Arnott, Hsu, and Moore [2005] and many subsequent papers extending their approach. It also has theoretical support from models based on the classic noise-in-price framework. In this article, we extend this body of research by applying the valuation-indifferent weighting approach to a new asset class.

Noise-in-Price Framework

The noise-in-price framework has been used to examine a variety of equity market anomalies.[1] Blume and Stambaugh [1983] and Roll [1983] used bid–ask bounce to motivate a rational noise-in-price model for high-frequency stock price dynamics. They concluded that the microstructure effect could explain about 50% of the documented size premium. The pricing noise, or the bid–ask bounce, through the Jensen Effect results in a higher compounded return than warranted by the stock's true risk exposure. Smaller stocks, which are more likely to face larger bid–ask spreads and therefore to contain greater price noise, earn higher risk-adjusted returns. The excess return is eroded, however, when one factors in the implied transaction cost associated with the bid–ask spread.

Summers [1986] and Poterba and Summers [1986, 1988] extended the noise-in-price framework to examine nonrational pricing dynamics, which can cause prices to significantly deviate from fundamental values over long periods. They concluded that standard econometrics cannot reject the efficient market hypothesis when the true asset pricing process contains economically significant mean-reverting noise. It is precisely this econometric identification problem that does not allow inefficiencies to be fully exploited. Building on Summer's [1986] conjecture about persistent price inefficiency, Arnott and Hsu [2008] and Arnott et al. [2010] used the noise-in-price framework to explain the size and value effects. They concluded that size and value premiums are not risk based, but are, in fact, free lunches.

The fundamental indexation outperformance of Arnott, Hsu, and Moore [2005] can be interpreted as an empirical validation of the noise-in-price model. They argued that when prices are inefficient, cap-weighted portfolios overallocate to overvalued stocks and underallocate to undervalued stocks. They proposed and showed that, on average, an accounting-based (valuation-indifferent) weighting scheme would deliver better performance than traditional cap weighting. Hsu [2006] used a noise-in-price model to compute the advantage of a valuation-indifferent weighting strategy and estimated the advantage to be approximately two times the noise variance. Empirical works by Tamura and Shimizu [2005], Chen, Chen, and Bassett [2007], Hsu and Campollo [2006], Estrada [2008], Hemminki and Puttonen [2008], Houwer and Plantinga [2008], and Neukirch [2008] have found outperformance of valuation-indifferent weighting strategies in a variety of equity market applications.

While empirical evidence supporting the merit of valuation-indifferent weighting appears to be robust, the source of outperformance remains controversial. The efficient market hypothesis cannot be rejected in favor of the noise-in-price framework. A significant portion of the valuation-indifferent weighting outperformance is explained by the value and size factors. The inference on this result depends on the analyst's interpretation of the size and value premiums. Arnott [2005b], Arnott and Hsu [2008], and Arnott et al. [2010] argued that size and value premiums are artifacts of noise in prices. They showed that value and size premiums and valuation-indifferent weighting outperformance are free lunches driven by the same inefficiency. Critics, however, reject the noise-in-price premise and argue that size and value are well-known proxies for hidden risks that we do not fully understand. Under this interpretation, valuation-indifferent weighting strategies are simply strategies that load up on more risk, and thus offer no useful advantage for investors.

Valuation-Indifferent Weighting

Valuation-indifferent weighting strategies refer to the class of mechanical portfolio-weighting schemes based on nonprice weighting metrics. Equal weighting is perhaps the oldest and most well-known valuation-indifferent weighting approach. Recent empirical evidence has rigorously demonstrated the performance advantage of valuation-indifferent weighting strategies against cap-weighting strategies. The excess returns appear robust across markets and applications, and they are economically and statistically large.

A popular variant proposed by Arnott, Hsu, and Moore [2005] uses nonprice-based accounting variables to create portfolio weights. Using the traditional noise-in-price framework, the authors argued that if a stock is overvalued its price will contain a positive pricing error (see also Arnott [2005b], Hsu [2006], and Arnott and Hsu [2008]). When portfolio weights are formed based on prices or market capitalizations, portfolio weights become positively correlated with pricing errors. In comparison, valuation-indifferent weighting does not exhibit this positive correlation between portfolio weights and pricing errors. Therefore, a price-weighted portfolio would have greater portfolio weights committed to overvalued stocks than a nonprice-weighted portfolio, which would result in suboptimal performance.

Others argue that the valuation-indifferent weighting strategy works because it indirectly exploits the small-cap and value premiums in equity markets (see Asness [2006], Schoenfeld and Ginis [2006], Jun and Malkiel [2008], and Blitz and Swinkels [2008]). Although critics do not uniformly regard size and value exposures as risk exposures, they do agree that valuation-indifferent weighting is best interpreted as a simple way of incorporating size and value premiums into a portfolio in lieu of a strategy that exploits new market anomalies. This view is corroborated by Arnott and Hsu [2008] and Arnott et al. [2010] who showed that size and value premiums and the valuation-indifferent weighting strategy outperformance are two sides of the same mispricing coin.

The real debate, then, is whether one subscribes to the efficient market hypothesis or the noise-in-price hypothesis. The former suggests that valuation-indifferent weighting is mean-variance superior to cap weighting because valuation-indifferent weighting takes on non-Gaussian hidden risks, which are correlated with small-cap and value exposures. The latter hypothesis remains controversial because it suggests a financial market free lunch.

Perold [2007] questioned the noise-in-price model proposed in Hsu [2006] and Arnott and Hsu [2008] in which valuation-indifferent weighting outperformance was shown as a financial market free lunch. Perold argued that the noise model must also generate negative autocorrelation in stock returns and would predict the existence of strategies that identify stock valuation errors. This flies in the face of the extensive empirical literature supporting market efficiency. Perold's concerns, in fact, pertain to the entire class of noise-in-price models. Summers [1986], Poterba and Summers [1988], Rosenberg, Reid, and Lanstein [1985], Black [1986], DeBondt and Thaler [1985, 1987], and others addressed the possibility of persistent mispricing opportunities.

This Article's Contribution to the Literature

Strong disagreement and diverse interpretations remain regarding the benefits and efficacy of valuation-indifferent weighting schemes and the reasonableness of the noise-in-price modeling framework. In this article, we contribute to the debate by applying the valuation-indifferent weighting technique to bonds.

We believe the results of our study add to the growing body of literature in at least two important ways. First, the fixed-income application provides a reliable out-of-sample test for the efficacy of valuation-indifferent weighting. Second, in applying the methodology to the bond market, we examine the strategy in a market where equity size and value factors do not play a role as return–risk drivers and where the known risks are of a different nature than those present in the equity market. If, on the one hand, valuation-indifferent-weighted bond portfolios do not add value, then the noise-in-price model loses some credibility. If, on the other hand, we observe outperformance in valuation-indifferent-weighted bond portfolios, then the noise-in-price model gains credibility and we have a few more "hidden risks" to explain.

In a similar spirit, the valuation-indifferent concept has been extended by Hsu, Kalesnik, and Li [forthcoming] to listed real estate investing. Due to the high correlation between investable real estate markets and equity markets, however, the evidence found in this extension is alone insufficient to address the criticism that the approach outperforms simply through size and value tilts.

We apply the valuation-indifferent weighting scheme to investment-grade corporate bonds, high-yield corporate bonds, and emerging market bonds. The common risk factors for pricing corporate and emerging sovereign bonds are sensitivities to changes in the interest rate term structure, default probability, collateral quality, and maturity. These factors differ from the factors governing equity dynamics. Examining the valuation-indifferent-weighting performance in the context of these bond risk factors can bring new insights, particularly if we observe outperformance adjusted for standard bond risk factors and other hidden risk factors proxied by equity value and size factors.

CONSTRUCTION OF FIXED-INCOME VALUATION-INDIFFERENT PORTFOLIOS

The construction of a valuation-indifferent portfolio in the fixed-income sector essentially uses the same methodology as that applied to equity portfolio construction, but modified for several challenges unique to fixed-income securities. For example, most companies have only one issue of common stock, but many companies have multiple bond offerings. The emerging debt markets offer a plethora of country data, but the measures of company size used for corporate issuers (e.g., sales, profits, book values, and dividends) have no meaning in defining the size of an emerging market economy.

We first describe the construction of the U.S. corporate investment-grade and high-yield portfolios. Because the only difference between the underlying constituents in these portfolios is credit quality, we use the same factors and methodology to construct both portfolios. These factors and methodology are broadly similar to the factors and methodology applied by Arnott, Hsu, and Moore [2005]. Then, we turn our attention to the different factors needed for construction of the valuation-indifferent portfolio of emerging market bonds.

U.S. Corporate Investment-Grade and High-Yield Bonds

As with the application of the valuation-indifferent-weighting scheme in equity markets, it is also important to define weighting metrics in the fixed-income space that produce a representative portfolio of the scale of the underlying debt issuers and, thus, deliver a broad representation of the particular asset class. We have good reason to assume that the same metrics that measure representativeness in the equity markets would also be useful in the corporate bond markets. Both debt and equity offerings are, at the most basic level, vehicles for financing a corporate enterprise, and both are simple claims on the future cash flows from these projects. The metrics that determine the strength of these cash flows and the economic viability of their underlying projects are the basis for the cash distributions and, therefore, valuations of both corporate equity and debt.

Because the bond investor's perspective of a company's economic scale differs somewhat from the equity investor's perspective, we deviate slightly from the primary metrics used in the equity portfolio to construct the corporate debt benchmarks. We examine five factors: 1) total cash flow, 2) total dividends, 3) book value of assets, 4) sales, and 5) face value of the debt issue. We compute the lagged five-year average for all factors except the book value of assets for which we use the most recently reported number. The total dividends figure includes aggregate dividends paid, both common and preferred. The equity index uses shareholders' book equity, but the fixed-income index uses the book value of *assets,* recognizing the claims that bondholders have on the asset side of the corporate balance sheet. We use debt offering size, measured by the face value of debt, rather than company size. We do not include face value in our composite measure due to the link with default probability.[2] Data on these corporate financials are from the Worldscope database.

Before applying a fundamental weight to the individual bond offerings, we use the four company-specific factors to construct fundamental weights for each corporation. Each company is ranked on each of the four metrics and given a relative weight on that metric. We compute a composite measure by equally weighting four of the measures: assets, dividends, cash flow, and sales. If a company does not pay a dividend, we equally weight the remaining three metrics, as Arnott, Hsu, and Moore [2005] did in the equity markets.

We then turn our attention to the individual bonds. The corporate bond constituent data are from the Merrill Lynch U.S. Corporate Master Index (investment-grade bonds) and the Merrill Lynch U.S. High Yield Master II Index (high-yield bonds) for the period January 1997 through December 2009. The Merrill Lynch U.S. Corporate Master Index includes all corporate investment-grade bonds (bonds rated AAA to BBB–), and the Merrill Lynch U.S. Master II Index includes all corporate bonds rated BB+ and below (high-yield bonds). We exclude C- and D-rated bonds and compare our results to the subset of the Merrill Lynch U.S. High Yield Master II Index that includes bonds rated BB+ to B–.

Next, we merge the data for individual bonds with their respective corporate fundamental data, but we encounter a matching problem; many of the bonds in the Merrill Lynch (ML) indices are issued by unlisted corporations, consequently there is no public access to these companies' accounting data. We also have difficulty matching privately owned or employee-owned companies and companies that are based in foreign countries or traded on the OTC markets. For example, GMAC is a large issuer of high-yield debt, but the automobile financing company is 49% owned by General Motors and 51% owned by private equity. We lack direct corporate financials in order to measure the GMAC debt. Another example is Freescale Semiconductor, a company that was taken private in 2006, but whose debt still trades on the public markets and is included in the ML index. The data in December 2009 include 1,408 bonds in the high-yield index. Of those, 1,177 are domiciled in the U.S. We can match 993 of the issues to corporate accounting data by using either a ticker symbol or CUSIP number, but the resulting 84% match rate removes a sizable portion of the published index from our analysis.

To minimize the impact of sample bias, and to reduce the risk that our results spring from fundamental selection and weighting, we compare our valuation-indifferent portfolios with both the published benchmark *and* a cap-weighted index, which we construct from the more limited universe of successfully matched bond issues. Although this does not eliminate the possibility of selection bias, we can obtain a crude indication of the magnitude of the potential problem by observing the difference between the published benchmark and our cap-weighted measure of the bonds in the valuation-indifferent indices.

Another complication is that many corporations have multiple bond issues. To avoid overweighting a single company in the index simply because it parcels its debt among a variety of instruments, we do not directly apply the fundamental weight from the corporation to each of its bond issues. Instead, we divide the fundamental score among the corporation's bond issues according to the ratio of each bond issue's face value to the sum of the face value of the overall debt issued by that corporation.[3] We then rescale the weights to correct for the fact that not all corporations with a fundamental score have debt issues on their books.

The resulting list of debt issues and weights constitutes our portfolio. Using the preceding construction, we are reasonably assured of a valuation-indifferent index that is liquid, tradable, and scalable, in marked contrast to other valuation-indifferent methodologies such as equal weighting.

Emerging Market Bonds

We use a similar procedure with different factors to construct the valuation-indifferent portfolio of emerging market bonds. The search for factors on which to base a fundamental emerging market index offers many choices. To state the obvious, emerging market bonds do not have metrics such as sales, profits, book value, or dividends on which to gauge the size of the bond issuer! Still, analogues for country size exist. We focus on four factors that signify the current and potential importance of a country in the world economy: 1) total population, 2) square root of land area (as a crude proxy for resources),[4] 3) total gross domestic product (GDP), and 4) energy consumption. The data on the four country factors, excluding energy consumption, for the period 1993–2009 are from the *CIA World Factbook*.

Exhibit 1

Performance of Valuation-Indifferent Bond Portfolios vs. Cap-Weighted Benchmarks (500-Name Portfolios), January 1997–December 2009

	Return	Standard Deviation	Sharpe Ratio	Average Credit Rating	Duration	Excess Return	Alpha vs. Pub. Index	*t*-Statistic of Alpha	Tracking Error	Information Ratio
A: High-Yield Corporate Bonds										
Assets	9.61	17.74	0.36	BB3	4.92	3.36	2.14	0.63	12.75	0.26
Dividends	8.62	12.94	0.42	BB2/BB3	5.21	2.38	2.21	0.92	8.64	0.28
Cash Flow	8.73	11.44	0.48	BB3	4.77	2.48	2.21	1.42	5.66	0.44
Sales	8.61	10.38	0.52	BB3	4.65	2.36	2.32	1.81	4.62	0.51
Face Value	7.68	10.35	0.43	BB3/B1	4.68	1.43	1.10	2.20	2.08	0.69
Composite	**8.85**	**12.65**	**0.45**	**BB3**	**4.92**	**2.60**	**2.19**	**1.09**	**7.29**	**0.36**
500-Bond Benchmark	*6.69*	*9.13*	*0.38*	*BB3/B1*	*4.58*	*0.45*	*0.51*	*1.26*	*1.46*	*0.31*
Published Index	*6.25*	*9.19*	*0.33*							
B: Investment-Grade Corporate Bonds										
Assets	6.35	6.13	0.51	A1/A2	5.37	0.01	0.16	0.22	2.63	0.01
Dividends	6.88	5.40	0.68	A1	6.03	0.54	0.87	2.15	1.56	0.35
Cash Flow	6.78	5.39	0.66	A1/A2	6.07	0.44	0.74	2.17	1.33	0.33
Sales	6.86	5.31	0.69	A2	6.04	0.52	0.89	2.23	1.58	0.33
Face Value	6.49	6.12	0.54	A2	5.90	0.16	0.18	0.31	2.00	0.08
Composite	**6.75**	**5.43**	**0.65**	**A1**	**5.88**	**0.42**	**0.71**	**1.90**	**1.43**	**0.29**
500-Bond Benchmark	*6.30*	*6.02*	*0.51*	*A2*	*5.93*	*-0.03*	*0.03*	*0.06*	*1.94*	*-0.02*
Published Index	*6.33*	*5.81*	*0.54*							
C: Emerging Market Bonds										
Population	11.24	10.18	0.79	BB1	5.11	0.43	3.44	2.09	8.00	0.05
Area	13.10	13.38	0.74	BB1/BB2	5.10	2.30	3.18	2.10	5.63	0.41
GDP	11.47	10.53	0.79	BB1	5.35	0.67	3.07	2.36	6.36	0.10
Energy Consump.	13.31	13.28	0.76	BB1	5.20	2.50	4.04	1.95	7.87	0.32
Face Value	14.82	16.94	0.69	BB2/BB3	6.21	4.02	2.73	2.01	5.47	0.73
Composite	**12.23**	**11.72**	**0.77**	**BB1**	**5.13**	**1.43**	**3.38**	**2.14**	**6.64**	**0.22**
50-Bond Benchmark	*10.95*	*14.97*	*0.52*	*BB2*	*6.33*	*0.15*	*-0.39*	*-0.76*	*2.07*	*0.07*
Published Index	*10.80*	*13.87*	*0.55*							

Notes: For the valuation-indifferent portfolios, the top 500 names are selected by fundamental weight for the high-yield and investment-grade indices. For the investment-grade and high-yield corporate portfolios, "Composite" includes assets, dividends, cash flow, and sales. For the valuation-indifferent emerging market portfolios, the top 50 names are selected by fundamental weight. For the emerging markets, "Composite" includes population, area, GDP, and energy consumption. "Benchmark" is the cap-weighted benchmark constructed from our particular matched subsample. "Published Index" is the index return for the relevant ML benchmark return provided by Bloomberg. Excess returns and tracking errors are computed against the published index. The t-statistics are for the null hypothesis that the estimated alphas are not different from zero.

The data on energy consumption are from the 2009 *British Petroleum Statistical Review of World Energy* and include aggregate consumer and industrial consumption of oil, natural gas, coal, nuclear energy, and hydroelectric power.[5] All factors are computed as smoothed five-year averages.

These factors are much less volatile than the factors used for corporate U.S. bonds. In particular, land area does not change much from year to year; therefore, the target weights move only gradually. We then give each country a weight based on the five-year averages of each factor, proportional to its representation. A country's aggregate weight is the equally weighted average of its score on the four individual factors.

We then gather the constituent issues in the Merrill Lynch USD Emerging Market Sovereign Plus Index, which includes U.S. dollar-denominated foreign sovereign debt rated BBB+ and lower. As of 2009, this group includes 198 separate issues from 36 countries. To avoid the over-representation problem created by one country with multiple debt issues, we split the country weight among each of its issues according to the face value of the debt in a manner analogous to the procedure used with corporate bonds. In merging the data for individual bonds with the emerging market fundamental data, we successfully match nearly 100% of the emerging market bonds.

PORTFOLIO PERFORMANCE AND ATTRIBUTION

In the exhibits that follow, we present results for all three valuation-indifferent portfolios (investment-grade, high-yield, and emerging market debt) and their respective market-value-weighted benchmarks. For each benchmark, we examine two portfolios. One benchmark portfolio is based on the top 500 names for U.S. corporate investment-grade and high-yield debt and the top 50 names for emerging market debt, selected and weighted by composite fundamental value. The second benchmark portfolio includes all bonds in the database; as of 2009, 993 qualifying issues were in the high-yield index and 2,833 issues were in the corporate bond index.

Returns to the three valuation-indifferent portfolios and their benchmark indices for the constrained (500-name indices) sample are presented in Exhibit 1. Panel A shows that the valuation-indifferent composite portfolio outperforms the constrained index in the U.S. corporate high-yield bond space by 260 basis points (bps) per year, Panel B shows that the composite valuation-indifferent investment-grade portfolio outperforms the relevant ML index by 42 bps per year, and Panel C shows outperformance by the emerging market valuation-indifferent debt portfolio versus the constrained index by 143 bps per year, with much lower risk. In addition to these positive results for the composite indices, all of the individual metrics outperform their respective benchmarks as well.

This strong result provides evidence that valuation-indifferent indexing works in fixed-income markets; by severing the link between price and portfolio weight, the approach also separates the weight in the portfolio from any error in the price. As a result, the approach does not inherently overweight the overvalued bonds and underweight the undervalued bonds relative to their unknowable ex post realized fair value weights. Furthermore, these tests in the bond market serve as out-of-sample tests and confirm results we have found in the equity markets; that is, regardless of the metric used to create the weights, a valuation-indifferent weighting outperforms the cap-weighted benchmark in every specification.

In Exhibit 2, we present results for the entire available universe of bonds for which the valuation-indifferent metrics of size are available—that is, excluding the selection component. The outperformance of the valuation-indifferent indices is very similar to the outperformance of the more restricted indices, suggesting that a real-world portfolio created from the subset of the largest weights will not cause any significant biases when compared to the entire universe of debt offerings. Panel A of Exhibit 2 shows that the matched custom benchmark in the high-yield space, created to match the valuation-indifferent index subsample, outperformed the listed ML index by 81 bps. Apparently, there is great value in *excluding* foreign-based corporations and companies not listed on the major domestic stock exchanges.[6] We believe this is a fruitful path for future study. The strategy based on valuation-indifferent indexing shows sizable risk-adjusted outperformance over both the ML index and the substitute cap-weighted benchmark.

As will be explained later, the valuation-indifferent fixed-income portfolios are typically less volatile and less risky than the ML indices. Furthermore, the incremental return does not generally come from credit quality or duration risk, which could be viewed as the bond analogues of value and beta. Almost all boast a superior average credit rating, and duration tends to be similar to, or shorter than, the benchmark, especially for emerging market bonds. So—with higher returns and lower volatility—the

EXHIBIT 2

Performance of Valuation-Indifferent Fixed-Income Portfolios vs. Benchmarks (Entire Universe), January 1997–December 2009

	Return	Standard Deviation	Sharpe Ratio	Average Credit Rating	Duration	Excess Return	Alpha vs. Pub. Index	*t*-Statistic of Alpha	Tracking Error	Information Ratio
A: High-Yield Corporate Bonds										
Assets	9.69	17.48	0.37	BB3	4.89	3.45	2.29	0.68	12.53	0.28
Dividends	8.60	12.91	0.42	BB2/BB3	5.20	2.36	2.19	0.91	8.61	0.27
Cash Flow	8.69	11.06	0.50	BB3	4.74	2.44	2.24	1.55	5.24	0.47
Sales	8.56	10.17	0.53	BB3	4.62	2.32	2.31	1.91	4.37	0.53
Face Value	7.72	9.75	0.46	BB3/B1	4.65	1.47	1.32	3.45	1.50	0.98
Composite	**8.79**	**12.24**	**0.46**	**BB3**	**4.87**	**2.54**	**2.19**	**1.17**	**6.83**	**0.37**
Benchmark	*7.06*	*8.88*	*0.43*	*BB3/B1*	*4.58*	*0.81*	*0.94*	*3.14*	*1.15*	*0.70*
Published Index	*6.25*	*9.19*	*0.33*							
B: Investment-Grade Corporate Bonds										
Assets	6.41	5.94	0.54	A1/A2	5.52	0.07	0.18	0.33	1.97	0.04
Dividends	6.89	5.47	0.67	A1/A2	6.04	0.56	0.80	2.68	1.15	0.48
Cash Flow	6.82	5.51	0.66	A2	6.10	0.49	0.68	2.68	0.98	0.50
Sales	6.83	5.46	0.66	A2	6.08	0.50	0.74	2.38	1.20	0.41
Face Value	6.68	5.74	0.61	A2/A3	5.95	0.34	0.40	2.06	0.71	0.48
Composite	**6.76**	**5.49**	**0.65**	**A2**	**5.94**	**0.43**	**0.63**	**2.65**	**0.93**	**0.46**
Benchmark	*6.52*	*5.66*	*0.59*	*A2/A3*	*5.95*	*0.18*	*0.28*	*1.49*	*0.70*	*0.26*
Published Index	*6.33*	*5.81*	*0.54*							
C: Emerging Market Bonds										
Population	11.17	9.94	0.80	BB1	5.11	0.37	3.23	2.31	7.19	0.05
Area	12.63	13.07	0.72	BB1/BB2	5.13	1.83	2.64	2.23	4.47	0.41
GDP	11.45	10.53	0.78	BB1	5.31	0.64	2.86	2.65	5.57	0.12
Energy Use	13.01	13.01	0.75	BB1	5.16	2.21	3.66	1.98	7.08	0.31
Face Value	13.74	15.39	0.68	BB2/BB3	5.69	2.94	2.35	2.28	3.91	0.75
Composite	**12.07**	**11.45**	**0.77**	**BB1**	**5.17**	**1.27**	**3.09**	**2.43**	**5.60**	**0.23**
Benchmark	*11.06*	*13.98*	*0.56*	*BB2/BB3*	*5.79*	*0.26*	*0.22*	*0.78*	*1.00*	*0.26*
Published Index	*10.80*	*13.87*	*0.55*							

Notes: For the corporate indices, "Composite" includes assets, dividends, cash flow, and sales. For the emerging market indices, "Composite" includes population, area, GDP, and energy consumption. "Benchmark" is the cap-weighted benchmark constructed from our particular matched subsample. "Published Index" is the index return for the relevant ML benchmark return provided by Bloomberg. Excess returns and tracking errors are computed against the published index

valuation-indifferent fixed-income portfolios generally have much higher Sharpe ratios than the ML benchmarks.

IS THIS ALPHA DRIVEN BY KNOWN RISK SOURCES?

The investment-grade and high-yield spaces provide an excellent opportunity to test the proposition that the efficacy of a valuation-indifferent portfolio is correlated with the level of noise in a marketplace. The direct comparison between the investment-grade valuation-indifferent portfolio and the high-yield valuation-indifferent portfolio shows that much greater outperformance is realized in the noisier high-yield space than in the presumably more efficient investment-grade space.

A common criticism of valuation-indifferent indexing in the equity market is that the strategy is merely a value play in disguise. Because the value and size factors are of primary importance in the equity markets, we cannot expect them to adequately explain the returns on a fixed-income portfolio. Instead, to fully examine the risk loadings on the valuation-indifferent returns for fixed-income securities, we follow the footsteps of Fama and French [1993, 1996] and use the classic equity three-factor model, augmented by the two most relevant factors in the fixed-income markets—duration and credit risk.

CAPM and Fama–French Analysis

In Exhibit 3, we present a formal analysis of the valuation-indifferent portfolios in relation to the risk factors. Panel A shows the results of the basic regression of the three valuation-indifferent portfolio returns and the benchmark returns using the capital asset pricing model (CAPM). We do not expect the CAPM to fully capture the risk present in these portfolios, but it serves as a starting point and interesting comparison between the valuation-indifferent portfolios and their benchmarks. The benchmark alphas are smaller and less significant across the board, whereas all the valuation-indifferent portfolios show significantly positive risk-adjusted alphas.

Panel B of Exhibit 3 shows that the Fama–French three-factor model [1992] has some explanatory power for the fixed-income valuation-indifferent portfolios. Although the alphas are positive, adding in these additional sources of risk weakens the *t*-statistics. Note that the three-factor model does a reasonable job of explaining the returns in the benchmarks. Most notably, the valuation-indifferent indices have small-size and value tilts, not significantly different from that of the benchmarks and far milder than the tilts observed in valuation-indifferent equity market indices. This outcome is not entirely surprising because Fama and French [1993] suggested that the size and value factors proxy for unknown risk sources common to both stocks and bonds, even though these risk factors may be difficult to measure in the fixed-income area. Most of the alpha is not explained, however, by the Fama–French factors in Exhibit 3.

Panel C of Exhibit 3 details the results for the regression of the three Fama–French factors augmented by a duration risk factor and a default risk factor. The term spread is the difference in returns between a portfolio of 10-year to 15-year U.S. Treasury notes and the three-month T-bill. The default risk factor (DEF) is the difference between the return earned by a portfolio of investment-grade corporate debt and the return earned by the 10-year T-bond. It is no surprise that these factors explain much of the alpha in the benchmark, but it is very interesting to see how little of the *incremental* alpha of the valuation-indifferent indices is explained by these bond factors.

Our results are robust to these risk adjustments. Panel C of Exhibit 3 shows that the valuation-indifferent portfolios have, in general, higher sensitivities to the term spread and default risk factors. Despite adjusting for these loadings, the alphas still far exceed those of the benchmarks. And although the five-factor model does a reasonable job of explaining the returns of the benchmark portfolios, the *t*-stats on the alphas for two of the valuation-indifferent portfolios are highly significant. The results clearly indicate that the outperformance of the valuation-indifferent strategy in fixed-income markets is not—or, at least, historically has not been—a result of excess exposure to the well-known stock or bond market risk factors.

Attribution Analysis

Of course, all of these models attempt to explain the returns of a portfolio that are above the risk-free rate. Because the valuation-indifferent portfolio is so closely related to its cap-weighted counterpart, a comparison of the attribution details of these two indices is of great interest. Accordingly, we carry out a Brinson-type attribution analysis (see Brinson and Fachler [1985]) of the variation in excess returns of the valuation-indifferent portfolios against the cap-weighted benchmarks. The results are presented in Exhibit 4. We include the results of a dynamic version of this analysis (see Hsu, Kalesnik, and Myers, [2010]) in which the portfolio holdings are examined on a security-by-security basis. This approach determines how much of the outperformance of valuation-indifferent indexing is a result of stock selection and how much is a result of a static or dynamic allocation to risk factors.

We examine duration risk and credit risk in the attribution analysis. The matched group of cap-weighted portfolios serves as the benchmark in lieu of the published index. Because of the difference in the selection universe, the cap-weighted benchmark gives a better appraisal of the risk assumed by the valuation-indifferent portfolios. Our constructed cap-weighted benchmarks outperform the published benchmarks and are, therefore, a higher hurdle for the valuation-indifferent portfolios.

Because the valuation-indifferent portfolios provide superior performance even after controlling for the risk exposures, the results in Exhibit 4 are quite illuminating. For the investment-grade and emerging-market valuation-indifferent fixed-income portfolios, most of the outperformance comes from "security selection." Because a valuation-indifferent portfolio does not engage in security selection in any conventional sense of the word (i.e., bonds

Exhibit 3

CAPM, Three-Factor, and Five-Factor Regressions for Cap-Weighted Benchmark and Valuation-Indifferent Portfolios, January 1997– December 2009

A. CAPM Model

	Benchmark			Valuation-Indifferent Index		
	Alpha	Beta	Alpha t-Stat.	Alpha	Beta	Alpha t-Stat.
High Yield	1.76	0.34	0.87	4.26	0.36	1.38
Investment Grade	2.77	0.09	1.77	3.31	0.06	2.21
Emerging Markets	5.68	0.50	1.87	7.44	0.42	2.87

B. Three-Factor Model

	Benchmark					Valuation-Indifferent Index				
	Alpha	Beta	SMB	HML	Alpha t-Stat.	Alpha	Beta	SMB	HML	Alpha t-Stat.
High Yield	1.15	0.34	0.13	0.11	0.57	2.78	0.38	0.16	0.23	0.91
Investment Grade	2.30	0.10	–0.01	0.05	1.44	2.87	0.07	–0.01	0.05	1.88
Emerging Markets	5.35	0.51	0.00	0.04	1.72	6.69	0.43	0.04	0.10	2.54

C. Five-Factor Model

	Benchmark							Valuation-Indifferent Index						
	Alpha	Beta	SMB	HML	TERM	DEF	Alpha t-Stat.	Alpha	Beta	SMB	HML	TERM	DEF	Alpha t-Stat.
High Yield	0.48	0.17	0.10	0.06	0.66	1.34	0.35	1.79	0.09	0.10	0.14	1.08	2.28	1.01
Investment Grade[a]	N/A							0.58	-0.01	0.00	0.00	0.93	0.82	1.81
Emerging Markets	3.41	0.45	0.02	0.00	0.77	0.62	1.18	4.66	0.33	0.05	0.05	0.90	0.92	2.07

Notes: [a]*No regression results are given for this row, because the investment-grade benchmark is perfectly correlated with the DEF factor so that the results are not meaningful.*

Monthly regressions of portfolio and benchmark returns on risk factors. Results for alphas are presented as an annualized return percentage. The beta, SMB (small minus big), and HML (high minus low) regressors are the three Fama–French factors and are taken from Kenneth French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The TERM regressor is the return on a portfolio of 10-year to 15-year T-bills minus the risk-free rate. The DEF (default) regressor is the return on the ML Corporate Master (investment-grade) Index minus the risk-free rate.

Exhibit 4

Dynamic Brinson Performance Attribution, January 1997–December 2009

Panel A: Total Returns	Valuation-Indifferent	Benchmark	Difference
High Yield	8.85%	6.69%	2.16%
Investment Grade	6.75%	6.30%	0.45%
Emerging Markets	12.23%	10.95%	1.28%
Panel B: Duration Impact on Returns	**Total**	**Static**	**Dynamic**
High Yield	0.43%	0.14%	0.29%
Investment Grade	0.08%	–0.05%	0.13%
Emerging Markets	0.56%	0.48%	0.08%
Panel C: Credit Impact on Returns	**Total**	**Static**	**Dynamic**
High Yield	0.62%	0.16%	0.46%
Investment Grade	–0.07%	–0.14%	0.07%
Emerging Markets	–0.45%	–0.41%	–0.04%
Panel D: Security Selection	**Valuation-Indifferent**		
High Yield	1.11%		
Investment Grade	0.44%		
Emerging Markets	1.17%		

Notes: This exhibit displays a holdings-based attribution of the performance of the valuation-indifferent indices versus the internally constructed cap-weighted benchmarks. The risk sources are broken down into static and dynamic components as demonstrated in Hsu, Kalesnik, and Myers [2010].

are selected and weighted based on the size of the issuer), this is a very interesting outcome. Hsu, Kalesnik, and Myers [2010] found similar results for valuation-indifferent equity portfolios, so the results for fixed-income portfolios are an independent ratification of the equity evidence.

A possible—and controversial—explanation could be that the valuation-indifferent portfolios "select" comparative overweights in names with negative pricing errors and comparative underweights in names with positive pricing errors. According to the model set forth by Arnott et al. [2010], this result would come about naturally for a valuation-indifferent portfolio, and these differences would not be captured by the standard bond risk factors. Hence, attribution models would categorize this as "security selection."

In short, the outperformance of the valuation-indifferent portfolios in the fixed-income markets cannot be explained away by exposure to either the Fama–French equity market risk factors or the two primary conventional risk factors in the bond market—duration and credit risk. Rather, the gains come from superior security selection in a process that does no security selection per se. To the extent that risk factors play a role, they do so dynamically through shifts in the risk factor "bets," rather than from persistent factor loadings. Because these risk factor bets are merely a mirror image of the risk factor bets that the cap-weighted bond markets are making, relative to the economic scale of companies or countries, the following gains attributable to dynamic shifts in these factors are interesting:

- The high-yield index benefits from exposure to the risk factors. Panel B, Exhibit 4, shows that the net duration impact helps performance by 43 bps, with two-thirds of the duration-related excess return coming via dynamic allocation to duration risk. Panel C, Exhibit 4, shows that credit exposure helps significantly (62 bps) in producing excess returns with the majority of the credit-related excess return attributable to a dynamic allocation to credit.
- For investment-grade corporate bonds, both duration and credit risk are negligibly different from the benchmark. The static average allocation had a negative effect on the portfolios, but was more than offset by a positive dynamic component to credit and duration risk. Superior security selection delivers 44 bps of outperformance.
- In the emerging market sector, the portfolio shows a positive impact on excess return (56 bps) due to the allocation to duration risk, but a negative impact on excess return (–45 bps) from the allocation to credit risk. Both allocations were primarily static in nature. The results, however, still leave 117 bps of outperformance to security selection.

SENSITIVITY TO MARKET AND ECONOMIC CONDITIONS

An important element in examining the performance of a valuation-indifferent approach is to dissect the performance in various macroeconomic conditions. Exhibit 5 shows the performance in bull and bear markets and in regimes of a rising versus falling federal funds rate.[7] Previous research in the equity markets has shown a pattern of the valuation-indifferent portfolio typically matching the cap-weighted benchmark performance in good markets, but outperforming significantly in most flat or down markets, especially when such weak markets span multiple years (see Arnott, Hsu, and Moore [2005]).

Exhibit 5 shows that to a large extent this pattern is repeated in the fixed-income space. An exception, however, is high-yield bonds. Panel A shows that the valuation-indifferent portfolio strongly outperforms the cap-weighted benchmark in bull markets (3.4%) and outperforms in bear markets by a comparatively small amount (0.6%). The valuation-indifferent portfolio also outperforms in periods when the federal funds rate is falling (2.7%) more strongly than in periods of when the federal funds rate is rising (1.9%).[8] Corporate investment-grade debt underperforms in bull markets (–0.5%) and outperforms in bear markets (2.5%), and outperforms in falling short-rate regimes (1.8%) and underperforms in rising short-rate environments (–1.0%).

Finally, the emerging market valuation-indifferent portfolio shows a wonderful result—strong outperformance

EXHIBIT 5

Performance of the Valuation-Indifferent Indexing Strategy in Macroeconomic Cycles, January 1997–December 2009

	Bull Market	Bear Market	Rising Federal Funds Rate	Falling Federal Funds Rate
A. High-Yield Bonds				
Valuation-Indifferent High-Yield Bond Index Return	16.0%	-5.8%	11.9%	5.5%
Merrill Lynch U.S. High-Yield Master II Index Return	12.5%	-6.4%	10.0%	2.8%
U.S. 3-Month T-Bill Return	3.5%	3.6%	3.4%	3.6%
Valuation-Indifferent High-Yield Bond Volatility	11.0%	14.8%	10.7%	14.1%
Merrill Lynch U.S. High-Yield Master II Volatility	6.0%	13.0%	5.5%	11.4%
Valuation-Indifferent High-Yield Bond Sharpe Ratio	1.13	-0.63	0.79	0.13
Merrill Lynch U.S. High-Yield Master II Sharpe Ratio	1.51	-0.76	1.19	-0.07
Valuation-Indifferent High-Yield Bond Excess Return over Merrill Lynch U.S. High-Yield Master II	3.4%	0.6%	1.9%	2.7%
Valuation-Indifferent High-Yield Bond Tracking Error with respect to Merrill Lynch U.S. High-Yield Master II	7.6%	6.7%	7.6%	7.0%
Valuation-Indifferent High-Yield Bond Information Ratio	0.45	0.08	0.26	0.38
B. Investment-Grade Bonds				
Valuation-Indifferent Corporate Bond Index Return	6.7%	7.0%	3.6%	9.6%
Merrill Lynch U.S. Corporate Master Index Return	7.2%	4.5%	4.6%	7.8%
U.S. 3-Month T-Bill Return	3.5%	3.6%	3.4%	3.6%
Valuation-Indifferent Corporate Bond Volatility	4.9%	6.5%	4.9%	5.8%
Merrill Lynch U.S. Corporate Master Volatility	5.0%	7.3%	4.9%	6.5%
Valuation-Indifferent Corporate Bond Sharpe Ratio	0.66	0.54	0.04	1.04
Merrill Lynch U.S. Corporate Master Sharpe Ratio	0.75	0.14	0.25	0.65
Valuation-Indifferent Corporate Bond Excess Return over Merrill Lynch U.S. Corporate Master	-0.5%	2.5%	-1.0%	1.8%
Valuation-Indifferent Corporate Bond Tracking Error with respect to Merrill Lynch U.S. Corporate Master	0.6%	2.3%	0.9%	1.7%
Valuation-Indifferent Corporate Bond Information Ratio	-0.91	1.10	-1.19	1.02

EXHIBIT 5 (*continued*)

	Bull Market	Bear Market	Rising Federal Funds Rate	Falling Federal Funds Rate
C. Emerging Market Debt (EMD)				
Valuation-Indifferent EMD Index Return	15.6%	5.4%	17.9%	7.6%
Merrill Lynch IGOV Index Return	15.2%	0.9%	16.5%	5.4%
U.S. 3-Month T-Bill Return	3.5%	3.6%	3.4%	3.6%
Valuation-Indifferent EMD Volatility	11.1%	12.8%	8.9%	13.6%
Merrill Lynch IGOV Volatility	14.2%	13.0%	8.3%	17.2%
Valuation-Indifferent EMD Sharpe Ratio	1.09	0.14	1.63	0.30
Merrill Lynch IGOV Sharpe Ratio	0.82	-0.20	1.57	0.10
Valuation-Indifferent EMD Excess Return over Merrill Lynch IGOV	0.5%	4.4%	1.4%	2.3%
E Valuation-Indifferent MD Tracking Error with respect to Merrill Lynch IGOV	6.8%	6.3%	5.6%	7.5%
Valuation-Indifferent EMD Information Ratio	0.07	0.71	0.25	0.30

Notes: We define the bull–bear cycle in a forward-looking way; if next month is a bull market, but the market hit a new low in the current month, then the current month is a bear market, otherwise, the market is a bull market. If next month is a bear market, but the market hit a new high in the current month, then the market is a bull market, otherwise, the market is a bear market. S&P 500 returns are used to measure new highs and lows. Similarly, rising and falling rate cycles are defined using one-month T-bill rates.

across all macroeconomic environments. The outperformance is significantly stronger, however, in bear markets and in falling fed funds rate periods. Our results show that for both corporate bonds and emerging market debt, using valuation-indifferent indexing generates a portfolio that is less vulnerable to macroeconomic events than a portfolio constructed using a cap-weighted benchmark. Such a countercyclical trend indicates that hidden macroeconomic risk factors are not likely to be behind the returns.

CONCLUSION AND FUTURE RESEARCH

Valuation-indifferent weighting has been shown to outperform cap weighting in the mean-variance space for equity portfolios. In this article, we have extended the method described by Arnott, Hsu, and Moore [2005] to show outperformance of valuation-indifferent weighing in investment-grade, high-yield, and emerging market bonds. More interestingly, we show that very little of the outperformance in the bond markets can be attributed to hidden risks proxied by the small-cap and value equity factors or by traditional fixed-income risk factors. This suggests that we have identified a new anomaly in fixed-income pricing and that the proposed valuation-indifferent-weighted bond strategies can provide new opportunities to bond investors.

The results of our study are entirely consistent with the noise-in-price model predictions of Hsu [2006] and Arnott and Hsu [2008]. Not only do we observe outperformance in the valuation-indifferent-weighting approach, we also observe greater value-added for the more noisy bond markets, such as high yield and emerging markets. A testable implication of the noise-in-price model would be the existence of size and value equivalent factors in bonds and further research could be done to detect and measure their factor premiums. Arnott and Hsu [2008] and Arnott et al. [2010] predicted the existence of these two nonrisk-based factor premiums for all asset classes when the premium is measured against a cap-weighted market beta.

Finally, there is no theoretical reason that valuation-indifferent weighting should only be valid in the equity and fixed-income spaces. Extending this study to other asset classes could further contribute to the current debate and improve our understanding of valuation-indifferent-weighting strategies.

ENDNOTES

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[1]Noise-in-price models set market price equal to fair value plus a transient pricing noise ($P = V + e$).

[2]Because the amount of debt outstanding is correlated with default probability, including this measure leads to added risk in a fixed-income index. It also provides some insight into the "bums" problem, that is, the biggest debtors are given the biggest weight in a fixed-income index.

[3]We also examined a specification of assigning $1/N$ of the weight to each bond issue; the results are similar to those we report.

[4]We use a square root function on land area to avoid a "Russia problem." The results are very similar if we do not use the square root, but this expedient affords a bit broader diversification.

[5]*The World Factbook* prepared by the U.S. Central Intelligence Agency (CIA) is available at https://www.cia.gov/library/publications/the-world-factbook/. The *BP Statistical Review of World Energy* (June 2009) is available at http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/2009_downloads/statistical_review_of_world_energy_full_report_2009.pdf.

[6]Our high-yield published benchmark, the BB+ to B–rated subset of the Merrill Lynch U.S. High Yield Master II Index, underperforms the broad ML index by 18 bps per year over our sample period. Our self-constructed benchmark also ignores constituents moving in and out of the index intra-monthly, but it is unlikely that this effect could account for such a large discrepancy.

[8]For most categories of investors, this pattern of returns is very auspicious. If assets are falling in value (a bear market), adding value is more important than when asset values are generally rising (a bull market). If interest rates are falling, so that liabilities or the net present value of future obligations are rising, adding value is especially important.

REFERENCES

Arnott, R. "What Cost Noise?" *Financial Analysts Journal*, Vol. 61, No. 2 (2005a), pp. 10-14.

——. "Disentangling Size and Value." *Financial Analysts Journal*, Vol. 61, No. 5 (2005b), pp. 12-15.

Arnott, R., and J Hsu. "Noise, CAPM, and the Size and Value Effects." *Journal of Investment Management*, Vol. 6, No. 1 (2008), pp. 1-11.

Arnott, R., J. Hsu, and P. Moore. "Fundamental Indexation." *Financial Analysts Journal*, Vol. 61, No. 2 (2005), pp. 83-99.

Arnott, R., J. Hsu, J, Liu, and H. Markowitz. "Can Noise Create the Size and Value Effects?" Working Paper, University of California at San Diego and Research Affiliates, 2010.

Asness, C. "The Value of Fundamental Indexing." *Institutional Investor*, Vol. 40, No. 10 (2006), pp. 94-99.

Black, F. "Noise." *Journal of Finance*, Vol. 41, No. 3 (1986), pp. 529-543.

Blitz, D., and L. Swinkels. "Fundamental Indexation: An Active Value Strategy in Disguise." *Journal of Asset Management*, Vol. 9, No. 4 (2008), pp. 264-269.

Blume, M., and R. Stambaugh. "Biases in Computed Returns: An Application to the Size Effect." *Journal of Financial Economics*, Vol. 12, No. 3 (1983), pp. 387-404.

Brennan, M., and A. Wang. "The Mispricing Return Premium." Working Paper, University of California at Los Angeles and University of California at Irvine, 2008.

Brinson, G., and N. Fachler. "Measuring Non-U.S. Equity Portfolio Performance." *Journal of Portfolio Management*, 1985, pp. 73-76.

Chen, C., R. Chen, and G. Bassett. "Fundamental Indexation via Smoothed Cap Weights." *Journal of Banking and Finance*, Vol. 31, No.11 (2007), pp. 3486-3502.

De Bondt, W. and R. Thaler. "Does the Stock Market Overreact?" *Journal of Finance*, Vol. 41, No. 3 (1985), pp. 793-805.

——. "Further Evidence on Investor Overreaction and Stock Market Seasonality." *Journal of Finance*, Vol. 41, No. 3 (1987), pp. 557-581.

Estrada, J. "Fundamental Indexation and International Diversification." *Journal of Portfolio Management*, 2008, pp. 93-109.

Fama, E., and K. French. "The Cross-Section of Expected Stock Returns." *Journal of Finance*, Vol. 47, No. 2 (1992), pp. 427-465.

——. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, Vol. 33, No. 1 (1993), pp. 3-56.

——. "Multifactor Explanations of Asset Pricing Anomalies." *Journal of Finance*, Vol. 51, No. 1 (1996), pp. 55-84.

Hemminki, J., and V. Puttonen. "Fundamental Indexation in Europe." *Journal of Asset Management*, Vol. 8, No. 6 (2008), pp. 401-405.

Houwer, R., and A. Plantinga. "Fundamental Indexing: An Analysis of the Returns, Risks, and Costs of Applying the Strategy." Paper presented at Corporate Finance Day, Erasmus University, Rotterdam, The Netherlands, September 19, 2008.

Hsu, J. "Cap-Weighted Portfolios Are Sub-Optimal Portfolios." *Journal of Investment Management*, Vol. 4, No. 3 (2006), pp. 1-10.

Hsu, J., and C. Campollo. "New Frontiers in Index Investing: An Examination of Fundamental Indexation." *Journal of Indexes*, 2006, pp. 32-58.

Hsu, J., F. Li, B. Myers, and J. Zhu. "Accounting-Based Index ETFs and Inefficient Markets." *A Guide to Exchange-Traded Funds and Indexing Innovations*, 6th ed. Institutional Investor, 2007.

Hsu, J., V. Kalesnik, and F. Li. "Does Valuation-Indifferent Indexing Work for the Real Estate Market?" *Journal of Investing*, forthcoming.

——. "International Size and Value Effects." Working Paper, Research Affiliates, 2010.

Hsu, J., V. Kalesnik, and B. Myers. "Generalized Performance Attribution." Working Paper, Research Affiliates and Purdue University, 2010.

Jun, D., and B. Malkiel. "New Paradigms in Stock Market Indexing." *European Financial Management*, Vol. 14, No. 1 (2008), pp. 118-126.

Neukirch, T. "Alternative Indexing with the MSCI World Index." Working Paper, 2008.

Perold, A. "Fundamentally Flawed Indexing." *Financial Analysts Journal*, Vol. 63, No. 6 (2007), pp. 31-37.

Poterba, J., and L. Summers. "The Persistence of Volatility and Stock Market Fluctuations." *American Economic Review*, 76 (1986), pp. 1142-1151.

——. "Mean Reversion in Stock Prices: Evidence and Implications." *Journal of Financial Economics,* Vol. 22, No. 1 (1988), pp. 27-59.

Roll, R. "On Computing Mean Returns and the Small Firm Premium." *Journal of Financial Economics*, Vol. 12, No. 3 (1983), pp. 371-386.

Rosenberg, B., K. Reid, and R. Lanstein. "Persuasive Evidence of Market Inefficiency." *Journal of Portfolio Management*, 13 (1985), pp. 9-17.

Schoenfeld, S., and R. Ginis. "Worth the Weight?" *Journal of Indexes*, 2006, pp. 10-21.

Summers, L. "Does the Stock Market Rationally Reflect Fundamental Values?" *Journal of Finance*, Vol. 41, No. 3 (1986), pp. 591-601.

Tamura, H., and Y. Shimizu. "Fundamental Indices: Do They Outperform Market-Cap-Weighted Indices on a Global Basis?" *Security Analysts Journal*, Vol. 43, No. 10 (2005), pp. 32-46.

Treynor, J. "Why Market-Valuation-Indifferent Indexing Works." *Financial Analysts Journal*, Vol. 61, No. 5 (2005), pp. 65-69.