Seeing through the Smoke Screen of Fundamental Indexers: What are the Issues with Alternative Equity Index Strategies?

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Introduction
With an ever-growing number of alternative index construction methods on offer, investors should, in principle, be thankful for comparative analysis. Such comparison has recently been provided in several articles written by promoters of fundamentally-based equity indices. In particular, Arnott (2011) and Chow et al. (2011) offer a back-test of several alternative weighting strategies and come to the conclusion that there are no differences in performance and risk factor exposures of alternative weighting schemes; but when it comes to implementation, fundamental weighting schemes are superior. While the conclusions of these articles may not come as a surprise, it is important to mention that the results reported in these articles are based on a flawed methodology which has the potential to lead to misleading conclusions on the relative merits and the properties of various indices. Moreover, beyond the methodological flaws in these articles, such performance comparisons fail to address the more important question of the conceptual underpinnings of various alternative equity indices.

In the end, such articles only set up a smoke screen which hides the real issues behind the different alternative weighting schemes. This short article tries to see through the smoke screen by pointing out the methodological flaws in recently published comparisons of back-tested performance, and by underlining some more important conceptual considerations with alternative indices.

1. Creating Confusion by Discussing Pseudo Issues
Arnott (2011) and Chow et al. (2011) classify equity index construction strategies into two classes: heuristic-based-weighting methodologies and optimization-based-weighting methodologies. The heuristic indices they analyse include equally weighted (EW) indices, risk-clusters equal weighted (RCEW) indices, fundamentals-based indices and diversity-weighted indices. The optimization-based indices include maximum diversification, minimum volatility and efficient indices. The above-cited papers conclude on the superiority of fundamentals-based approaches in comparison to optimization-based approaches. However, for a number of reasons, the conclusions drawn in these articles appear to be somewhat misleading.

A bias against optimization-based strategies
Arnott (2011), based on results in Chow et al. (2011), concludes that portfolio optimization does not lead to a higher degree of diversification. However, the setup used in the paper by Chow et al. (2011) does not allow for a fair comparison between optimization-based and heuristic strategies. The back-testing is based on a universe of 1,000 stocks whereas, in practice, the optimization-based strategies are implemented for a much smaller stock universe. A well known phenomenon – the curse of dimensionality – states that by increasing the number of constituents, the number of estimated parameters increases more than proportionally. In the same vein, Tu and Zhou (2011) show that heuristic equal-weighting tends to perform better in large universes while optimized portfolios tend to perform better in smaller universes. Increasing the number of constituents thus works against the optimization-based strategies. Rather than providing a better understanding of optimization-based and heuristics-based strategies, such biases in perspective have the potential to create confusion about the properties of different types of alternative equity index strategies.

Moreover, the comparison in Arnott (2011) and Chow et al. (2011) uses a fundamentals-weighting strategy that is based on a different security selection than all other approaches, and the performance derived from stock selection is not disclosed. Comparing strategies that involve stock selection with strategies that simply change the weighting within a given universe is not a correct way to analyze different indexing schemes as the comparison is not based on the same universe. Instead, it should be recognized that portfolio optimization methods can be applied to any selection of stocks. The value of portfolio optimization relative to ad-hoc approaches should therefore be measured using the same set of securities. Alternatively, if a strategy benefits from a different stock selection than
other strategies in a comparative test, the value obtained through stock selection should at least be properly disclosed if the objective is to provide a better understanding of the strategies. A paper written by some of the authors of the Chow et al. (2011) paper (see Hsu, Kalesnik and Xie 2011) actually shows that stock selection accounts for a quarter to a third of the excess return of the fundamentals-based index over the standard index. Given that such stock selection is known to be an important driver of return differences between indices, it is surprising that Chow et al (2011) do not either eliminate this difference in the strategies they create or at least explicitly account for this difference in their performance attribution. Moreover, it is important to note that such differences in stock selection are not only a source of potential outperformance, but also an important source of risk for investors. Lowry (2007) pointed out that “it doesn’t make sense to create a new index system that picks certain stocks at the expense of others [...]. Using a well-established, broad-market index ensures that the index will own the necessary securities to perform well in both growth and value markets”. Unsurprisingly, when analyzing the performance of fundamental weighting, many studies analyse fundamentals-based indices that solely reweight the stocks in a standard index without changing the stock selection to avoid introducing a selection bias (Branch and Cai 2009; Houwer and Plantinga 2009).

In order to assess the selection bias that can arise in studies of fundamentals-based portfolios, we provide a simple empirical illustration. Rather than trying to replicate any specific commercial offer and given that fundamentals-based indices which exist in practice are based on different stock selection rules, different variable selection, different types of adjustments of accounting variables and different rebalancing mechanisms and periods, below we study a generic fundamentals-based strategy. The following table illustrates the selection bias in our test portfolio where we select and weight stocks in a global equity universe by the average firm size according to five firm fundamentals (dividends, earnings, cash flow, book value and sales).

The table reports the percentage of weight in the fundamentals-based portfolio that is taken up by stocks that would not be included when selecting by market cap. It is clear from the results that stocks not contained in the selection based on market cap make up an important proportion of our fundamentals-based portfolio. For the global universe of 1,000 stocks, this difference reaches 15.5% on average but can exceed 20% in a given calendar year. Moreover, the selection bias tends to be more pronounced for smaller universes.

Exhibit 1: Selection bias: Allocation of a global equity portfolio that selects and weights stocks by accounting measures to stocks which are not contained in the corresponding cap-weighted portfolio.

<table>
<thead>
<tr>
<th>Weight of stocks that are not contained in corresponding cap-weighted portfolio</th>
<th>1,000 stocks</th>
<th>500 stocks</th>
<th>100 stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average weight</td>
<td>15.5%</td>
<td>18.6%</td>
<td>29.8%</td>
</tr>
<tr>
<td>Maximum weight</td>
<td>21.5%</td>
<td>26.2%</td>
<td>43.8%</td>
</tr>
<tr>
<td>Calendar year of occurrence</td>
<td>2010</td>
<td>2010</td>
<td>2010</td>
</tr>
<tr>
<td>Minimum weight</td>
<td>9.3%</td>
<td>9.8%</td>
<td>17.0%</td>
</tr>
<tr>
<td>Calendar year of occurrence</td>
<td>2006</td>
<td>2006</td>
<td>2002</td>
</tr>
</tbody>
</table>

The results are based on data from Worldscope and DataStream. The fundamentals-based portfolio is constructed by selecting the largest 1,000 (respectively 500 and 100) stocks in the universe by the average of their book value, dividend, cash flow, sales and earnings and then weighting the selected stocks by the same measure of size. The test portfolio is rebalanced yearly at the end of June of each year based on accounting variables for the past year. Our World universe includes all stocks belonging to any of the following 24 developed countries: Canada, United States, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Australia, Hong Kong, Japan, New Zealand, Singapore. The cap-weighted portfolio is constructed from the largest 1,000 (respectively 500 and 100) stocks based on their market cap and reconstituted each year in June. The analysis period runs from July 1987 to June 2011. An obscure assessment of risk factor exposures.

The conclusion in the above-cited articles which compare different equity index construction approaches is that all strategies “outperform because of the positive value and size loadings” and that “none of these strategies are different from naïve equal weighting”.

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1. Our objective is to propose a generic method rather than replicate the specific design features of any of the commercially available strategies. We have tested several modifications of the generic fundamentals-based strategy, including different variable selection, different adjustment rules, and different rebalancing dates. While the performance of such strategies turns out to be quite sensitive to such changes, the broad conclusions concerning the properties analysed in this article (notably on the existence of a selection bias and on sector exposures) remain similar whatever the strategy specification. The objective of this article is not to evaluate any particular strategy but rather to provide an understanding of what the important issues are with the various possible fundamentals-based strategies in terms of risk control and in terms of robustness of performance.
The claim that all strategies are similar is however inconsistent with the results tables shown in the same articles, which show that the back-tested methodologies lead to differences in factor exposures. In particular, the results in the articles show that diversity weighting has a significant negative value exposure, fundamentals weighting has a value exposure of more than 10 times that of equal weighting and the different strategies also have divergent exposure to the momentum factor.

Moreover, the results of a mostly positive value exposure of alternative strategies are questionable. While the authors of these papers claim that equal weighting has value exposure, one can argue that equal-weighting is a completely style neutral index as by definition it holds equal weights of value and growth stocks. In this sense, it is more proper to say that the cap-weighted index has a growth bias relative to the equal-weighted reference. Kaplan (2008) showed that a fundamentally-weighted index mechanically overweights value stocks. Other weighting schemes do not rely on fundamental information and do not lead to such a systematic value bias. Therefore the conclusion that all alternative weighting schemes are alike is inconsistent with economic considerations as well.

Arnott (2011) and Chow (2011) also report that all non-cap-weighted indices have positive small-cap exposure. Their choice of universe of 1,000 stocks combined with the choice of the narrower S&P 500 index as the reference index is not neutral for the assessment of small-cap exposure. In fact, it is quite clear that when using the narrower S&P 500 index as a reference, any index of 1,000 stocks (including the cap-weighted index) would be likely to pick up some exposure to smaller stocks. However, when considering economic arguments, it should be noted that, of all the strategies tested, only the fundamental-weighting approach would be potentially able to select any small cap stocks. None of the other alternative strategies (which are all based on the largest 1,000 US stocks) can have any holdings in small-caps stocks and thus no economically meaningful small-cap exposure. In fact, Fama and French (1992) explain that the small cap factor is constructed from a universe of all firms listed on a US exchange (NYSE, AMEX, and NASDAQ) by splitting the universe at the median market cap. Thus any stock that is contained in any of the other indices tested in the Chow et al. (2011) paper would be much larger than any of the stocks contained in a small cap portfolio as defined by Fama and French (1992). It is clear that in the context of this study, using a small cap factor based on stocks which are not even contained in the indices that are tested can only mean that the small cap exposure corresponds to a statistical artefact rather than to any actual holdings.

Using self-created pseudo-indices

Lastly, despite citing the providers of index offerings, Arnott (2011) and Chow et al. (2011) back-tested self-made indices that did not replicate the actual index rules. For example, they completely disregarded the weight constraints which are used in portfolio optimization strategies both to avoid concentration and also to improve robustness (Jagannathan and Ma 2003), while both academic research and practical implementations of such strategies pays much attention to choosing appropriate constraints. An important conclusion in Arnott’s (2011) article is that “diversity weighting and fundamentals weighting generally have the lower turnover and trading costs than the other strategies”. When judging the practical relevance of this conclusion, it is important to note that Arnott (2011) and Chow et al. (2011) did apply the turnover control rules used in actual implementations of fundamental weighting (with the use of trailing 5 year averaged measures for most of the weighting criteria) while they chose to test the competing weighting schemes without properly implementing the implementation constraints used in the actual index series.

Overall, it is surprising that what is supposed to be a comparison of indexing methodologies is in fact based on strategies which do not reflect the actual index rules used in practice. Moreover,
it does not add clarity that one of the approaches tested, notably fundamental weighting, is
implemented while respecting turnover constraints actually used in practice, while for the other
indices, implementation rules are modified for the back-tests. The authors’ main conclusion is
that one should distinguish between these indices based on their ease of implementation and
that the fundamentals-based approach is superior in this respect. Of course these results are
likely to be biased as a result of not using the implementation rules of the actual indices. The
authors claim they have conducted an “apples to apples” comparison but perhaps some apples
are more equal than others. It is clear that the analysis of strategies in a generic form is not
a problem and can even be insightful. We have ourselves employed a test involving a generic
strategy for this article. However, what is problematic and unfair is to omit important rules of the
official index methodology which is being replicated to then conclude that the index performs
poorly in terms of the results which directly depend on the omission of the omitted rules.

Beyond the methodological issues with such artificial back-tests of pseudo-methodologies, it
is clear that one should ask questions about the conceptual foundations of various indexing
approaches. In fact, it is important to look further than just analyze track records and to try to
understand the logic of the construction rules used for alternative equity index strategies. We
now turn to a brief discussion of this issue.

2. Real Issues with Alternative Equity Index Strategies
Before one analyzes the performance and risk characteristics of different alternative weighted
indices, it is important to make a clear distinction between optimally diversified indices and
fundamentals-based indices.

Several alternative index construction approaches draw on Modern Portfolio Theory (MPT), which
provides a framework for designing well diversified portfolios. All optimally diversified weighting
schemes make a set of assumptions about risk and return characteristics of stocks under which
the weighting scheme would be optimal in the sense of MPT. For example, an optimised minimum
variance strategy would be optimal if all stocks have identical expected returns. On the other
hand, fundamentals-based indices weight stocks by one or more firm characteristics (such as
book value, dividends or sales). It has been shown that such characteristics-based indices would
be optimal if the volatilities and pair-wise correlations are identical across stocks and expected
returns are proportional to the accounting measures that are used to attribute the weights. 2
Clearly these assumptions are rather unrealistic. More importantly, there is no theoretical
foundation for the choice accounting parameters. In practice, different variable selections are
being used. For example, Schwartz and Siracusano (2007) argue that earnings or dividends are
a relevant weighting criterion, while some index providers use revenues as the sole weighting
criterion. 3 Arnott et al. (2005) use a composite measure including sales, cash flow, book value and
dividends. Some index providers use similar composite measures but prefer to include earnings,
exclude dividends, exclude book value or adjust the sales measure. Given the many possibilities
of specifying such strategies, there is a pronounced parameter selection risk.

The absence of theoretical guidance on how to best construct the fundamentals-based indices
means that the back-tests are not completely reliable. Techniques that perform well in back-tests
may fail to deliver robust out-of-sample performance, simply because there is no good reason
why it should be otherwise. Optimally diversified strategies, on the other hand, can be argued to
be less sensitive to arbitrary specification choices as they rely on portfolio selection models that
are based on statistical methods and economic theory developed and improved upon by 60 years
of academic research whose importance has been recognised through the award of numerous
Nobel prices.

It is clear that in the absence of any theoretical guidance on how variables in a fundamentals-based index should be selected, one can easily be subject to data-snooping biases. In the end, if a strategy does not have strong theoretical guidance, one has a risk of relying on effects found in past data which are specific to the sample and will not necessarily be robust out of sample. For example, when various offers for fundamentals-based indices started to be heavily marketed around 2005, they had attractive simulated back histories over the recent five year period or so. During this period, fundamentals-based approaches moved away from technology companies that had no or little dividends, sales or other traditional fundamental metrics, but often had significant market capitalisation. Therefore, such indices avoided being heavily exposed to the segment of the market that was most hurt by the dotcom crisis that started in 2000 and that (also known as the burst of the internet bubble). However, during the period of the 2007/2008 global financial crisis and the ensuing sovereign debt crisis that continues to unfold today, concentrating on the companies that had high past dividends or high past cash flows meant being overexposed to financial stocks which then became a drag on performance. Therefore, what helped performance in the historical simulation of the strategy actually led to underperformance during this recent period.

In order to assess the role that the two crises had on fundamentals-based portfolio construction approaches, we again test a generic strategy which uses a simple composite of five accounting measures to select and weight stocks in a global equity universe. We analyze returns over the period starting with the dotcom crisis in 2000 and going through to 2011. The table below illustrates the impact of two main crises on the performance of the strategy over this period. For the dotcom crisis, its inclusion pushes up the outperformance of the strategy by approximately 2.5% annually compared to the outperformance that would be shown when the crisis is excluded. On the other hand, the inclusion of financial crisis period pulls down the outperformance relative to the case when this crisis is excluded from the track record.

Exhibit 2: Impact of crisis periods on the track record of a fundamentals-based portfolio construction approach

<table>
<thead>
<tr>
<th>For a five metric fundamentals-based global equity portfolio</th>
<th>Annualised excess return over cap-weighted benchmark</th>
<th>Impact of including crisis period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full period (03/2000 to 06/2011)</td>
<td>4.3%</td>
<td></td>
</tr>
<tr>
<td>Full period excl. Dotcom crisis</td>
<td>1.8%</td>
<td>+2.5%</td>
</tr>
<tr>
<td>Full period excl. Financial crisis</td>
<td>7.4%</td>
<td>-3.1%</td>
</tr>
</tbody>
</table>

* The results are based on data from Worldscope and DataStream for a global developed markets equity universe. The fundamentals-based portfolio is constructed on the basis of book value, dividend, cash flow, sales and earnings. The test portfolio is rebalanced yearly at the end of June of each year based on accounting variables for the past year. The excess return is the annualized geometric return of the fundamentals-based portfolio over that of the cap-weighted benchmark. The benchmark used is the portfolio of the largest 1,000 stocks by market cap held in proportion to their market cap, and reconstituted annually in June. The analysis period runs from March 2000 to June 2011. The Dotcom crisis period is defined as the drawdown period of the NASDAQ 100 index from March 2000 to September 2002. The Financial crisis period is defined as the period over which the credit risk of the financial sector was high as measured by the fact that the Itraxx Senior Financial 5 Years CDS index exceeds a level of 10 index points, which was the case from July 2007 until the end of analysis period.

It is interesting to look at the causes of over- and underperformance of our fundamentals-based approach during these two crises periods in more detail. The table below shows that during the technology crisis, our fundamentals-based strategy heavily underweighted the technology sector and overweighted financials. When considering that in addition to shifting the sector weights, the accounting-based portfolio also creates differences in stock weights within each sector, one can come up with a total contribution of the weighting decisions within a given sector to the portfolios’ outperformance over the cap-weighted strategy. This total contribution shows that the fundamentals-based strategy benefited heavily from moving away from cap-weighting in the technology sector and in the financial sector during the dotcom crisis. However, these same weighting decisions lead to underperformance over the period of the financial crisis and ensuing sovereign debt crisis.
Exhibit 3: Sector attribution: Total contribution of weighting decisions within different sectors to outperformance of fundamentals-based approach over market-cap-based approach

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average sector weights</td>
<td>Total Sector Contribution</td>
</tr>
<tr>
<td></td>
<td>Fundamentals-based strategy</td>
<td>Cap-weighted</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>8.6%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Basic Materials</td>
<td>4.1%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Industrials</td>
<td>10.6%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>13.0%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Health Care</td>
<td>5.3%</td>
<td>11.0%</td>
</tr>
<tr>
<td>Consumer Services</td>
<td>8.9%</td>
<td>11.3%</td>
</tr>
<tr>
<td>Telecom</td>
<td>7.7%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Utilities</td>
<td>6.5%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Financials</td>
<td>29.6%</td>
<td>22.5%</td>
</tr>
<tr>
<td>Technology</td>
<td>5.7%</td>
<td>14.9%</td>
</tr>
<tr>
<td>Others</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

We use a multi-period holding-based method of performance attribution (Brinson and Fachler 1985, Menchero 2004) to analyse the sources of the outperformance of our 5-metric fundamentals-based test portfolio with respect to the cap-weighted portfolio. Outperformance is broken down into two factors: the stock-weighting factor which accounts for the share of outperformance attributable to the ability of the strategy to select stocks, and the sector-weighting factor, which accounts for the share attributable to the ability of the strategy to overweight sectors that outperform the benchmark. For simplicity, here we show the total contribution of these two factors. The contribution is the overall excess return over benchmark during the period without annualisation. The portfolios are constructed based on data from Worldscope and DataStream for developed market equities. The fundamentals-based portfolio being analysed here is the five-metric composite portfolio from the illustrations above. The benchmark is the 1,000-stock cap-weighted portfolio. The sectors are based on the ICB classification of stocks.

The various existing or potentially possible fundamentals-based strategies correspond to ad-hoc stock picking formulas. Their ex-post definition may lead them to take on factor tilts and to load on stock characteristics which allow for good performance over the back-testing period, but which may turn out to lack robustness out of sample. Clearly, the various types of fundamentals-based indices, which have appeared after the burst of the internet bubble, can be seen as an attempt to avoid drawing investors into being exposed to this type of crisis. These indices however have not been able to protect investors from being exposed to the financial crisis and the ensuing sovereign risk crisis which heavily affected banking stocks over the recent past.

An alternative to such ad-hoc strategies is to go back to the fundamental principle of diversification. Financial theory suggests that one can combine imperfectly correlated assets to achieve improved risk adjusted performance. This diversification effect has been described as the only free lunch in finance. While fundamentals-based indices follow a pre-Markowitz approach by focusing on the stand-alone stock characteristics and by ignoring the dependence structure of stock returns, optimally diversified strategies are free of any view on which stocks to select and rather focus on improving diversification through considering the relationship between different stocks. Importantly, it is by drawing on a well-established theoretical framework that such optimal diversification approaches limit the risk of arbitrary specification and data-snooping. Moreover, since risk and return parameter inputs are explicit choices rather than an implicit by-product of ad-hoc specification choices, such approaches can draw on a rich academic literature on how to improve the out of sample robustness of portfolio optimization. To be sure, it is clear that investors – in addition to holding well diversified portfolios – may wish to make choices in terms of stock picking if they have the view that certain types of stocks are particularly attractive. Optimal diversification schemes can, however, be applied to any such stock selection without implying a stock selection by construction.

Another distinction between fundamentals-based and optimally diversified strategies is that an optimization-based strategy by nature has to clearly state its objective. The same cannot be
said of fundamentals-based strategies. Their objective initially was stated as obtaining economic representativity. However, what is meant by economic representativity has never been defined, nor has any improvement in representativity ever been assessed empirically. Moreover, there are multiple other objectives that have been put forth to justify such indices. Arnott (2009) describes the methodology as a contrarian strategy. West (2010) describes the methodology as dynamic value strategy which has an ability to time the value premium. Djehiche and Rinné (2010) claim that a fundamentals-based strategy is a way to manage liability risk. It is difficult to understand how an index construction approach can achieve all these separate objectives at once. Moreover, it is clear that an approach which simply uses a set of accounting metrics does not include any explicit reference to the stated objective in its construction methodology.

Fundamentals-based strategy indices ignore Modern Portfolio Theory and rather follow a pre-Markowitz approach. It has however been argued that such indices nevertheless have a theoretical basis. In particular, Arnott and Hsu (2008), coming to similar conclusions as Hsu (2006), claim that pricing errors and market capitalisation are positively related. This means that the securities with higher market cap will tend to have below average returns, hence a cap-weighted index will result in a drag on returns. This has been coined the “noisy market hypothesis”. However, a first issue with such a claim is that such a theory does not justify any particular fundamentals-based weighting scheme. Rather, such a theory suggests that any non-price related weighting scheme, including for example equal or random weights, would lead to higher performance than using cap-weighting. A second issue is that the theory is “fundamentally flawed” (Perold 2007). Perold points out that the result of the “noisy market hypothesis” depends on the completely unrealistic assumption that the fair value of each stock is observable. Perold concludes that rather than being theoretically justified, "Fundamental indexing is a strategy of active security selection through investing in value stocks." More recently, Graham (2011) also pointed out that the results in Arnott and Hsu (2008) can be derived only with an implicit assumption that investors know the stock’s fair value. This assumption contradicts the noisy market hypothesis’ basic premise that the securities’ fair value is unobservable. Consistent with Perold’s claim that fundamental weighting is just a value strategy, Graham concludes that it is important for investors to "not fool themselves into thinking that the superior returns they may experience are due to some sort of mathematical certainty."

Conclusion
There is a clear need for investors to better understand alternative weighting schemes in order to make informed investment decisions. Comparing pseudo-methodologies, providing a confusing assessment of risk factor exposures, and not attributing performance to differences in stock selection, can only help to set up a smoke screen that hides the real issues with alternative weighted indices. In this article, we have summarized several important points of distinction between optimal diversification approaches and ad-hoc characteristics weighting. Clearly, research there is existing that aims to provide insights into the theoretical underpinnings behind the different alternative index construction methodologies, that assesses the ability of an approach to reach its declared investment objective, and that identifies sources of risk and of performance. Improving upon this research and extending it will be even more important in the future to see through the smoke screen of fundamental indexers.
References


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