THE INDEX AS A BENCHMARK

VITAL FACTOR IN FUND PERFORMANCE

by DEREK CONDELL

The sharemarket crash gave a new emphasis to the management of risk and return and has highlighted the growth of index funds as a low-cost, safe-performance investment strategy.

Statistics show that indexes outperform fund managers over medium to long-term periods. Investments in assets replicating indexes give the fund trustees or sponsors knowledge that their assets will closely track the market, be highly liquid (even after crashes such as that of October 20, 1987), be diversified across the sector, give performance that holds no surprises, are low-cost and get access to market growth.

Apart from all these benefits, any investor who bases the core of his portfolio on an index can spend more time on other major issues — getting the overall asset allocation right (e.g., fixed versus equity) and, within the market sector, making important decisions on new asset classes or dealing in big blocks to add value to that of the benchmark.

The worldwide push into indexes orginates in the United States. The US is the leader in quantitative money management methods, with reasons including the fact that investment funds are so large and that so many of the world's major academic financial institutions are there (Harvard, MIT, Stanford and Berkeley). Fund managers in America recognised that they could not consistently perform well when assets were over, say, several hundred million dollars in any one sector.

In Australia, two distinct changes are making the concept of indexing attractive.

First, more and more funds are being held in fewer and fewer hands. Corporate groups such as Elders are taking over and merging with other companies and combining their superannuation funds; individual persons' investments, in $5,000 parcels, are being concentrated in the hands of financial institutions; government investment groups, such as the State Superannuation Board and the Public Authorities Superannuation Board in NSW, are being merged; and there is an increasing concentration of funds in the hands of professional managers.

The second distinct change that is occurring in Australia can be related to the crash of 1987. This is causing more investment trustees and sponsors to look at control of their asset allocation, rather than "handing over a blank cheque". In turn, this is seeing a re-evaluation of performance statistics, in which indexes are leading the way over periods of three or five years and longer.

Several organisations in Australia are actively promoting indexes and many institutions are measuring their own performance against the performance of the index benchmark or are directly indexing their assets. In some cases, the remuneration of fund managers and employees is directly related to index-judged performance.

An index serves as a benchmark for performance, since it represents the performance of the market-related

Derek Condell is Executive Director, Dominguez Barry Samuel Montagu, where he heads the funds management division. This and the preceding article are edited versions of papers delivered at IIR funds management conference in December.

investment management strategy — namely, buy, hold and sell (with reinvestment) according to the index weightings. For more active management strategies to be justified, they must produce performance superior to the corresponding index.

The process of risk reduction through diversification suggests that the standard benchmark should be a wide-coverage index, with each component bond being represented according to its value on issue. Such an index allows the analyst to separate diversification (and consquently risk) from return in the performance measurement.

The mathematics of diversification leads to actual portfolios tending to produce index-like performance. This process was orginally noticed in the equity markets, but " closet indexing" has been observed in the bond markets as well.

A related concept is that of the market being efficient in incorporating new information into prices. Again, the idea of market efficiency originated with equity markets, and managers have only recently started to debate the idea of bond market efficiency. The concept implies that managers who lack "superior" information will be unable to improve on the performance of an index, and may easily do worse.

It is mathematically true, but often not realised, that one half of all managers will underperform a representative index even before allowing for the extra costs of active trading. This occurs because the index (being based on market prices) represents average performance. After transaction costs, we can expect more than half of all managers to underperform the index. This is borne out by evidence from both the US and Australian markets. Table 1 shows that in two of the past three years, median returns for the government securities sectors of the IMS survey (of Pooled Funds and Investment Managers in Australia) were less than the returns of the Commonwealth Bank Bond Index (all maturities, non-rebateable).

Equity index performance statistics continue to emphasise the difficulty active managers have in outperforming market indices on a consistent basis. A detailed study commissioned by DBSM and conducted by the actuaries Mercer Campbell Cook & Knight calculated rates of returns for a number of unlisted unit trusts invested primarily in Australian shares.

An index fund, based on a representative index, is the low-cost investment vehicle for any market. The only transaction costs which need to be incurred are those for reinvestment of payouts and the taking up of new issues. Since index funds are largely driven by computers, management fees are also relatively low.

To be useful as a benchmark, an index must have wide coverage of the market. The most commonly known index in Australia is the All Ordinaries Index, and of course there are within it sub-indices such as retail, banks, liquor and transport. In the US the most accepted bond indices, those of Shearson Lehmann and Salomon, essentially have complete coverage of the government market. In Australia, complete coverage can be more easily achieved, in principle, because of the smaller number of fixed interest securities that must be tracked. There are only slightly more treasury bonds in the US (150) than there are Commonwealth securities in Australia (110), but in the US there are many more agency (semi-government) and corporate bonds. The only bond index currently available in Australia is the Commonwealth Bank's but we believe it has shortcomings, for which reasons we at DBSM are constructing a new index.

Since index returns are increasingly being used to represent potential actual performance, an index must be easily replicable by market participants. In particular, this means that the index portfolio must be liquid, and otherwise tradeable. It also means that assumptions built into the index must be capable of real-world implementation. A problem with the equities index is the dividend payment; a problem with any bond index is the Reserve Bank's holdings.

The construction method used for an index should be made public, so that market participants can verify that the index is indeed achievable. This is of paramount importance where it is assumed that a portfolio manager can simply "buy and hold" the index portfolio and thus match consistently the performance of the market. In the case of the All Ordinaries Index, there is a very good book, *Stock Exchange indices and Statistics*, and other public information.

The data used in the index calculations must also be made public. In particular, accurate and reliable valuation data for each security contained in the index is crucial. Ideally, the index would rely only on traded prices or on genuine market-maker offer prices.

An index must be able to be delivered promptly to market participants. This requires calculation of the index in as close to real time as is technically feasible (at least daily) and its electronic delivery directly to those who will use it.

To enhance the usefulness of an index as a performance benchmark, it is desirable that it should be constructed as

Table 1: Fixed-interest manager and index returns (% p.a.)

	1986/87	1985/86	1984/85
Manager median	12.95	17.14	12.84
CBA index	12.85	17.34	13.07

Table 2: Trust and index performance

	3 years to 3.12.86	5 years to 31.12.86
Number of fund managers in sample	13	5
Number of unit trusts underperforming the index	10	4
Number of trusts outperforming the index	3	1
Percentage of sample outperforming the index	23%	20%

Table 3: Regression statistics

Fund	Alpha (%)	Beta	R-Sq(%)	Corrl Coeff.	% of All Ords*
All Ords	0	1.00	100.0	1.00	100.0
Top 10	-0.06	1.32	88.8	0.94	29.4
Top 20	0.0002	1.23	93.3	0.97	40.8
Top 30	0.0210	1.19	94.8	0.97	53.0
Top 50	0.0149	1.14	96.5	0.98	64.7

Similar techniques could be applied with fixed-interest securities.
* As at December 1, 1987.

a family of sub-indices, covering particular sections of the market as well as overall performance. Further, an index should be "tiltable," with different section weights available for specialised purposes. These enhancements allow the index family to be used to generate benchmarks for portfolios which are deliberately constructed to be other than well diversified, as happens with some types of asset allocation and immunisation models.

The most elementary and yet perhaps the best method of structuring a fund to match index performance is full replication: this involves simply holding all issues in the index proportions.

One form of sampling involves dividing the full index into a number of groups. The index is then created by choosing a stock to represent each group and holding a weighting of this stock equal to the proportion of the group in the index. This is repeated for all of the chosen groups and called group sampling.

Another form of sampling is called optimisation. This involves using optimising techniques on past performance characteristics of the index stocks to choose a sample with fewer issues but similar risk/return features as the index.

INDEXED EQUITIES FUNDS

Three basic types of models can be used for indexed equities:

Basic replication: The most basic need is to be able to structure a number of different kinds of replicated index funds. We commissioned a study by Palmer, Gould and Evans which suggested the leading 50 stocks provided a suitable sample, and as the Australian Stock Exchange promotes a 50 Leaders Index itself, we are promoting this as the major vehicle for clients. Replication of the Australian Stock Exchange 50 Leaders provides good market coverage with very low transaction costs. An All Ordinaries Index Fund gives complete index performance at the cost of relatively high transaction expenses. Funds may also be structured on individual groups, as is done by the Australian Stock Exchange.

Fund optimisation: A quantitative method of limiting a portfolio by using a stratified optimiser. This involves using linear programming to select stock-based on ▒ representation of each industry through stratification ▒ correlation of each industry ▒ beta of index ▒ alpha minimisation.

All stocks in the index are listed with their alpha, beta and their industry correlation. The linear program can select an optimal match to the index using these characteristics.

The advantage of optimisation is that it gives a small number of stocks with the same performance characteristics as a larger fund but with lower transaction costs. The disadvantage is that their selection is based on historical data and the fund is more vulnerable to tracking variance than is the case with full replication.

Factor modelling: Here a large number of historic factors (share price data and balance sheet data) for each share are stored in a database. The factor model can quantify the variance of individual stocks from the index. An advantage is that the model is a good tool for measuring the risk of a portfolio away from its benchmark. The factor modelling system can also be used to select a sample portfolio with combined factors as close to the index as possible. A disadvantage is that the model requires a very large database with some years of history.

Index sampling techniques can be applied to indices split into many kinds of groups, selected by whatever criteria suit the needs of the fund or investors.

A common sub-group of a full replication index is a group of "leading" stocks, based on either capitalisation or turnover or a combination of both.

The Palmer, Gould and Evans study (market capitalisation) of the Australian All Ordinaries Index and sub-groups of the top 10, 20, 30 and 50 stocks showed that at least 20 stocks are needed to achieve acceptable correlation with the All Ordinaries Index, and that fewer than 50 stocks do not provide a good coverage of all industries in the index.

We have tested an equities index fund operating on a monthly rebalance. Australian Stock Exchange indices are subject to restructuring only once a year, and one month's notice is given of any anticipated changes. Monthly rebalancing has proved quite sufficient in producing a minimal tracking variance.

Australian Stock Exchange accumulation indices reinvest income across the index overnight after dividend "ex" date. If one uses monthly rebalancing, then that income is held until the next rebalance before reinvestment — a problem which will be referred to later.

There are many operational problems with any equity or fixed-interest index fund. Some of these problems cause tracking variances on a month-to-month basis, but most them should balance over time.

The presence in an index of the stocks that are largely captively owned occurs with both equities and bonds. In Australian Stock Exchange indices this liquidity problem is covered by the inclusion in the index calculation of a DC factor as a percentage; stocks with captive ownership and a low turnover may have only a reduced percentage of their total market capitalisation included in the index because of this "discounting".

The most dramatic cause of tracking errors in indexed equity accumulation funds is the difference between "ex" and paid dates of dividends. While the "ex" payment may accrue to the fund it cannot reinvested across all the stocks because the cash is not there. This difference can amount to up to two months lost reinvestment — fortunate in a bear market but annoying in a bull market.

This problem is similar to that of the timing of the rebalances. Where monthly rebalances are used, dividends and coupon income cannot be reinvested in stocks for the rest of the current month. This is one of the variances which must be considered when deciding the period between rebalances, keeping in mind that continuous rebalancing would lead to transaction costs which could cripple performance and tracking.

BOND INDEX

There is no publicly available database of fixed-interest securities on issue. Such a database is needed because index calculation requires, for each bond included in the index, the bond identifier, amount on issue, face value, maturity details, coupon details and price series. Keeping a bond database updated in real time is a major effort. However, we have created, and maintain, such a database as part of our activities.

It can be difficult to obtain the amount on issue for bonds subject to open market operations by the Reserve Bank. In the US, the Federal Reserve makes its holdings public, enabling their exclusion from the quantity on issue (which is desirable, since these holdings are not available to fund managers). Perhaps in time the Reserve Bank of Australia will adopt a similar helpful approach.

The lack of trading volume in certain issues in the Australian market makes it

impossible to obtain daily traded prices for all bonds. Thus there must be a trade-off between two of the desirable features of a bond index — coverage and frequency — if the index is to rely only on reported trades.

This problem exists even in the much larger US market. The solution adopted there for the broad-coverage indices is for a major market-maker to poll its traders for "realistic" prices for all securities in the index. These will often be recent trade prices, but by no means always. While this method appears more objective than relying on theoretical models based on the yield curve and quality rankings, it nevertheless leaves open the question of how such "realistic" prices can be convincing when there has been no recent trade.

The tender method used by the Australian Treasury to issue new bonds also causes a problem when constructing a bond index. The problem is that newly announced issues begin to trade before the date of issue, with delivery deferred. In theory, prices for these trades could be included in the index returns for the days before the issue date, even though the tender price is yet unknown.

What should a bond index look like?

A bond index should be an accumulation index, quantifying total return from both capital gains and coupon income, plus accumulated additional return from the reinvestment of income back into the bond market. It should be publicly available and should represent performance up to the close of trading for each day.

Lest it be thought that daily index calculation is overly ambitious, we should point out that (apart from the consumption of resources) this does not involve any greater problems than a weekly index such as the existing Commonwealth Bank Bond Indices. This is because a weekly index is accurate only if all prices used in its calculation are are current as at the last day of each week. The use of prices up to five trading days old in a weekly index can give misleading results, analogous to the thin trading problem that occurs with many sharemarket indices. Thus, valuation accurate to a given day is required for any index. It is also important that the time of valuation is suited to the market. We think 4.30 pm is suitable, not 12.30, nor 3.30.

An index should provide parameters which describe its overall composition in terms of duration, modified duration, convexity and M-squared. These parameters provide a measure of the sensitivity of the index portfolio to movement in interest rates.

It is difficult to separate performance due to superior skill from that due to better luck.

Duration: This measure is similar to term-to-maturity, but takes into account the timing of coupons as well as maturity payments. Duration is calculated as the weighted average time to payment of all the cash flows relating to a bond, using as weights the cash flows expressed as present values.

Modified duration: This measure is defined as duration divided by one plus yield, where the yield is expressed fractionally for the coupon period. It is a measure of the bond price sensitivity to interest rate changes. However, modified duration allows only a linear approximation to price changes.

Convexity: This is a measure of how much a bond's price/yield curve deviates from linearity, and explains the discrepancy between actual price changes and those predicted using modified duration alone. Convexity thus indicates how sensitive is modified duration itself to changes in interest rates.

M-squared: This concept, first suggested by Fong and Vasicek, is a measure of the cash flow dispersion of a portfolio. It is defined as the weighted sum of the squares of the time to payment of each cash flow around the duration of the portfolio. Thus, whereas duration is a weighted average of time to portfolio payments, M-squared is a similarly weighted variance of time to payment (in this case, variance around the duration measure itself, or a central moment).

The index provides values for a range of maturity or duration categories. This allows fund managers to calculate non-standard indices using weights different from those used in the overall market index. An investment manager may wish to follow one or more members of the index family, with the maturity or duration parameters best suited to the fund's objectives. This recognises that portfolio structure should bear some relationship to the fund's liability structure.

How the index is computed

First, it uses an existing database of bonds on issue to provide the universe of securities covered by the market index. This database gives the necessary information about coupons payable, maturities, other terminations and new issues. The previous day's prices, multiplied by the amount on issue, provide the index weights for a given day.

Second, it classifies the securities by maturity or duration, in order to form the sub-index structure described above.

Third, it should value each security in the universe on a daily basis, at the close of trading. The valuing of a broad universe of securities is a formidable task. Where traded prices are available for that day, these will be used unless there has been a significant shift in yields since the time of the trade. Where traded prices are not available, the index will seek quotes from the market participants. At least 30 of the 100-or-so securities in the index can be priced in this manner each day.

Fourth, coupons and maturities are reinvested in market value proportions at the day's closing prices (that is, reinvested along the yield curve). Thus the index is a true wealth or accumulation index, unlike those indices which reinvest in the short-term money market until, say, month-end.

The measurement of investment manager performance, using an index as a benchmark, should be of more than just historical (or accounting) interest. A fund which pays a manager to actively manage a portfolio, in the expectation of achieving better performance than a nominated benchmark, will need to monitor actual performance in order to provide feedback. The information obtained can be used to communicate to the manager the perceived interest of the fund; for example, by altering constraints on managers, or by changing the objectives or the amount of money allocated.

In practice, however, it is difficult to separate performance due to superior skill from that due to better luck. It is not enough simply to compare the compound return on the managed portfolio with that of the index, since deviations between the two may be due to differences in risk profile as well as to differences in ability.

Portfolio analysis using risk measures enables the analyst to assess whether the realised performance of the portfolio against the index was due to superior selection ability or to differences in risk exposure between the index and the actual portfolio. □