

DO-IT-YOURSELF INDEX FUNDS?

SMALL INVESTORS CAN MATCH THE BIG PLAYERS



by *NORMAN SINCLAIR*

A challenge to the conventional wisdom that big-is-best in managed portfolios. Small investors have problems, but they also have opportunities to beat the performance of major funds.

The advantage to the small investor from investing in professionally managed equity trusts is the subject of continuing debate. Some advisors argue that the small investor gains immediate access to a highly diversified portfolio that could not be otherwise replicated at a similar cost. However, others point to evidence that suggests that managed equity trusts appear to over-diversify their portfolios by holding too many securities, incurring excessive transaction, holding and monitoring costs. It has also been suggested that managed equity trusts reflect professional skills which lead to levels of performance that the average small investor cannot achieve.

On the other hand, there is considerable evidence that suggests that many passive/active portfolio managers do not perform as well as naive benchmarks such as the All Ordinaries Accumulation Index. Unfortunately, the debate provides very little guidance to small investors who must decide whether to assign the management of their equities exposure to someone else or attempt to do it themselves.

The response of some managed funds to the recent volatility in Australian equity markets has added another dimension to the small investor's decision. There is now an emerging trend towards the adoption of passive investment strategies by many equity trusts seeking to mirror the performance of an underlying stockmarket index. Although this trend may not be an admission

of a lack of comparative advantage in stock selection by professional portfolio managers, it does imply that there is some value to be gained by the small investor from the passivity of index-related trusts.

The dilemma for the small investor is that whereas reputed diversification benefits and performance differentials may or may not have been obtainable by the small investor on his own account, it appears that index funds can only be constructed and managed by large institutions. Indeed, if an index fund is to be constructed from a stratified sample of securities from the index or as a fully replicative portfolio, then the resource requirements are clearly beyond the small investor.

However, before reaching this conclusion there is one other line of inquiry to be pursued. Equity portfolios can also be constructed using statistical optimisation procedures which have the capacity to identify optimised portfolios of a predetermined size and, with additional constraints, may be engineered to possess the historical performance features of any selected index benchmark.¹

The purpose of this paper is to investigate the extent to which an investor with limited resources can build a portfolio which has the performance

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characteristics of a "miniature" index fund. In other words, is it possible to select a small number of securities which give an adequate trade-off between the return volatility of the market index (systematic risk) and the additional return volatility of the individual securities (unsystematic risk)?

If the answer is yes, then it implies that there is a passive investment strategy which is conceptually identical to that being marketed by professional equity managers. More important, it can be implemented by the small investor directly and at minimum cost. A major implication for managed equity trusts is clear. If a trust is no longer marketing its active funds management skills, then there is a possibility that investors will place a low priority on passive investment strategies that they can implement themselves.

Passive investment strategies

The trend away from *active* funds management into *passive* or *hybrid* investment strategies raises important questions for investors and professional fund managers alike.

First, it may be asked exactly what special skills are being offered to the market by passive funds managers. Conventionally, professional fund managers are thought to offer special skills in security selection and market timing but a move towards passive investment strategies involving complete indexation reduces the importance of the first in favour of the second.

By implication, the passive fund manager is, at best, offering a market-timing ability. While the extent of this skill is largely an empirical issue which is specific to an individual fund manager, the overall evidence on professional fund managers indicates a startling lack of market-timing ability. Alternatively, if the fund manager is not offering market-timing skills, then the index fund will be allowed to rise and fall with the volatility of the benchmark index. If the fund selects a volatile benchmark index such as the All Resources Accumulation Index, which has historically offered approximately the same return as industrial securities but with twice the volatility, then the ability to mimic this index is clearly of dubious value to the investor.

Certainly, the marketing of passive investment strategies requires a very careful assessment of the skills being

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offered by the fund and some anticipation of the likely reaction of potential clients.

Second, an investor who is aware of the principle of diversification must question the need to hold the complete market index to achieve equivalent performance. This principle states that as more securities are added to a portfolio, to the extent that the returns on those securities are not perfectly correlated with the returns on the existing portfolio, then the overall volatility of the portfolio returns can be reduced by the inclusion of those securities, without necessarily reducing the return on the portfolio.

In particular, it has been observed that a major improvement in diversification occurs in quite small portfolios of less than 15 securities, even when these are combined in equal investment proportions. By itself, this principle implies that there exist small portfolios that can achieve performance that is analogous on the performance of significantly larger portfolios such as index funds.

If the managed fund is to be structured as entirely passive, then the investor must be satisfied that the same performance cannot be achieved with a smaller portfolio on his own account. Passive strategies that can be replicated at lower cost will not achieve significant marketing success.

Such issues need to be acknowledged by financial institutions that are considering a switch to a passive investment strategy. The answers to these questions bear on the marketing strategy of the managed fund and the likely market reaction to the switch of strategy.

There are convincing arguments that completely passive investment strategies are of limited value to investors and that hybrid strategies which imply the continued use of traditional skills such as security selection and market timing will achieve more marketing success. For example, a hybrid investment strategy could involve a core indexed portfolio,

with the portfolio manager encouraged to exercise security selection skills at the margin, in addition to active risk management which utilises the manager's market-timing skills. Clearly, this strategy not only reflects the essence of passivity but also allows the portfolio manager scope for creative enhancement of the portfolio.

The central issue to be addressed in this paper is whether a small investor with limited resources can construct an optimised equity portfolio that provides an effective passive investment strategy relative to a broad-based benchmark such as the All Ordinaries Accumulation Index.

Limited diversification and the small investor

Small investors are defined as individuals or institutions with limited resources to devote to the selection and purchase of securities for a portfolio. This lack of resources may extend to the possession of insufficient skills or time to monitor and rebalance the portfolio. For that reason, the approach to statistical optimisation which may be adopted by a large institution must be modified to suit the small investor.

In particular, unconstrained optimisation of the proportionate investment in securities could lead to buy/sell decisions that cannot be executed by the small investor. For example, one such optimal allocation may require the small investor to assign 1 per cent of the portfolio to a particular security but the amounts involved may mean that the purchase order cannot be filled or can only be executed at a prohibitive cost.

Given the limited value of the investor's portfolio, it is likely that round-lot trading and minimum parcel requirements will place this constraint on the small investor. For that reason, it is preferable to optimise the small investor's portfolio under the assumption that equal investment will be made in all securities.

The assumption of equal investment proportions is equivalent to claiming that the small investor is more concerned with the selection of securities than determining the amounts to be invested in any one security. In this way, the small investor can make effective use of the principle of diversification to minimise unsystematic risk and construct a miniature index portfolio by engineering the systematic risk of the optimised portfolio to be equal to that of a market index such as the All Ordinaries Accumulation Index.

Two suitable metrics for performance evaluation which focus on the deviations of the portfolio from its target (tracking error) are the standard deviation of the tracking error and the correlation coefficient between the portfolio and the target index. At the outset, there will be some performance differences between

large-scale optimised index funds and mini-index portfolios designed for small investors. Due to the smallness of the portfolio it is likely that it will contain more unsystematic risk which will be reflected in a higher standard deviation of the tracking error and a lower correlation coefficient.

Therefore, the return on the small investor's portfolio could be significantly more or less than the return on the target index over a defined investment horizon. However, this is an empirical issue and in the next section of the paper the empirical qualities of mini-index portfolios are assessed.

An empirical study

A sample of 133 securities was selected subject to the following criteria:

- Each security had a minimum of 30 weekly return observations within the

60-week estimation period, from Wednesday November 4 1987 to Wednesday December 21 1988 inclusive. In addition, each security had no more than 20 per cent of its returns equal to zero during this period.²

- Each security had a complete price history in a 21-week holding period from Wednesday December 28 December 1988 to Wednesday May 17 1989 inclusive.

From this sample, mini-index portfolios of various sizes ranging from two to fifty securities were formed in such a way that the tracking error relative to the All Ordinaries Accumulation Index is minimised. The performance characteristics of mini-index portfolios are assessed over two separate time periods.

In the 60-week optimisation period, the tracking statistics of the portfolios are compared to the tracking statistics of randomly selected portfolios of equivalent size. In the 21-week holding period, the actual investment experience of a mini-index portfolio is examined and compared with the investment experience of the target index as well as three listed professionally managed equity trusts assuming a simple buy-hold investment strategy.

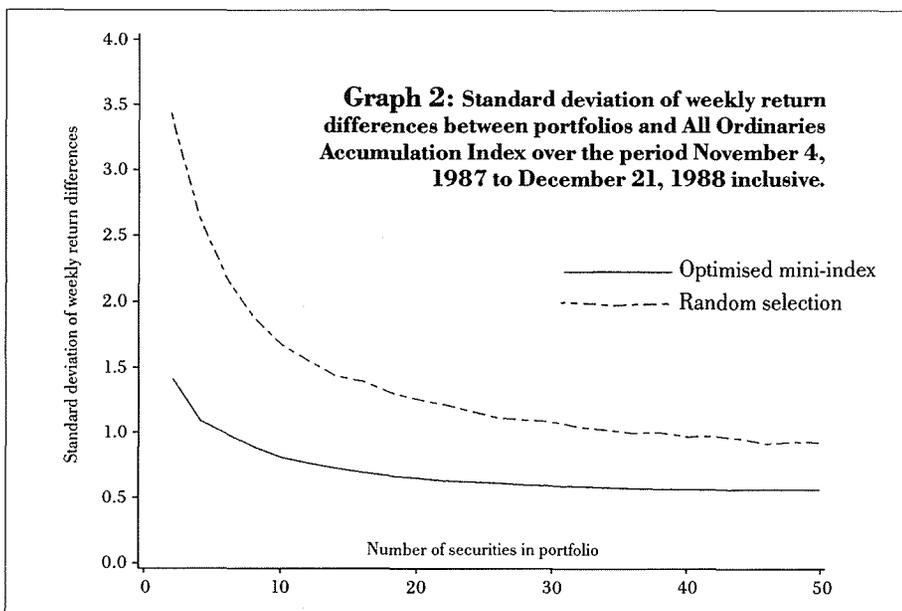
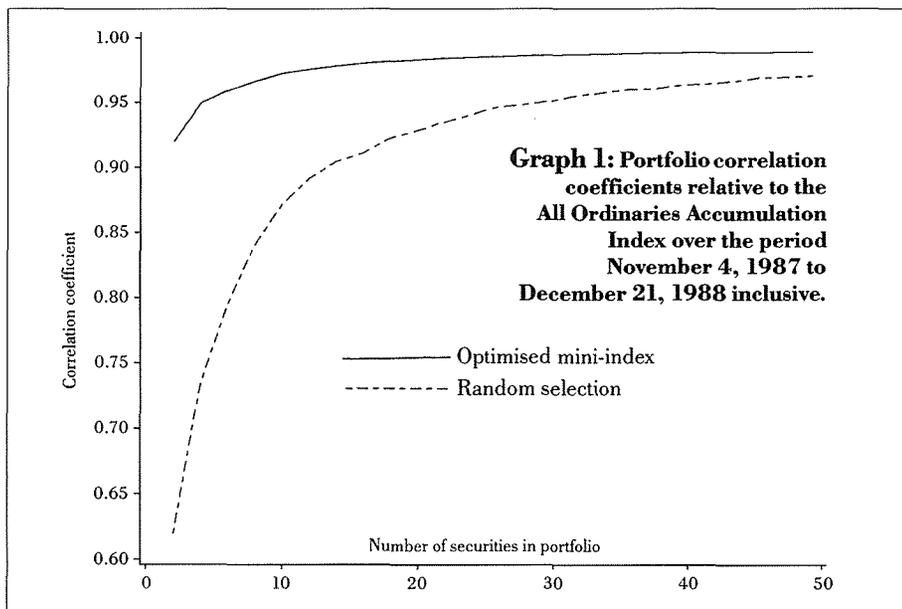
The three listed equity trusts may be characterised as active fund managers, although they probably differ in their explicit investment strategies with respect to both security selection and market timing.³ Although these equity trusts are not explicit index funds, they do represent feasible alternative investment opportunities for the small investor and therefore make natural alternative benchmarks for mini-index portfolios. The All Ordinaries Accumulation Index is used as the passive benchmark in the holding period.

Results: optimisation period

The optimisation technique ensures that a mini-index portfolio of a predetermined size is the most efficiently diversified and has the minimal tracking error with the All Ordinaries Accumulation Index among all possible portfolios of that size. The two measures of closeness between the optimised portfolio and the target index used here are:

- The correlation coefficient between the returns on the mini-index portfolio and the target index which will tend towards 1.0 as the portfolio becomes closer to the target index.

- The standard deviation of the weekly



return differences between the optimised portfolio and the target index which will tend toward 0.0 as the portfolio becomes closer to the target index.

These measures of tracking ability are graphed in Graphs 1 and 2 respectively, where comparisons are made between the optimised mini-index portfolios and randomised portfolios of equivalent size.⁴ The results provide highly convincing evidence that it is possible to construct small optimised mini-index portfolios that converge impressively on the target index with as few as 8-to-10 securities.

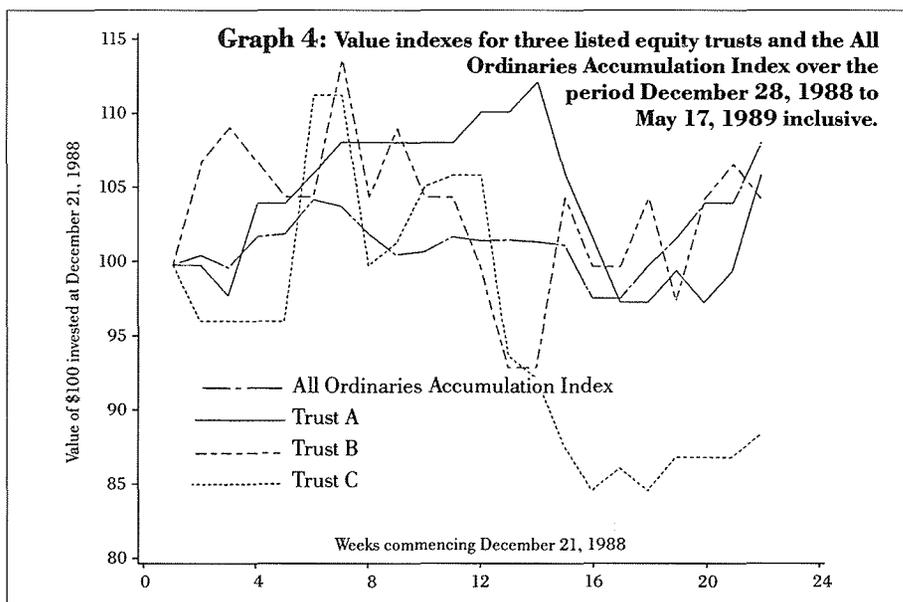
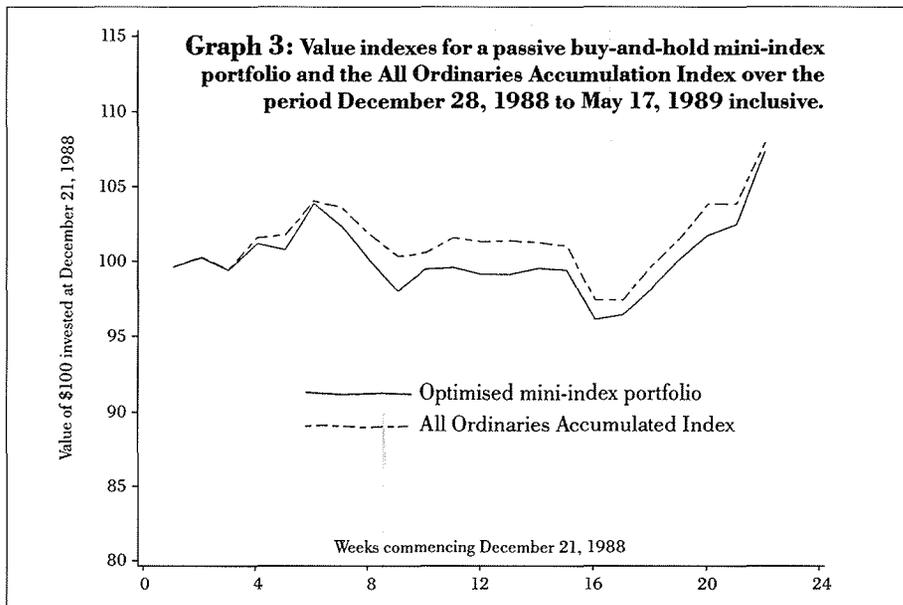
In Graph 1, a mini-index portfolio with as few as 10 securities held in equal proportions has a correlation with the All Ordinaries Accumulation Index of 0.969 compared to 0.851 for its randomised equivalent. It is also worth noting that a randomised portfolio of 50 securities has a correlation coefficient with the target index of 0.965 which could have been achieved with an optimised portfolio of only 8-to-10 securities.

For the larger optimised portfolios, there is only a very marginal improvement in correlation which reaches an asymptote of approximately 0.987 for a portfolio of 50 securities.

The tendency for the correlation coefficient not to reach its ideal value of 1.0 as the portfolio size increases reflects the joint effect of the optimisation technique and the constraint of equal investment proportions. This result is consistent with Sinclair (1988)⁵ and indicates that the choice of investment proportions is considerably less important than the selection of securities, even in relatively small portfolios.

Graph 2 presents the standard deviation of the weekly return differences between the All Ordinaries Accumulation Index and optimised and randomised portfolios of varying size. The results are consistent with the impression gained from Graph 1 to the extent that optimised portfolios with as few as 8-to-10 securities offer the most immediate improvements in tracking the target index. For example, the standard deviation of the tracking error is 0.852 per cent for a mini-index portfolio of 10 securities and 1.772 per cent for its randomised equivalent.⁶

Overall, the results in Graphs 1 and 2 clearly indicate that statistical optimisation can identify small portfolios which have performance characteristics closer to the All Ordinaries Accumulation Index than randomly selected portfolios of equivalent size. Further, since the



most dramatic improvements in tracking ability occur with a portfolio of approximately 10 securities, then it is possible that these mini-index portfolios offer a feasible passive investment strategy to investors with limited resources.

In the next section of the paper, a mini-index portfolio is constructed for an investor with \$50,000, under realistic trading conditions involving round-lot trading, minimum marketable parcels, transaction costs and stamp duties.⁷ The actual investment performance of this portfolio is then examined under a strict buy-and-hold investment policy over a subsequent time period. It is assumed that a small investor purchases the mini-index portfolio and holds it over the holding period with no further rebalancing or re-optimising. While this buy-and-hold strategy is the least-cost alternative available to the small investor, it is likely

to sacrifice tracking ability with the target index as the holding period is extended. The extent of the loss in tracking performance is the subject of the next section of the paper.

Investment performance of a mini-index portfolio

In this section of the paper, the financial performance of a mini-index portfolio is examined over a 21-week holding period, from December 28 1988 to May 17 1989 inclusive. Using a buy-and-hold investment strategy, this portfolio is compared with the financial performance of three listed equity trusts (A, B and C) and the All Ordinaries Accumulation Index. The initial portfolio is presented in Table 1, with details of its tracking ability over the optimisation period, November 4 1987 to December 21 1988 inclusive.

The information in Table 1 shows that with the exception of NMP and CRA, investment proportions are approximately equal at \$5,000 per security. Deviations from this equal proportion investment policy arise from the nature of the optimisation and the necessity to trade in round lots and marketable parcels.

The portfolio in Table 1 is the traded equivalent of a portfolio of size 10 presented in Graphs 1 and 2 and it can be seen that the performance statistics are relatively unaffected by the imposition of realistic trading conditions. For example, the correlation coefficient between the portfolio in Table 1 and the All Ordinaries Accumulation Index is still 0.969 and the standard deviation of the tracking error has increased slightly from 0.852 in Graph 2 to 0.872 in Table 1.

The performance statistics in Table 1 indicate clearly that a small portfolio of approximately 10 securities can be constructed to possess the historical characteristics (means, variances and systematic risk) of the All Ordinaries Accumulation Index.

However, the acid-test is how well this portfolio retains these characteristics over an independent holding period. Consistent with a buy-and-hold investment experience, the investment proportions implicit in Table 1 are used to commence the holding period but are permitted to change as the market values of the securities (and the value of the overall portfolio) change over time.

Table 2 contains summary performance statistics computed over the 21-week holding period from December 28 1988 to May 17 1989 inclusive for the optimised portfolio, three listed equity trusts and the All Ordinaries Accumulation Index. One striking result in Table 2 is the close overall association maintained between the mini-index portfolio and the target index over this independent holding period. For example, the correlation coefficient is 0.943 and the standard deviation of the tracking error is only 0.624 per cent per week.

To see the closeness of this association more clearly, the mini-index portfolio and the target index are transformed into "value indexes" constructed with a base value of \$100 as at December 21 1988. In Graph 3, these value indexes illustrate the investment experience of an equivalent investment in both portfolios over the holding period. From Graph 3, it is clear that although

TABLE 1: A Mini-index portfolio for a small investor with \$50,000 as at December 21, 1988 after all costs*

Security	Shares held	Price at 21-12-88	Market value	
ANZ	Australia and New Zealand Bank	900	5.38	4842.00
BHP	Broken Hill Proprietary Limited	700	7.18	5026.00
BOR	Boral	1400	3.60	5040.00
GPT	General Property Trust	1800	2.75	4950.00
LLC	Lend Lease Corporation	450	10.55	4747.50
NAB	National Australia Bank	800	6.58	5264.00
NMP	National Mutual Property Trust	800	1.13	904.00
TNT	TNT Limited	1400	3.60	5040.00
CRA	CRA Limited	400	7.70	3080.00
STO	Santos Limited	1500	3.30	4950.00
WMC	Western Mining Corporation	1000	4.88	4880.00

PERFORMANCE STATISTICS: OPTIMISATION PERIOD

	Mini-index portfolio (as above)	All Ordinaries Accumulation Index
Average weekly return (%)	0.238	0.240
Standard deviation of weekly returns	3.518	3.316
Systematic risk of portfolio (Beta)	1.028	1.000
Correlation with All Ordinaries Accum.	0.969	1.000
Standard deviation of weekly deviations from target	0.872	0.000

* The net portfolio value is \$48,723.50 after all costs and includes a small cash deficit of \$140.84 which is implicitly assumed to have been made up by the investor.

TABLE 2: Summary performance statistics for a mini-index portfolio; 3 managed equity trusts and the All Ordinaries Accumulation Index over an independent holding period: December 28 1988 to May 17 1989 inclusive.

	Optimised mini-index portfolio	Managed equity trusts			All Ordinaries Accumulation Index
		A	B	C	
Average weekly return (%)	0.377	0.332	0.361	-0.445	0.399
Standard deviation of returns	1.857	3.005	5.544	5.396	1.668
Systematic risk of portfolio	1.050	0.998	0.326	1.372	1.000
Correlation with All Ordinaries	0.943	0.554	0.098	0.424	1.000
Standard deviation of weekly return differences	0.624	2.501	5.631	4.927	0.000

the mini-index portfolio is not rebalanced or re-optimised throughout the 21-week period, it retains a consistently close association with the target index.

The summary statistics in Table 2 also show that the three listed equity trusts are very dissimilar to each other and to the overall market index. In the absence of specific knowledge of the trust investment strategies during this period, this result is surprising, since all three probably hold large equity portfolios in which the importance of the investment proportions on any security are diminished.

One possible explanation for these differences may lie in the security-selection and market-timing activities of the trusts over this period. Whatever the reason, it is clear in Table 2 that all three equity trusts underperformed All Ordinaries Accumulation Index and even the trust with the lowest volatility of 3.005 per cent is considerably higher than the volatility of the mini-index portfolio of 1.857 per cent.

In terms of the tracking error relative to the target index, all three equity trusts are clearly very poor substitutes for an index fund with relatively high standard

deviations of tracking error at 2.501 per cent, 5.631 per cent and 4.927 per cent respectively. This may be compared with the equivalent tracking error statistic for the mini-index portfolio of only 0.624 per cent. Similarly, the correlation coefficients between the trusts and the target index are only 0.554, 0.098 and 0.424 respectively, which compares unfavourably with 0.943 for the mini-index portfolio.

In Graph 4, "value indexes" are constructed for the trusts and the target index which illustrate the high volatility of an investment in these listed equity trusts relative to the All Ordinaries Accumulation Index. Further, it can be seen that the terminal value of \$100 placed in each investment at the beginning of the holding period with a strict buy-and-hold policy is 106.25, 104.65 and 88.46 for the listed trusts compared with 108.43 for the target index and 107.85 for the mini-index portfolio. A comparison of Graphs 3 and 4 clearly reveals the volatility that a small investor would have incurred by investing in these equity trusts relative to a passively held mini-index portfolio.

Overall, the results in Table 2 and Graphs 3 and 4 indicate unambiguously that a small investor with limited resources could have constructed an optimised mini-index portfolio of approximately 10 securities that not only retained a high level of association with the target index but also outperformed three major listed equity trusts in terms of risk and return.

In addition, this result did not require the small investor to rebalance or re-optimize the initial portfolio,

A small portfolio of approximately 10 securities can possess the historical characteristics of the All Ords Accumulation Index.

A small investor with limited resources could have . . . outperformed three major listed equity trusts in terms of risk and return.

thereby minimising transaction costs. In other words, passive index-related portfolios may be constructed for small investors and offer a feasible alternative to investment in professionally managed active or passive funds.

Conclusions

In this paper, the sagacity of marketing passive investment strategies was questioned in light of the potential for investors to construct small optimised portfolios with index characteristics. It was demonstrated that an optimised mini-index portfolio with as few as 10 securities has desirable performance characteristics relative to the All Ordinaries Accumulation Index.

Within the optimisation period, these portfolios make efficient use of the diversification principle and dominate randomly selected portfolios of equivalent size. Further, using a simple buy-and-hold strategy in a separate holding period, a mini-index portfolio outperformed three listed equity trusts and still maintained a high degree of association with the All Ordinaries Accumulation Index.

In conclusion, passive investment strategies appear to be easily within the resource limitations of small investors and therefore may cast some doubt upon the potential marketing success of totally passive index funds. □

NOTES

1. Sinclair, N. A., 1988, "Optimisation - Fact or Fantasy?", JASSA, 3, September, pp28-31, discusses statistically optimised index funds and their performance characteristics relative to other randomly selected portfolios of similar size.

2. Weekly rates of return are estimated on a Wednesday weekend because there tends to be higher liquidity in the stockmarket mid-week. Adjustments are

made for all dividend and capitalisation changes. Weekly rates of return greater than 20 per cent are omitted from the analysis under the assumption that they may be due to the omission of capitalisation changes or price errors. Only securities with less than 20 per cent zero returns are included in the sample to minimise estimation bias in the optimisation.

3. The identities of the three listed equity trusts are not revealed; they are referred to as A, B and C. The results in Sinclair (1988) indicate that the performance differences arising from differences between optimal and actual investment proportions in large portfolios are very slight. The fact that most managed equity funds tend to be quite dissimilar to index funds may indicate significant activity in security selection and market timing which alters the intrinsic tendency for large portfolios to follow the index. It is likely that this is the case for the three listed trusts examined here.

4. The estimates for the randomised portfolios are based on the average of 50 replications for a given portfolio size.

5. Op. cit.

6. It is worth noting that this measure of tracking error obtained from a large unconstrained statistical optimisation against the same target index reduces to approximately 0.25 per cent a week but requires a portfolio of about 120 securities and variable investment proportions.

7. One idiosyncrasy of the optimisation to identify an equally weighted portfolio of N securities is that it generally leads to a portfolio requiring N + 1 securities with less than 1/N weights on some securities. Under actual trading conditions, these "underweighted" securities often do not appear in the final traded portfolio. In this instance, a desired 10-security mini-index portfolio with 10 per cent in each security resulted in a traded portfolio of 11 securities with less than 10 per cent in two securities.