Carter, K. J.; Affleck-Graves, J. F.; Money, A. H.

Article

Unit trusts and portfolio selection on the Johannesburg Stock Exchange

South African Journal of Business Management

Provided in Cooperation with:
University of Stellenbosch Business School (USB), Bellville, South Africa

Suggested Citation: Carter, K. J.; Affleck-Graves, J. F.; Money, A. H. (1982) : Unit trusts and portfolio selection on the Johannesburg Stock Exchange, South African Journal of Business Management, ISSN 2078-5976, African Online Scientific Information Systems (AOSIS), Cape Town, Vol. 13, Iss. 4, pp. 169-175, https://doi.org/10.4102/sajbm.v13i4.1194

This Version is available at:
https://hdl.handle.net/10419/217812

Unit trusts and portfolio selection on the Johannesburg Stock Exchange

K.J. Carter
Allan Gray Investment Counsel, Cape Town
J.F. Affleck-Graves
Department of Mathematical Statistics, University of Cape Town
A.H. Money
Graduate School of Business, University of Cape Town

The application of the standard techniques of portfolio selection on the 34 sectors comprising the JSE All Share index is undertaken for the three equal non-overlapping five-year periods between February 1965 and January 1980. Efficient portfolios in each period which carry the same risk as the market index are seen to outperform the market substantially. Portfolios chosen at random to span the efficient frontier in each period reveal the consistent inefficiency of 10 sectors over the 15-year period. Three of these sectors, namely Mining Holding, Mining Houses and Industrial Holding are shown to be favoured in the Association of Unit Trusts portfolio relative to these sectors' proportion of the market. On the presumption that unit trust managers attempt to act efficiently, holding these sectors is only justified if the measure of risk used in the portfolio selection algorithm, namely standard deviation of expected return, is less appropriate than other measures of risk such as earnings volatility. If standard deviation of expected return is a more appropriate measure of risk in the selection of efficient portfolios, it must be concluded that the large sophisticated investors managing the unit trusts act inefficiently.

S. Afr. J. Bus. Mgmt. 1982, 13: 169 – 175

Standaardtegnieke van portefeulje-seleksie uit die 34 sektore waaruit die Johannesburgse Effektebeurs bestaan, is op die drie nie-ooreenvallende vyf-jaar periodes tussen Februarie 1965 en Januarie 1980 toegepas. Daar is gevind dat doeltreffende portefeuljes — wat dieselfde risiko as die markindeks dra — in elke tydperk baie beter as die mark presteer. Portefeuljes is willekeurig gekies om die grense van doeltreffendheid ('efficient frontier') te dek en tydens elke tydperk het die deurlopende ondoeltreffendheid van 10 sektore oor die 15-jaar periode aan die lig gekom. Daar is bewys dat drie van hierdie sektore, naamlik mynbeheer, mynhuise en nywerheidsbeheer, deur die portefeulje van die Vereniging van Effektetrusts begunstig word in verhouding tot hierdie sektore se aandeel van die mark. Indien daar van die standpunt uitgegaan word dat die bestuurders van die effektetrusts daarna streef om doeltreffend te funksioneer, kan die hou van hierdie sektore in portefeuljes alleenlik geregverdig word as die risikofaktor betrokke by die algoritme van portefeulje-seleksie, naamlik standaardafwyking van verwagte opbrengs, minder toepaslik as ander risikofaktore, soos verdienste-onbestendigheid, is. Indien standaardafwyking van verwagte opbrengs 'n geskikter risikomaatstaf by die seleksie van doeltreffende portefeuljes is, moet daar afgelei word dat die groot gesofistikeerde beleggers, deur wie die effektetrusts beheer word, ondoeltreffend funksioneer.

S.-Afr. Tydskr. Bedryfsl. 1982, 13: 169 – 175

K.J. Carter,* J.F. Affleck-Graves and A.H. Money
Allan Gray Investment Counsel, Southern Life Building,
101 St George's Street, Cape Town 8001, Republic of South Africa
*To whom correspondence should be addressed

Received June 1982; accepted September 1982

Following an amendment of the Unit Trust Control Act, the first South African unit trust was launched in June 1965 with assets totalling R600 000. At present there are 12 unit trusts in existence, which are controlled by six management companies. These management companies are each part of one of the country's major financial institutions. At December 31, 1980, the total equity assets under management by the movement totalled R566,3 million, accounting for 1,49% of the market capitalization of the JSE All Share index at the same date.

The Association of Unit Trusts was established in 1967 to represent the joint interests of its member trusts and their unit holders in dealing with the authorities, to promote the common interests of the industry, and to maintain communication with the media.[1] For the purposes of this paper, the Association of Unit Trusts portfolio (T), which is a combined portfolio of the 12 underlying trusts, is significant in that it is the largest professionally managed portfolio, the constituents of which are public knowledge. In this paper, the structure of this portfolio at December 31, 1980 is analysed and discussed with respect to the selection of efficient portfolios on the Johannesburg Stock Exchange (JSE) over the past 15 years.

The JSE Actuaries index and the Association of Unit Trusts portfolio

Comparatively recently, a comprehensive set of share price indices has been produced for the JSE,[2] providing a monthly price history of the JSE from January 1960 to September 1978 and daily thereafter. Since these indices are weighted by marked capitalization, a useful guide to a portfolio's structure is provided by comparing the proportion of the portfolio invested in each sector with the proportion that sector represents of the JSE All Share index. Clearly a higher relative weighting of a sector in the portfolio to the market indicates a favourable expected outcome in future performance of that sector relative to the market, while a relative exposure of less than unity indicates expected future underperformance relative to the market. A relative exposure of unity indicates a neutral performance expectation relative to the market. Table 1 shows the T portfolio represented in this way relative to the JSE All Share index at December 31, 1980.

Table 1 Association of Unit Trusts Portfolio relative to the JSE All Share index[a]

Sector	Proportion of JSE All Share	Proportion of Unit Trusts	Relative proportion Unit Trusts to JSE All Share
1. Gold — Rand	0,0242	0,0047	0,1942
2. Gold — Evander	0,0142	0,0040	0,2817
3. Gold — Klerksdorp	0,0729	0,0288	0,3951
4. Gold — OFS	0,0765	0,0144	0,1882
5. Gold — W. Wits	0,1424	0,0117	0,0822
6. Coal	0,0365	0,0605	1,6575
7. Diamonds	0,0696	0,0818	1,1753
8. Platinum	0,0251	0,0183	0,7291
9. Copper, Tin, others	0,0209	0,0070	0,3349
10. Mining Holding	0,0600	0,0389	0,6483
11. Mining House	0,1350	0,1537	1,1385
12. Inv. Trusts	0,0072	0,0070	0,9722
13. Insurance	0,0057	0,0079	1,3860
14. Property	0,0054	0,0004	0,0741
15. Banks	0,0305	0,0695	2,2787
16. Ind. Holding	0,0639	0,1452	2,2723
17. Beverages	0,0200	0,0609	3,0450
18. Building	0,0122	0,0143	1,1721
19. Chemicals	0,0611	0,0459	0,7512
20. Clothing	0,0054	0,0026	0,4815
21. Electrical	0,0071	0,0083	1,1691
22. Engineering	0,0154	0,0171	1,1104
23. Fishing	0,0010	–	–
24. Food	0,0143	0,0183	1,2797
25. Furniture	0,0077	0,0243	3,1558
26. Motors	0,0048	0,0013	0,2708
27. Paper, Packaging	0,0146	0,0192	1,3151
28. Pharmaceutical	0,0015	0,0021	1,4000
29. Printing	0,0009	–	–
30. Steel	0,0063	0,0072	1,1429
31. Stores	0,0169	0,0861	5,0947
32. Sugar	0,0073	0,0006	0,0822
33. Tobacco	0,0078	0,0361	4,6282
34. Transport	0,0057	0,0019	0,3333
	1,0000	1,0000	

[a]The JSE All Share index has been expressed excluding Property Trusts which only appeared from January 1976: At December 31, 1980 it was 0,32% of the JSE All Share index.

It can be seen that two sectors, namely Fishing and Printing, were not present in the portfolio and therefore carried the lowest relative exposure at zero. The highest relative exposure was Stores at 5,09, followed by Tobacco, Beverages and Furniture, the former over four times, and the latter two more than three times the market proportion for these sectors. The gold sectors all carried a low relative weighting. The appropriateness of the weightings revealed in Table 1 will be discussed later in this paper.

Selection of efficient portfolios

In 1952 Markowitz published a now famous paper on portfolio selection,[3] from which a whole theory of portfolio selection has been derived. The basic notion is that only two factors need be considered in choosing a portfolio, namely the return an investor can expect to receive from holding the portfolio and the uncertainty associated with this return. For the purposes of this paper the generally accepted measures of these variables have been used and they are, respectively, the weighted average monthly return of the components of the portfolio, and the standard deviation of the monthly return on the portfolio (both expressed in percent per month). Any portfolio may thus be represented by a point in a risk/return plane. In fact all feasible (i.e. attainable) portfolios will fill some region in this plane. In particular, a set of portfolios, known as the efficient set, can be found which will dominate all other portfolios, because for these portfolios it is not possible to obtain either a greater expected return without incurring greater risk or obtain smaller risk without decreasing expected returns.[4] Therefore investors will only wish to hold portfolios belonging to the efficient set and each investor is left to choose the single one portfolio (i.e. trade off the levels of risk and return) for himself.

Standard techniques are available for choosing the efficient set,[5] and this has been done on the JSE.[6,7] For this paper, three equal, non-overlapping time periods of monthly intervals were chosen for study, namely:

February 1965 to January 1970 — Period 1
February 1970 to January 1975 — Period 2
February 1975 to January 1980 — Period 3.

It must be stressed that these three time periods were not chosen because of any market or economic consideration. They were chosen merely to divide the data set into three equal non-overlapping time periods.

The 34 sectors of the JSE Actuaries index (see Table 1) represented the universe of 'securities' for portfolio formation in each period. The efficient set chosen in each period is pictorially displayed in Figures 1, 2 and 3 for Periods 1, 2 and 3 respectively. Also marked as points in the risk/return plane are the JSE All Share index (M), the JSE All Mining index (A), the JSE Mining Financial index (F), the JSE Industrial and Financial index (I) and the Association of Unit Trusts portfolio (T).

It can be seen that the range and slope of the efficient set or frontier is markedly different in each period. Further, each of the indices plotted and the T portfolio have been consistently inefficient over time. The inefficiency of M particularly, suggests that efficient portfolios will contain sector weightings which differ greatly from the weightings applying in the M index. This feature is examined in the next section.

It must be mentioned that this study is an *ex post* study whereas an investor wishing to utilize the Markowitz model must use estimates of the expected return and risk for each of the securities in the coming period (i.e. *ex ante*). Nevertheless, *ex post* studies are useful in that they demonstrate the investment opportunities that actually were available in the period. An analysis of such results could help investors to decide why their *ex ante* portfolios did not produce the desired results. In addition, investors whose portfolios lie far from the efficient frontier should realize that this is as a result of poor *ex ante* forecasts. Whether they could have

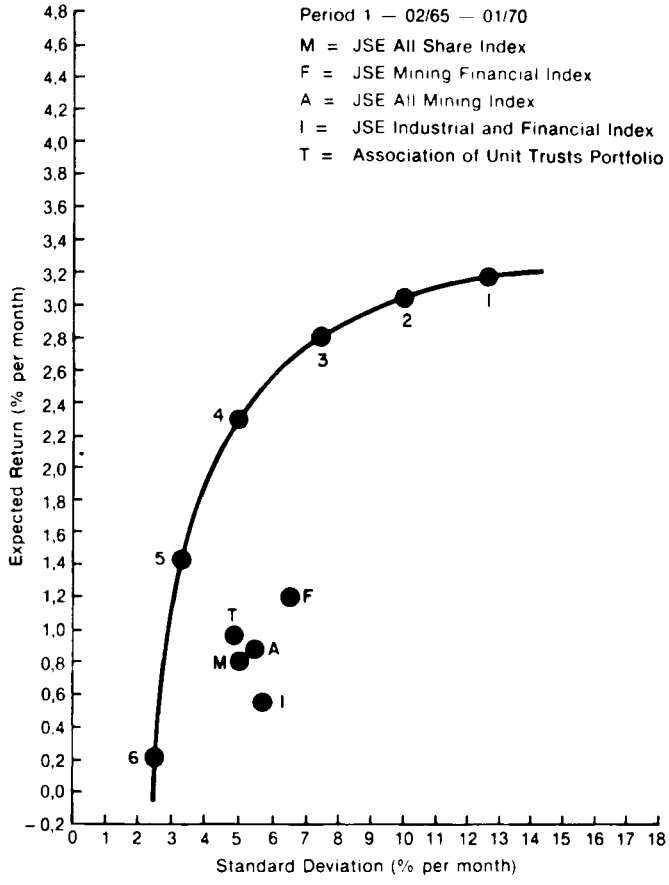

Figure 1 Efficient set chosen for Period 1

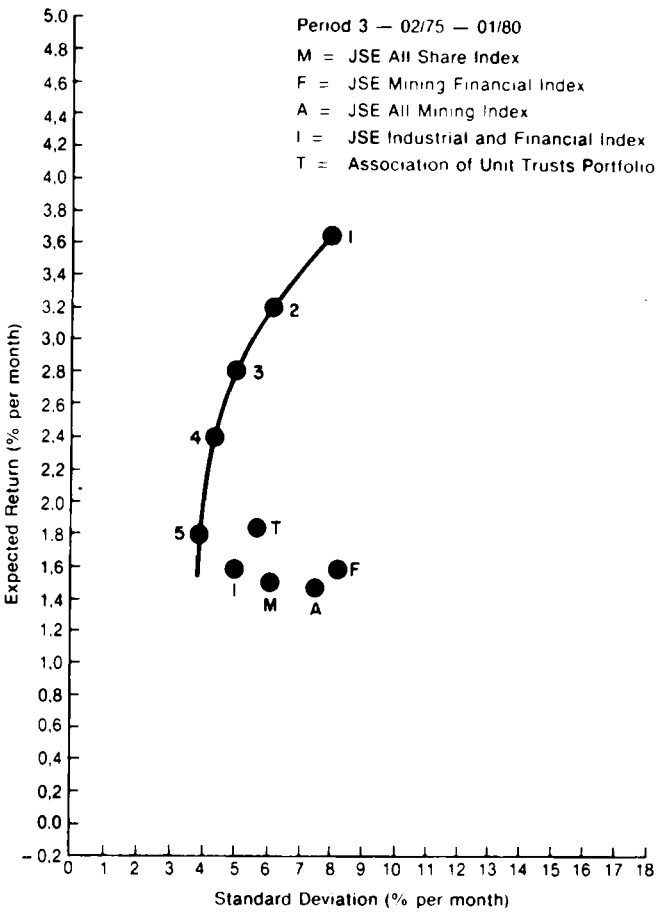

Figure 3 Efficient set chosen for Period 3

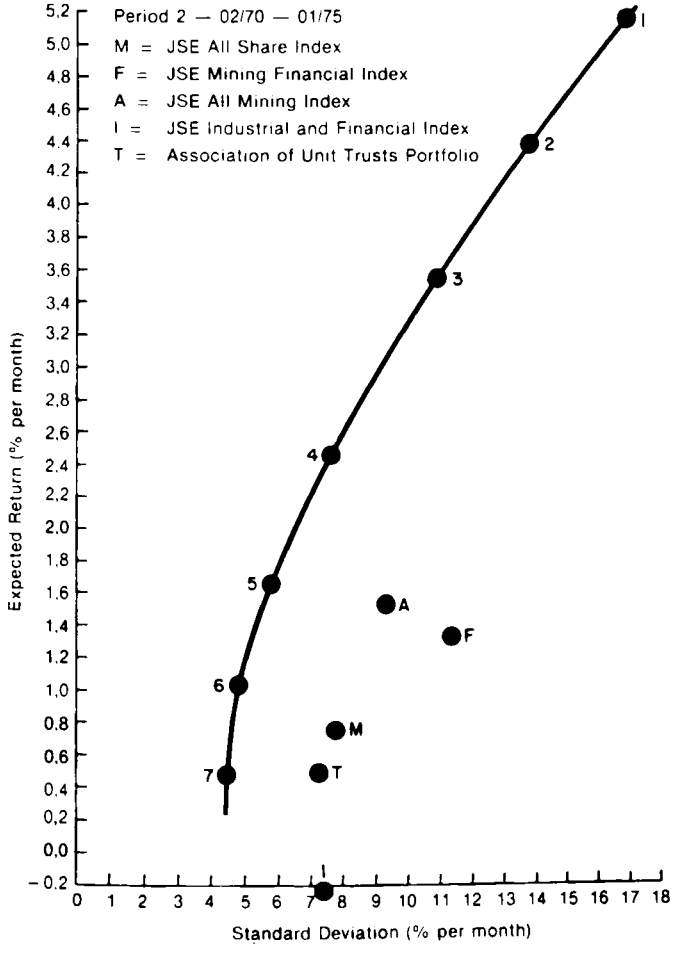

Figure 2 Efficient set chosen for Period 2

done better or not *ex ante*, is a question addressed by the efficient market hypothesis and beyond the scope of this paper.

Composition of efficient portfolios

On any given efficient frontier there are an infinite number of different portfolios. For the purpose of studying the composition of efficient portfolios several portfolios were selected from each efficient frontier and are numbered in each of Figures 1, 2 and 3. They were chosen at random to embrace the full risk/return range of the efficient frontier, with the exception that the efficient portfolio which carried the same risk (i.e. standard deviation of return) as the M index was a required selection. Tables 2, 3 and 4 show the composition of these efficient portfolios by sector weighting for Periods 1, 2 and 3 respectively.

Several points emerge from a study of these tables:

- At very high risk, limited diversification occurs because only a limited number of sectors in each period has a sufficiently high expected return to compensate the investor for the high risk.
- As the risk decreases, diversification increases. In fact the increased diversification serves to reduce risk. Also lower-risk portfolios approach the area where M, by definition fully diversified, plots.
- Some sectors changed their risk character over the periods studied. For example, the gold sectors tend to occur in lower-risk portfolios in Period 1 and higher-risk portfolios in Period 2 while hardly at all in Period 3. Undoubtedly the behaviour of the gold price in these

Table 2 Efficient portfolios in Period 1

Portfolio no.	1	2	3	4[a]	5	6
Standard deviation (% per month)	13,000	10,000	7,500	5,020	3,400	2,500
Expected return (% per month)	3,193	3,028	2,784	2,312	1,331	0,184
1. Gold — Rand						0,0081
2. Gold — Evander						0,0612
3. Gold — Klerksdorp					0,0427	0,1002
4. Gold — OFS						0,0690
5. Gold — W. Wits						
6. Coal					0,0584	0,2010
7. Diamonds				0,1468	0,0811	
8. Platinum	0,0311	0,3560	0,5519	0,3065	0,1503	0,0678
9. Copper, Tin, others			0,0887	0,2531	0,1615	0,0361
10. Mining Holding						
11. Mining Houses						
12. Inv. Trusts						
13. Insurance	0,9689	0,6440	0,3124	0,0197		
14. Property						
15. Banks						
16. Ind. Holding						
17. Beverages						
18. Building						
19. Chemicals						
20. Clothing						
21. Electrical						
22. Engineering						0,0100
23. Fishing						0,0681
24. Food						
25. Furniture						
26. Motors						
27. Paper, Packaging					0,0331	0,0490
28. Pharmaceutical						
29. Printing					0,3111	0,2491
30. Steel						0,0047
31. Stores						
32. Sugar					0,0395	0,0712
33. Tobacco				0,1576	0,0932	
34. Transport			0,0470	0,1163	0,0291	0,0045
Total	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

[a]Portfolio with same risk as the market

periods profoundly affected this situation. Other sectors like Printing, Electrical and Engineering only appear in lower-risk portfolios throughout.

- In each period (Platinum in Period 1, Gold-West Wits in Period 2 and Coal and Clothing in Period 3) a sector appeared in all efficient portfolios considered. Since each sector is only a point itself in the risk/return plane,this can only occur if it displays not only a high return but also a low covariance with other currently efficient sectors. In this way it will be selected for the high marginal return added for low marginal risk borne.
- It can be seen that sectors, once efficient, tend to persist in efficient portfolios over quite a range in the efficient frontier. This suggests that in each period the sectors tend to form into a hierarchy of efficiency dominance implying that quite a number of sectors are too inefficient to be held in efficient portfolios.
- Certain sectors do not appear in any of the efficient portfolios in any period. They are Mining Holding, Mining Houses, Property, Banks, Industrial Holding, Building, Furniture, Motors, Pharmaceutical and Stores. It can be concluded that it has always been possible to replace these sectors in a portfolio with a combination of other sectors which has been more efficient. Together these 10 sectors represent 33,8% of the market capitalization of the JSE All Share index (see Table 1) and it is surprising that such a large por-

Table 3 Efficient portfolios in Period 2

Portfolio no.	1	2	3	4[a]	5	6	7
Standard deviation (% per month)	17,000	14,000	11,000	7,861	6,000	5,000	4,500
Expected return (% per month)	5,190	4,406	3,500	2,392	1,606	1,064	0,637
1. Gold — Rand	0,8601	0,5268	0,2520	0,0497			
2. Gold — Evander	0,1215	0,1129	0,1005	0,0658	0,0178		
3. Gold — Klerksdorp							
4. Gold — OFS							0,0363
5. Gold — W. Wits	0,0185	0,3603	0,5320	0,5329	0,4614	0,3398	0,1914
6. Coal				0,0601	0,1305	0,1839	0,2187
7. Diamonds							
8. Platinum							
9. Copper, Tin, others							
10. Mining Holding							
11. Mining Houses							
12. Inv. Trusts							
13. Insurance							
14. Property							
15. Banks							
16. Ind. Holding							
17. Beverages				0,0585	0,0554	0,0536	
18. Building							
19. Chemicals							0,0686
20. Clothing							
21. Electrical				0,0070	0,2091	0,3596	0,4156
22. Engineering							
23. Fishing			0,0520	0,0867	0,0484	0,0157	
24. Food			0,0635	0,1393	0,0702	0,0061	
25. Furniture							
26. Motors							
27. Paper, Packaging							
28. Pharmaceutical							
29. Printing							0,0261
30. Steel					0,0072	0,0414	0,0433
31. Stores							
32. Sugar							
33. Tobacco							
34. Transport							
Total	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000

[a]Portfolio with same risk as the market

tion of the maret index has been so consistently inefficient.

Arguments may possibly be lodged against this analysis because of its *ex post* nature, but the fact remains that over the past 15 years 10 of the 34 sectors examined did not appear in any *ex post* efficient portfolio. While it is possible that from an *ex ante* point of view some of these sectors may have appeared efficient to investors, the fact remains that *ex post* they were never efficient. This is true for each of the three periods examined and this should be the cause of some concern to investors who were heavily invested in these sectors. The only reasonable conclusion one can draw is that these sectors appear to have been inefficient over the time period studied.

- The composition of the efficient portfolios changes markedly from period to period. For example, in Period 2, the portfolio with the same risk as the market has holdings which, with the exception of Coal, do not appear in the corresponding portfolio of Period 3. Clearly the feasibility of a large investor performing such a large shift in his portfolio is an important question, as is the holding of a massive proportion of a portfolio in one sector (e.g. 96,48% in Coal in portfolio 1 of Period 3). Although beyond the scope of this paper, these issues and that of the inefficiency of the M index and its implications for modern portfolio theory applied to the JSE, have been addressed

Table 4 Efficient portfolios in Period 3

Portfolio no.	1	2[a]	3	4	5
Standard deviation (% per month)	8,000	6,292	5,000	4,400	4,000
Expected return (% per month)	3,644	3,235	2,765	2,379	1,802
1. Gold — Rand					
2. Gold — Evander			0,0044		
3. Gold — Klerksdorp					
4. Gold — OFS					
5. Gold — W. Wits					
6. Coal	0,9648	0,7228	0,4523	0,2905	0,1442
7. Diamonds					
8. Platinum					
9. Copper, Tin, others					0,0020
10. Mining Holding					
11. Mining Houses					
12. Inv. Trusts				0,0376	
13. Insurance					
14. Property					
15. Banks					
16. Ind. Holding					
17. Beverages					
18. Building					
19. Chemicals			0,0944	0,1031	0,0406
20. Clothing	0,0346	0,2726	0,3892	0,3283	0,1608
21. Electrical				0,0867	0,1286
22. Engineering					0,2338
23. Fishing					0,0479
24. Food					
25. Furniture					
26. Motors					
27. Paper, Packaging					
28. Pharmaceutical					
29. Printing					0,0558
30. Steel	0,0006	0,0046			
31. Stores					
32. Sugar			0,0134	0,0712	0,0759
33. Tobacco			0,0138		
34. Transport			0,0325	0,0826	0,1104
Total	1,0000	1,0000	1,0000	1,0000	1,0000

[a]Portfolio with same risk as the market

elsewhere.[7]

Performance of efficient portfolios

To illustrate the performance of efficient portfolios relative to the M index, the efficient portfolios in each period carrying the same risk (i.e. standard deviation of return) as the M index were examined. These portfolios are designated in Tables 2, 3 and 4. In Table 5 the relative performance figures are shown.

It can be seen that substantial superior performance is achieved by efficient portfolios thereby demonstrating that on the JSE it has been possible to outperform the market consistently without bearing additional risk to that borne by investing in the market index itself.

Efficiency of the Association of Unit Trust portfolio (T)

It has already been seen in Table 1 that the unit trust managers have collectively adopted a portfolio which has quite different sector weightings from those in the market index. Furthermore, it has been established that efficient portfolios also display this phenomenon with several sectors never appearing in efficient portfolios. One of the characteristics of the T portfolio is its low exposure to the gold sectors, representing only 6,36% of T but 33,0% of M. It has been shown[8] that the gold sectors on the JSE have produced similar mean monthly returns for a United States (US) and South African (SA) investor over the past 15 years. However, the US investor has borne very little undiversifiable risk in achieving this return, which has been almost

Table 5 Performance of efficient portfolios at same risk as the market

	Period 1	Period 2	Period 3
Standard deviation of return (% per month)	5,020	7,861	6,292
Expected return on portfolio (% per month)	2,312	2,392	3,235
Expected return on the market (% per month)	0,804	0,749	1,482
Numbers of times portfolio outperformed the market	2,876	3,194	2,183

four times the Standard and Poors 500 index mean monthly return, because the gold sectors' returns have virtually no covariance with the return on this index. To a SA investor, who is limited to the JSE for his equity investments, the covariance of the gold sector returns with the M index returns is high, which implies that undiversifiable or market risk is also high. Therefore the gold sectors as an asset group have more value to a US investor than a SA investor and should be preferred by the former and not the latter. The unit trust managers tend to act in a manner consistent with this hypothesis.

It was shown that 10 sectors never appeared in any efficient portfolios. These sectors represent 53,6% of the T portfolio compared with 33,8% of the M index for a relative weighting of 1,59. At December 31, 1976, the earliest amalgamated T portfolio, the 10 inefficient sectors represented 55,4% of the T portfolio compared with 33,2% of the M index for a relative weighting of 1,67. This means that, although historically very inefficient, these sectors have been and are currently favoured by unit trust managers to improve future performances. Even if the argument presented above concerning the gold sectors is accepted and these sectors are rebased in the M index at December 31, 1980 to reflect their relative exposure in T (i.e. 6,36% of M instead of 33,0%), the 10 inefficient sectors become 47,2% of the adjusted M index and the relative exposure in T is still greater than unity at 1,14. Three of the 10 sectors concerned, namely Mining Holding, Mining Houses and Industrial Holding, account for 36,2% of the adjusted M or 25,9% of the unadjusted M. This represents 76,6% of the total market capitalization of the 10 inefficient sectors. It is worth noting that companies comprising these three sectors tend to have investments in quoted companies from other sectors of the JSE and/or unquoted companies drawn from all parts of the economy. Therefore it is unlikely that these sectors will have low covariance with the market and, more importantly from the portfolio selection viewpoint, with other sectors. Furthermore, it is unlikely that companies invested largely in the M index will achieve returns significantly different from it. Hence it is theoretically unlikely that these sectors will be selected in efficient portfolios, and this is evident in practice as well.

Unit trust managers are presumed to attempt to act efficiently in the construction of their portfolios. How is it, therefore, that they invest to such an extent in apparently inefficient sectors? The nature of the three sectors discussed above is such that the volatility of earnings performance is likely to be lower than that of other more specialized sectors on the market. For example, an industrial holding company is likely to have its earnings sourced from diverse parts of the economy, which means that if a particular economic sector suffers a downturn, the adverse effect is diluted by the other investments of the company. In other words, the risk, as measured by earnings volatility, is lower for a diversified company than for an individual industrial company in a specific sector. If an investor is prepared to pay a premium for lower risk earnings he may buy shares in such a diversified company in preference to a combination of its underlying holdings, assuming they are available for purchase. The fact that unit trust managers hold shares in the Mining Holding, Mining House and Industrial Holding sectors and the fact that these have proven to be inefficient in terms of the portfolio selection algorithm, produces an interesting conundrum. Either the standard deviation of return is a less correct measure of risk than earnings volatility and therefore the portfolio selection algorithm which has been used extensively in finance theory is wrongly specified, or if standard deviation of return is a more correct measure of risk, then the unit trust managers in South Africa are erroneously prepared to pay premiums for a diversification of risk which they can achieve themselves in the context of their portfolios at no cost.

If the former condition is true, finance theory, and in particular portfolio selection as applied on the JSE, will have to be revised. If the latter condition pertains, it implies that large and sophisticated investors on the JSE are operationally inefficient.

References

1. The Association of Unit Trusts. *Annual Review 1980.* Published by Association of Unit Trusts, Johannesburg, 1981.
2. *The JSE Actuaries Index* (3rd ed.). Published by the JSE Public Relations Department, Johannesburg, March 1982.
3. Markowitz, H.M. Portfolio selection *J. Finance*, 1952, **7**, pp.77 – 91.
4. Jensen, M.C. Risk, the pricing of capital assets and the evaluation of investment portfolios. *J. Bus.*, 1969, **42**, pp.167 – 247.
5. Sharpe, W.F. *Portfolio Theory and Capital Markets.* McGraw-Hill, Inc., 1970, pp.45 – 73.
6. Affleck-Graves, J.F. Portfolio Selection on the Johannesburg Stock Exchange. Unpublished M.Sc Thesis, Cape Town, 1974.
7. Carter, K.J., Affleck-Graves, J.F., Money, A.H. Markowitz Portfolio Selection Applied to Sectors on the Johannesburg Stock Exchange. Technical Report No. STM-7, University of Cape Town, 1982.
8. Carter, K.J., Affleck-Graves, J.F., Money, A.H. Are Gold Shares More Attractive than Gold as a Diversification? Technical Report No. STM-8, University of Cape Town, 1982.