

An analysis of an international set of share indices

INTRODUCTION

It is often suggested in investment circles that the performance of overseas stock markets has a significant bearing on the trend of share prices in South Africa and that the price performance of the different sections of the local market are interrelated. Indeed, technical analysts base their prediction of future share prices on the statistical analysis of historical auto- and cross price associations and have built up a formidable folklore about them. Thus, it is believed, for example, that the Dow Jones Industrial average leads the South African and other industrial markets and that the Dow consistently moves in the opposite direction to gold shares. How valid, however, are these assumptions?

The purpose of the exercise described in this paper was to provide an answer to this question.

STATISTICAL ANALYSIS

In order to assess various index relationships, especially with regard to their predictive capabilities, a multiple regression and correlation analysis was carried out firstly on a set of weekly index values and secondly, on the set of weekly changes in those index values. For example, a sequence from the first set of data might take the form RDM = 250, 255, 253, 258 . . . ; the corresponding sequence from the second set of data would then take the form RDM = +5, -2, +5, The first set of data was used to determine predictive capabilities and interrelationships with respect to the overall level or trend of the various indices, whilst the second set was used to analyse week-to-week index changes.

The data comprised 389 weekly observations of the following six share indices, covering the seven and a half year period from January 1966 to June 1973:

- 1 Dow-Jones Industrial Average (DJ)
- 2 Financial Times (UK) Industrial Index (FT)
- 3 Eurosyndicat (EUR)
- 4 Financial Mail West Wits Gold Index (GOLD)
- 5 Financial Mail Mining Finance Index (MF)
- 6 Rand Daily Mail '100' Industrial Index (RDM)

An index lagged by a certain number of weeks is denoted by the index abbreviation, accompanied by a subscript referring to the number of weeks' lag, e.g. DJ lagged by two weeks is denoted DJ₂.

For investment analysts, the main point of interest lies in the predictive capability of the various indices. The indices of lag zero weeks were, therefore, regarded as dependent variates in the analysis and were excluded from use as predictors of one another. In order to obtain as general a prediction as possible, all indices at all the different lags (excluding lag zero) were considered as possible predictors of the indices at lag

zero. Thus, if any one index could be of significant use in predicting its own value or the value of some other index weeks in advance, this would be reflected in the regressions.

It was decided initially in the exercise to consider lags of one, two and three weeks only. This was done in order to prevent the possibility of indulging in unnecessary and uninformative additional computation and also because prior inspection of the data had suggested that these lags seemed the most appropriate for investigation. Had the subsequent results indicated a trend of increasing association the greater the lag considered, the exercise would have been continued using progressively larger lags for each new computation. But in the event, such a trend was disproved and so it was deemed pointless to continue the exercise using larger lags.

Using all lagged indices as possible predictors, the following were the regressions on the set of weekly index values that were found to be statistically well-established:

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- 1 DJ = 0,96985 DJ₁
 - 2 FT = 0,99979 FT₁ - 0,03051 RDM₃
 - 3 EUR = 0,97482 EUR₁ + 0,00691 FT₁
 - 4 GOLD = 0,84898 GOLD₁ + 0,17277 GOLD₂
 - 5 MF = 0,98263 MF₁ + 0,24967 FT₁ - 0,21050 FT₂
 - 6 RDM = 0,69795 RDM₁ + 0,27035 RDM₂ + 0,02738 FT₁
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The following statistically well-established regressions were generated on the set of weekly changes in the indices:

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- 1 EUR = 0,03581 RDM₃
 - 2 GOLD = 0,13754 GOLD₁
 - 3 MF = 0,22249 FT₂ + 0,20802 RDM₂
 - 4 RDM = 0,58212 EUR₃ - 0,26967 RDM₁
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By substituting into the derived regression equations appropriate values for the independent variates, it is possible to obtain the most accurate prediction possible based on the data used of the value of the dependent variate, namely the index at zero lag.

For example, consider the hypothetical case of a derived regression equation of the form:

$$\text{RDM} = 0,2 \text{ MF}_3 + 0,4 \text{ FT}_2$$

Suppose that the FT is currently standing at 450 and that the MF one week ago was standing at 500. It follows that the most accurate prediction for the value of the RDM two weeks hence is:

$$\text{RDM} = 0,2 \times 500 + 0,4 \times 450 = 280$$

The same principle holds for the regressions on the set of weekly changes in the indices. For example,

suppose that the FT has fallen by 9 points during the week just elapsed and that the MF had risen by 3 points during the previous week. It follows that if the derived regression equation for the weekly changes in the RDM is of the form

$$\text{RDM} = 0,2 \text{ MF}_3 + 0,4 \text{ FT}_2$$

then the most accurate prediction for the change in the RDM during the second week from now over its value at the end of the coming week is:

$$\text{RDM} = 0,2 \times 3 + 0,4 \times -9 = -3$$

The correlation matrices obtained on the two sets of data are shown in Table I and Table II respectively.

The values obtained in the correlation matrix represent measurements of the degree and sign of associations that exist between the indices at different time lags. The values of the measurements can lie anywhere between -1 and 1. A value close to 1 implies a near-perfect positive association; a value close to -1 implies a near-perfect negative association; a value of 0 implies that there exists no association whatsoever between two sets of indices. For example, when with respect to Table I, the correlation between MF and DJ (=0,37) is compared with that between MF and EUR (=0,86), it is found that MF and EUR follow the same trend to a far greater extent than MF and DJ. On the other hand, a comparison of the correlation between MF and GOLD (=0,65) with that of MF and DJ (=0,01) regarding the week to week index changes (Table II) reveals a close association between mining financial and gold share price movements but little connection between changes in MF and DJ. As an additional example, it is interesting to note the value of -0,26 found for the correlation between the weekly changes of RDM and RDM₁. This suggests a slight tendency for industrial shares to change direction of movement from one week to the next.

CONCLUSIONS

Important individual observations to be made from the analysis were as follows:

- 1 There appears to be a general economic force that governs the long-term trend of all share prices, but no such generalisation can be made about short-term price fluctuations.
- 2 DJ is rather independent of other share indices.
- 3 EUR has a remarkably high correlation of trend with MF and RDM.
- 4 MF and GOLD are highly correlated in respect of trend but in the case of week to week fluctuations their correlation is outstanding particularly when compared with the week to week correlations of other indices.
- 5 The trends of RDM and MF are highly correlated but those of RDM and GOLD are not.

In addition, the following two general observations made from the regressions are of particular interest to investment analysts:

- 1 Most of the indices display a tendency to return to trendlines or other functions some time after having departed from them. This suggests that investment

strategy based on technical analysis is fully justified. Based on the same line of reasoning, the notion of random walk is necessarily rejected; the notion of random walk is associated with the idea that successive changes in the values of the indices are determined in completely random fashion so that historical data are of no use whatsoever in determining future values. Acceptance of the notion of random walk would, therefore, have implied that there is no tendency for values to return to some sort of trendline after having departed from it, with the corollary that technical analysis is of no use in predicting future values.

- 2 Predictions relating to any given share index should use the historical data of that index. The cross-association between different indices is, however, significant only at zero time lag. In other words, the indices move in step with one another, and this means that for predictive purposes the association is not of use.

Note

For a more detailed consideration of the statistical and economic aspects of the above analysis, the reader is referred to an article by the same authors that will appear in the March 1974 edition of the South African Journal of Economics.

TABLE I

Correlation matrix of the indices themselves

	DJ	FT	EUR	GOLD	MF	RDM
DJ	1,0					
FT	,63	1,0				
EUR	,34	,65	1,0			
GOLD	,50	,52	,51	1,0		
MF	,37	,65	,86	,75	1,0	
RDM	,29	,52	,76	,30	,77	1,0
DJ ₁	,97	,62	,35	,51	,38	,31
FT ₁	,62	,99	,66	,53	,67	,54
EUR ₁	,33	,64	,99	,51	,86	,76
GOLD ₁	,51	,52	,52	,99	,75	,30
MF ₁	,35	,64	,86	,73	,99	,77
RDM ₁	,27	,50	,75	,28	,76	,98
DJ ₂	,95	,61	,36	,51	,38	,32
FT ₂	,62	,98	,67	,53	,69	,55
EUR ₂	,31	,62	,98	,50	,85	,75
GOLD ₂	,51	,52	,51	,98	,74	,31
MF ₂	,34	,62	,86	,72	,98	,77
RDM ₂	,24	,48	,75	,27	,75	,97
DJ ₃	,92	,60	,36	,52	,39	,33
FT ₃	,61	,97	,68	,54	,70	,56
EUR ₃	,28	,61	,97	,50	,85	,75
GOLD ₃	,52	,51	,52	,98	,74	,32
MF ₃	,32	,60	,85	,71	,98	,77
RDM ₃	,22	,46	,74	,26	,74	,96

TABLE II

Correlation matrix of weekly changes in indices

	DJ	FT	EUR	GOLD	MF	RDM
DJ	1,0					
FT	,19	1,0				
EUR	,38	,19	1,0			
GOLD	-,15	,03	-,07	1,0		
MF	,01	,12	,07	,65	1,0	
RDM	,13	,13	,22	,06	,27	1,0
DJ ₁	,01	,01	,01	,07	,11	,04
FT ₁	,07	-,02	,06	-,10	-,02	,04
EUR ₁	,00	-,03	,07	,04	,09	,04
GOLD ₁	-,02	-,02	,07	-,14	-,05	,00
MF ₁	,01	,02	,08	-,08	-,06	,05
RDM ₁	-,06	,05	,04	-,02	,01	-,26
DJ ₂	-,06	,07	,05	-,10	-,02	,08
FT ₂	,01	,09	,05	,11	,21	,08
EUR ₂	,04	,07	,04	,03	,10	,13
GOLD ₂	,00	-,03	,02	,03	,00	-,03
MF ₂	-,05	-,03	,07	,05	,14	,07
RDM ₂	-,01	,00	-,04	,03	,19	,07
DJ ₃	-,04	,00	,08	-,03	,02	,06
FT ₃	,03	,11	,04	-,04	,05	,05
EUR ₃	-,03	-,02	,09	,00	,05	,01
GOLD ₃	-,01	,03	-,01	,10	,04	,02
MF ₃	-,02	-,02	,04	,00	,00	,11
RDM ₃	,09	-,02	,15	-,02	,00	,07