

The
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Number 23 June 1984

Die
Beleggings-
Navorsers
Tydskrif

Nommer 23 Junie 1984

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Inhoud

This issue in brief

Is a pension fund's investment yield influenced by the size of the fund's assets?

Although it is widely believed that size does influence return in pension fund investment, overseas research has tended to show that this is not so. This paper, by Peter Milburne-Pyle, describes the results of a study undertaken in South Africa along similar lines to studies previously undertaken in other countries. Interestingly, it points to similar general conclusions to those reached abroad.

The role of hedging in the marketing of gold

Since mid-1982, South African gold mines have been permitted to sell part of their production forward in order to secure the dollar value of their export receivables, but it has only been since 5 September 1983 that payment for gold output by the Reverse Bank has been effected in dollars and the mines have been permitted to sell dollars forward for covering purposes. The new situation created by these changes has greatly altered the position of the mines and this has affected the risks to which investors in mining shares are exposed. This paper by Graham Jones presents an outline of the theory of hedging in speculative markets and discusses its practical implications for the marketing of gold itself.

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The Krugerrand premium – an optimal strategy for the Reserve Bank

Since their issue, Krugerrands have sold at a premium above the rand equivalent of the free market gold price and this premium has persisted even since the abolition of the financial rand in February 1983. The premium needs explanation because it suggests that South African investors have a preference for gold in the form of gold coins as opposed to gold yet to be mined. Because the Reserve Bank is a monopoly supplier of Krugerrands, it could benefit from this phenomenon of the premium as long as exchange control vis-à-vis residents remains in force. David Rees examines the problem in some detail in this brief article.

Interest rates, the exchange rate and money supply in South Africa

The high rate of monetary expansion in South Africa in recent years has been a source of concern to all interested in monetary policy formulation. Fluctuations in the gold price complicate analysis and evaluation because they are outside the control of the monetary authorities but cannot escape consideration. This article, by Barr and Kantor, contains an analysis of the determination of deviations from expected interest parity which is essential to any understanding of the association between gold price changes and money supply changes since the early 1970s.

Popular myths: gilt switching

The fourteenth article in our investment basics series deals with the inadequacy of current methods of evaluating switching in the gilt-edged market. Methods are discussed as to how switches might be properly considered.



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The Investment Analysts Journal

Die Beleggingsnavorsers Tydskrif

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"No man is an island, entire of itself; every man is a piece of the continent, a part of the main; if a clod be washed away by the sea, Europe is the less, as well as if a promontory were, as well as if a manor of thy friends or of thine own were; any man's death diminishes me, because I am involved in Mankind; and therefore never send to know for whom the bell tolls; it tolls for thee."

John Donne

Do we stand on the brink of a new dollar crisis? This is a question which an editorial such as this is not designed to answer, but it is a question that it can justifiably consider in present circumstances because of its relevance to the future of the South African financial system. What happens to the dollar is of importance not only because it will affect the price of the country's single largest export, namely gold, it is of importance also because it will have implications for the wider world financial system of which the South African system is only a part. Were a dollar collapse to lead to a world monetary collapse, South Africa would be swept along with everybody else in the flood of disaster that would follow, and that is something in which we would not rejoice whatever the initial favourable consequences for the gold price.

There are a number of reasons why concern about a dollar collapse today is justified despite the currency's remarkable continued strength on world exchange markets in recent months. The first of these relate to the effect of its overvaluation (in purchasing power parity terms) on the competitiveness of US exporters in world export markets. This, clearly, has fallen sharply and can only be ignored by the US authorities while the momentum of domestic economic expansion is sufficient to cause further declines in the rate of unemployment. The extent of the loss of competitiveness and the inroads into domestic markets made by imports is measured by the size of the US external trade deficit which amounted to \$12,2 billion in April alone and could be as large as \$120 billion for the whole of 1984. Such a deficit would compare with a deficit of \$57,6 billion in 1983, itself a record, and one of \$31,8 billion in 1982.

A second cause for worry regarding the dollar relates to the state of the US banking system. Doubts about this have surfaced again because of the troubles of the Continental Illinois bank, the eighth largest in the US, and the dramatic rescue operation that was necessary to prevent its collapse. Although CI's problems arose because of bad debts in respect of domestic advances, the coincident announcement by Bolivia and Ecuador that they were suspending debt servicing payments to commercial banks has raised fears that other US banks with a high Latin American exposure will face liquidity difficulties also. Clearly, any loss of faith in the US banking system could have serious consequences for the maintenance of large US capital inflows irrespective of

Staan ons op die voorrand van 'n nuwe dollarkrisis? Dit is 'n vraag wat uit die aard van die saak nie in hierdie hoofartikel beantwoord kan word nie, maar gesien in die lig van huidige omstandighede is dit geregverdig om hier oorweging daaraan te skenk, aangesien dit betrekking het op die toekoms van die Suid-Afrikaanse finansiële stelsel. Wat met die dollar gebeur is nie net van belang omdat dit die prys van die land se enkele grootste uitvoer, naamlik goud, sal beïnvloed nie; dit is ook van belang omdat dit implikasies inhou vir die algehele finansiële stelsel van die wêreld, waarvan die Suid-Afrikaanse stelsel maar net 'n deel uitmaak. Indien 'n ineenstorting van die dollar aanleiding sou gee tot 'n wêreldwye monetêre ineenstorting, sou Suid-Afrika meegesleur word deur die vloed van rampspoed wat sou volg, en dit is iets waarvoor ons nie verheug sal wees nie, wat die aanvanklike gunstige gevolge vir die goudprys ook al mag wees.

Daar is 'n aantal redes waarom besorgdheid oor 'n dollarineeenstorting vandag geregverdig is ten spyte van dié geldeenheid se merkwaardige volgehoue sterkte op wêreldvalutamarkte die afgelope maande. Die eerste van dié redes hou verband met die uitwerking van die oorwaarderding daarvan (met betrekking tot koopkragpariteit) op die mededingendheid van VSA-uitvoerders op wêrelduitvoermarkte. Dit is duidelik dat dit skerp gedaal het en slegs deur die VSA-owerheid verontagsaam kan word solank die stukrag van binnelandse ekonomiese uitbreiding voldoende is om verdere afnames in die werkloosheidsyfer te veroorsaak. Die omvang van die verlies aan mededingendheid en die inbreuk wat invoere op binnelandse markte gemaak het, word gemeet aan die omvang van die VSA se buitelandse handelstekort, wat net in April op \$12,2 biljoen te staan gekom het en tot \$120 biljoen vir die hele 1984 kan wees. Só 'n tekort kan vergelyk word met 'n tekort van \$57,6 biljoen in 1983, wat al klaar 'n rekord was, en 'n tekort van \$31,8 biljoen in 1982.

Nog 'n rede tot kommer ten opsigte van die dollar hou verband met die toestand van die VSA-bankstelsel. Daar het weer eens twyfel daaroor ontstaan as gevolg van die probleme van die Continental Illinois-bank, die agtste grootste bank in die VSA, en die dramatiese reddingspoging wat nodig was om te verhoed dat dit ineenstort. Hoewel CI se probleme ontstaan het as gevolg van swak vordering ten opsigte van binnelandse voorskotte, het die samevallende aankondiging deur Bolivia en Ecuador dat hulle hul leningsdiensbetalings aan handelsbanke opskort die vrees laat ontstaan dat ander VSA-banke met 'n groot blootstelling aan Latyns-Amerika ook met likwiditeitsprobleme te kampe sal kry. Vanselfsprekend kan enige verlies aan vertroue in die VSA-

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interest rate levels and such inflows are necessary to balance the deficit on current account caused mainly by the massive trade deficit already referred to. The 1984 US current account deficit is likely to be in the region of \$80 billion, less than the trade deficit because of invisible earnings.

Of course, a breakdown of the US banking system would be serious enough in itself for the whole world economy. In the early 1930s, it was the failure of the banks which really was responsible for the depression. Had it not been for the banking collapse, the recession, which had been caused initially by the Wall Street crash, would in all probability not have been long enduring. This is the view not only of Milton Friedman but of other contemporary researchers also.* And it is reasonable to assume that the Fed would provide the reserves necessary to avoid a repetition of that experience. However, the world financial system today is vastly more complex than it was fifty years ago. Beyond the US banking system is the Eurodollar market, and linked to this is a currency system which has at its centre no central bank to act as lender of last resort.

The reasons why the dollar has been so strong during the first half of 1984 have to do with the fact that inflation in the US has remained effectively below 5 per cent per annum while nominal interest rates have been well above this figure. In short, real interest rates have been high in both absolute and relative terms in America. Also, improved growth in the real economy has encouraged capital inflows. But the danger is real that interest rates will have to continue rising if loan funds are to be attracted via the balance of payments and there would seem to be a limit to the extent to which interest rate levels can be pushed upwards without provoking further third world suspensions of debt servicing payments. Interestingly, the demand for credit in the US has been strong, despite the fact that real interest rates have been high, because returns on equity have been sufficient to compensate even for this. But high equity returns have been the consequence of rapid recovery from a very low level of capacity utilisation (69 per cent). This is now approaching the point (85 per cent) where the operating leverage effect will again begin to weaken.

As capacity utilisation increases and as unemployment falls (it is currently around 7,5 per cent of the workforce) the danger of a resurgence of inflation is bound to increase also. What worries many financial analysts in the US, is that a monetising of part of the huge Federal Government deficit (expected to be in the region of \$170 to \$180 billion this year) will add to inflation through a ballooning effect on the monetary stock. Monetising would become unavoidable were the Treasury to be unable to get the funds it required through the issue of long-dated securities without pushing interest rates up to unacceptable levels.

Of course, there is another and less pessimistic scenario. There need not be a dollar collapse if the present rise in US interest rates is sufficient to cool down the economy, if a moderate easing of the dollar is sufficient to restore US export competitiveness and if the third world debt problem is contained by *ad hoc* rescheduling with or without interest rate capping. A cooling of the US economy coincident with improved growth in the rest of the OECD area would probably result in an orderly downward adjustment of the US trade deficit. But that is in the short term, ie between now and 1986. What remains a source of nagging concern is the long-term position of the third world countries. They are in structural deficit on BoP current account and no amount

bankstelsel ernstige gevolge vir die handhawing van groot VSA-kapitaalinstromings inhou, ongeag rentekoerspeile, en dié instromings is nodig om die tekort op lopende rekening, hoofsaaklik as gevolg van die geweldige handelstekort, te balanseer. Die VSA se tekort op die lopende rekening vir 1984 sal waarskynlik ongeveer \$80 biljoen wees, wat minder is as die handelstekort, as gevolg van onsigbare verdienste.

Natuurlik sou 'n ineenstorting van die VSA-bankstelsel op sigself al ernstig genoeg wees vir die hele wêreldekonome. In die vroeë dertigerjare was dit die mislukking van die banke wat in werklikheid vir die depressie verantwoordelik was. Was dit nie vir die ineenstorting van die banke nie, sou die resessie, wat aanvanklik deur die Wallstraat-ineenstorting veroorsaak is, na alle waarskynlikheid nie so lank geduur het nie. Dit is nie net die beskouing van Milton Friedman nie, maar ook van ander hedendaagse navorsers.* En dit is redelik om te veronderstel dat die "Fed" die reserwes sal verskaf wat nodig is om 'n herhaling van dié ondervinding te vermy. Die hedendaagse finansiële stelsel van die wêreld is egter ontsettend meer kompleks as wat dit vyftig jaar gelede was. Anderkant die VSA-bankstelsel lê daar die Eurodollarmark, en gekoppel daaraan is 'n valutastelsel wat geen sentrale bank as kern het om as kredietverlener in laaste instansie op te tree nie.

Die redes waarom die dollar gedurende die eerste helfte van 1984 so sterk was, het te doen met die feit dat inflasie in die VSA effektief onder 5 persent per jaar gebly het terwyl nominale rentekoerse heelwat bokant dié syfer was. Kortom, reële rentekoerse in Amerika was absoluut en relatief gesproke hoog. Dan het verbeterde groei in die reële ekonomie ook kapitaalinstromings aangemoedig. Maar daar bestaan 'n wesenlike gevaar dat rentekoerse sal moet voortgaan om te styg om leningsfondse deur middel van die betalingsbalans te lok, en dit wil voorkom of daar perke is aan die mate waarin rentekoerspeile opwaarts gedruk kan word sonder om verdere opskortings van leningsdiensbetalings deur die derde wêreld uit te lok. Dit is interessant dat die vraag na krediet in die VSA sterk was ten spyte van die feit dat reële rentekoerse hoog was, aangesien die opbrengs op ekwiteit voldoende was om selfs dit te vergoed. Maar hoë ekwiteitopbrengste was die gevolg van spoedige herstel van 'n baie lae peil van kapasiteitbesetting (69 persent). Dit nader nou die punt (85 persent) waar die besettingshefboomuitwerking weer sal begin verswak.

Namate kapasiteitbenutting toeneem en namate werkloosheid afneem (dit is tans ongeveer 7,5 persent van die arbeidskorps) sal die gevaar van 'n herlewing van inflasie na alle waarskynlikheid ook toeneem. Wat baie finansiële ontleders in die VSA tot kommer stem, is dat 'n omsetting in geld van deel van die groot Federale Regeringstekort (wat na verwagting dié jaar naasteby \$170 - \$180 biljoen sal wees) tot inflasie sal bydra deur middel van 'n inflerende uitwerking op die monetêre voorraad. Omsetting in geld sou onvermydelik word indien die Tesourie nie in staat sou wees om die fondse wat hy nodig het te verkry deur middel van die uitreiking van langtermynneffekte sonder om rentekoerse tot onaanvaarbaar hoë peile op te druk nie.

Daar is natuurlik 'n ander, minder pessimistiese, scenario. Daar hoef nie 'n dollarineenstorting te wees nie, indien die huidige styging in VSA-rentekoerse voldoende is om die ekonomie te laat afkoel, indien 'n matige verruiming van die dollar voldoende is om VSA-uitvoermededingendheid te herstel en indien die skuldprobleem van die derde wêreld deur ad hoc-herkedulering, met of sonder groter terugbetalings, bekamp kan word. 'n Afkoeling van die VSA-ekonomie, gepaard met verbeterde groei in die res van die OESO-gebied, sal waarskynlik 'n ordelike aanpassing na onder van die VSA-handelstekort tot gevolg hê. Maar dit is op die kort termyn, d.i. tussen nou en 1986. Wat steeds 'n bron van tergende kommer is, is die langtermynposisie van die lande van die derde wêreld. Struktureel het hulle

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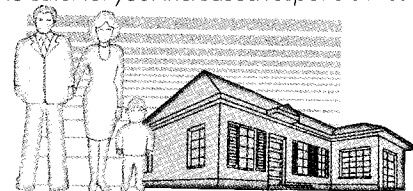


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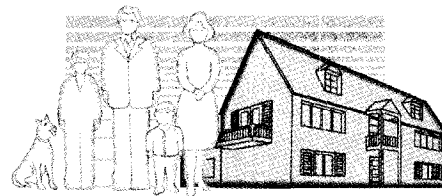


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of international financial fiddling is likely to change that. Nor will the fundamental deficit position be changed by the cyclical improvement currently being experienced because of the upswing in US, Western European and Japanese demand for LDC exports. Any correction in the US balance of payments deficit will necessarily involve a shifting of deficit onto others, and the LDCs are not well positioned to evade the consequences.

However, structural deficits with developing countries should not in themselves be a problem. Indeed, they are what one would expect. Growing economies lacking an adequate capital base must be capital importers. This has been so with South Africa, and other countries not yet as advanced industrially are no different. The problem has to do with how such deficits are financed. Ideally they should be financed by risk capital, or at least largely by such capital. They have not been so financed because of third world ideological resistance and multinational concern about expropriation. Going the loan capital route, and especially in putting so much emphasis on short-term financing, has imposed an enormous strain on Western commercial banks, and it is this that now needs attention. The point is that the commercial banks have reached the near limit of their LDC lending capacity and will have from now on to contain the proportion of LDC debt in their portfolios of advances if there is not to be a serious deterioration in their lending ratios.

The involvement of the commercial banks on so large a scale anyway was not ideal but was the way things happened after the oil crises of 1973/74 and 1979/80. The recycling of Opec surpluses would better have been done by international agencies such as the IMF and the World Bank or by government agencies in the developed countries. Such agencies, now, will have to assume a greater financing role if there is to be any chance of an enduring solution. Alternatively, but perhaps less likely, would be a change in third world attitudes and policy designed to welcome, and to make secure from the threat of expropriation, the risk capital that would be the proper financing alternative. We are beginning, perhaps, to see a glimmer of hope in this direction (witness the Nkomati Accord and the opening up of Mozambique to private investment from South Africa), but it is too soon yet for the drawing of firm conclusions here.

The really important lesson to be drawn, however, from the whole problem of third world debt financing relates not to banking technicalities but to something else. The world we live in cannot be compartmentalised any longer. The prosperity of industrialised countries cannot be maintained separately from the poverty of the third world. If third world countries are not given access to the markets of industrialised countries, they (the LDCs) will not be able to service their debts, and if debts are not serviced, ultimately the prospect of a collapse of the world financial system will have to be faced. This is the significance of the statement quoted at the beginning of our editorial.

The Editor

'n tekort op hulle betalingsbalans op die lopende rekening, en dis onwaarskynlik dat enige mate van internasionale finansiële gepeuter dit sal verander. Verder sal die fundamentele tekortposisie ook nie verander word deur die sikliese verbetering wat tans ondervind word as gevolg van die toename in die vraag na MOL-uitvoere in die VSA, Wes-Europe en Japan nie. Enige regstelling in die VSA-betalingsbalanstekort sal noodwendig 'n oordra van die tekort na ander lande behels, en die MOL'e verkeer nie in 'n goeie posisie om die gevolge vry te spring nie.

Strukturele tekorte by ontwikkelende lande behoort egter nie op sigself 'n probleem te wees nie. Dit is inderdaad wat 'n mens te wagte moet wees. Groeiende ekonomieë wat nie 'n voldoende kapitaalbasis het nie, moet kapitaalvoerders wees. Dit was die geval met Suid-Afrika, en ander lande wat industrieel nog nie so gevorderd is nie, verskil geensins nie. Die probleem het te make met hoe dié tekorte gefinansier word. Ideaal gesproke moet dit deur middel van risikokapitaal, of in elk geval grootliks deur middel van sodanige kapitaal, gefinansier word. Dit was nie die geval nie as gevolg van ideologiese weerstand deur die derde wêreld en veelvuldige besorgdheid oor onteiening. Die inslaan van leningskapitaalpaadjie, en veral die beklemtoning van korttermynfinansiering, het 'n geweldige stremming op Westerse handelsbanke geplaas, en dit is dié kwessie wat nou aandag moet geniet. Dit gaan hier om die feit dat die handelsbanke byna die perk van hulle MOL-leenkapasiteit bereik het en voortaan die verhouding van MOL-skuld in hulle voorskotportefeuljes sal moet inperk om 'n ernstige verslegting in hulle leenverhoudings te voorkom.

Die betrokkenheid van die handelsbanke op so 'n groot skaal was in elk geval nie ideaal nie maar was maar net die verloop van dinge na die oliekrisis van 1973/4 en 1979/80. Die hersirkulering van OPEC-surplusse moes eerder deur internasionale instellinge soos die IMF en die Wêreldbank of deur staatsinstellinge in die ontwikkelde lande waargeneem gewees het.

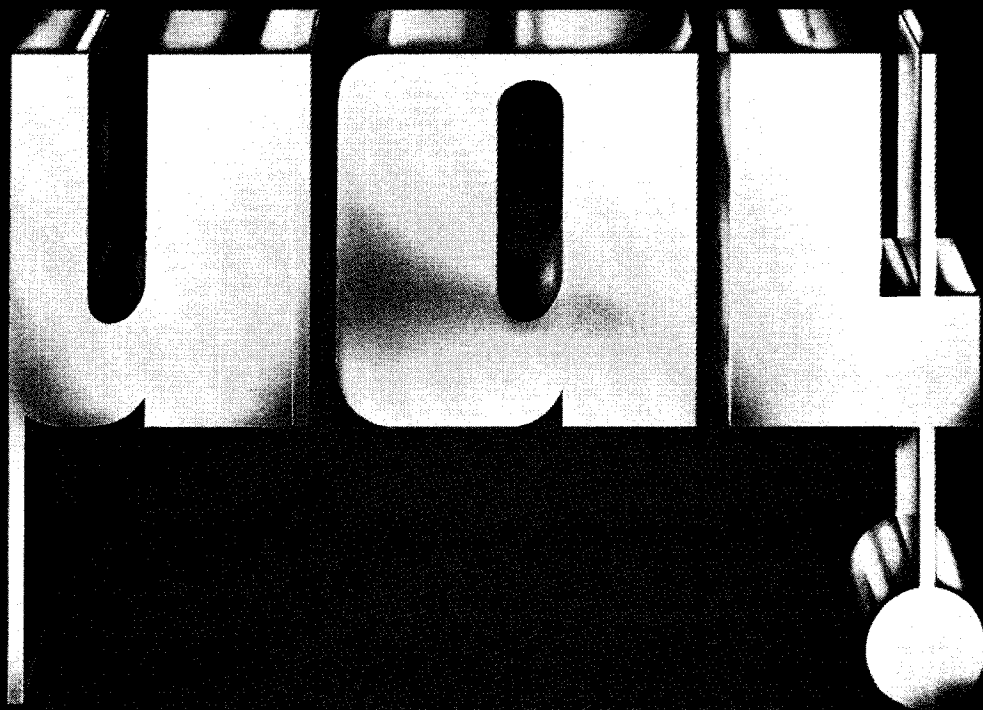
Dié instellinge sal nou 'n groter finansieringsrol moet aanneem om enigsins 'n kans op 'n blywende oplossing te bied. 'n Ander moontlikheid, wat egter miskien nie so waarskynlik is nie, is 'n verandering in die houdings van die derde wêreld en 'n beleid wat daarop ingestel is om die risikokapitaal wat die behoorlike finansierings-alternatief sou wees te verwelkom en teen die bedreiging van onteiening te beveilig. Ons begin miskien nou 'n straaljie van hoop in dié rigting te sien (waarvan die Nkomati-ooreenkoms op die oopstel van Mosambiek vir private belegging deur Suid-Afrika getuig), maar dit is nog te vroeg om in dié opsig tot besliste gevolg-trekkings te geraak.

Die werklike belangrike les wat daar egter te leer is uit die hele probleem van die leenkapitaalfinansiering van die derde wêreld hou nie verband met tegniese bank-besonderhede nie, maar met iets anders. Die wêreld waarin ons leef kan nie meer in kompartemente verdeel word nie. Die welvaart van geïndustrialiseerde lande kan nie afsonderlik van die armoede van die derde wêreld gehandhaaf word nie. Indien die lande van die derde wêreld nie toegang tot die markte van geïndustrialiseerde lande gebied word nie sal hulle (die MOL'e) nie hulle leningskuld kan bybring nie, en indien leningskuld nie betaal word nie, sal die vooruitsig van 'n ineenstorting van die wêreld se finansiële stelsel in die gesig gestaar moet word. Dit is waarin die belang van die aanhaling aan die begin van ons hoofartikel lê.

Die Redakteur

*See *The Great Depression, 1929-38: Lessons for the 1980s* by the French economist Christian Saint-Etienne (published by the Hoover Institution, Stanford) and reviewed by Samuel Brittan in the London Financial Times, 31 May 1984.

*Kyk *The Great Depression, 1929-38: Lessons for the 1980s* deur die Franse ekonoom Christian Saint-Etienne (uitgegee deur The Hoover Institution, Stanford) en geresenseer eur Samuel Brittan in die London Financial Times, 31 Mei 1984.



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"Is a pension fund's investment yield influenced by the size of the fund's assets?"

1 ABSTRACT

The question is occasionally asked whether the investment yield achieved on the assets of a pension fund in South Africa is liable to be influenced, adversely or otherwise, by the size of the fund's assets.

Statistical tests conducted overseas have tended to suggest that there is no noticeable correlation between size and yield. Nevertheless it seemed that an investigation could with advantage be carried out on the basis of South African conditions, to establish whether any different result would emerge here.

This paper sets out the results of such an investigation. They point to the same general conclusions as those arrived at overseas, but in the process certain pertinent questions arise.

2 INTRODUCTION

2.1 From the early 1970s, increasing attention has been paid in South Africa to the part played by the investment yield in the financial condition of a pension fund, particularly a fund providing pensions based upon earnings at or near retirement.

It has long been recognised that the investment yield was effectively the only element, out of the several factors influencing the eventual cost of a pension fund's benefits, that the trustees of the fund could control reasonably directly. In practice, however, the point seemed to be regarded as being of academic importance, until the early seventies when the adverse effect (on pension fund finances and benefits) of an increasing rate of inflation began to be felt. Thereafter interest rapidly grew in the need to optimise investment returns and thereby to mitigate the effects of inflation.

Two developments in particular have helped to focus attention on this subject:

(a) The establishment in 1971 of the "Investment Performance Survey", an arrangement whereby the investment yields achieved by privately administered pension funds could be calculated on a consistent basis, compared and analysed. The early results were, to say the least, enlightening, and membership of the Survey grew steadily as a result.

The background to, development of, and results achieved by the Survey to the end of 1978 were described in a paper presented to the 1979 Convention of the Actuarial Society of South Africa⁽¹⁾.

(b) The growth of life office "managed" pension funds, providing each managed fund client with a reasonably direct participation in the investment returns achieved by the life office on the assets underlying the office's managed pension fund investment portfolio; and the intense competition that in the process developed between life

offices in respect of managed pension funds, centred largely upon investment performance.

2.2 An aspect of the subject that began to attract particular attention was whether or not the yield achieved on a pension fund's assets was influenced – adversely or otherwise – by the size of the fund's assets. Opposing arguments were put forward. Some quarters, particularly certain life offices, contended that "bigger meant better", on the argument that performance was more stable, access to attractive investment opportunities was greater, and investment research was more extensive, in the case of the larger portfolios (such as a typical life office pension fund investment portfolio) than in the case of smaller portfolios (such as that of many a privately administered fund). Dare one suggest that this view was not unaffected by marketing considerations? Other quarters contended that large portfolios were inhibited by their size from implementing an active investment policy, and maintained that smaller investment units were likely to produce superior investment yields because of their greater freedom of movement.

This latter argument was one of several influences leading to the concept of "split-funding" – dividing the investment management of a pension fund between two or more managers, in the expectation that the smaller investment units thereby involved would lead to a better overall result than otherwise, either by way of a higher yield or a lower degree of risk or both.

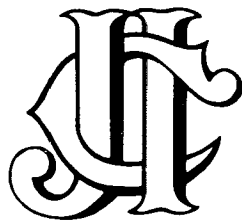
2.3 Interest in the subject arose from yet another quarter. The Investment Performance Survey uses an inter-fund comparison to determine the success or otherwise of individual funds' investment results, combining all participants for this purpose notwithstanding possible differences in respect of size, level of cash flow, nature of the fund's liabilities, constraints on the investment manager, or the level of risk that was acceptable to the trustees.

This combining process was adopted because it was considered unlikely that differences between participating funds in respect of the named influences were in practice of such significance in South Africa as to justify a subdivision of the results on this account. D. P. Hager² held a similar view as far as the United Kingdom was concerned. Investment risk had in any event been subject to specific investigation by the Survey, as far as investment in equities was concerned, and it was found that in general the degree of risk undertaken did not appear to vary significantly between funds.

To the author's knowledge all participants in the Survey have accepted the "combined" approach, save only for the question of size. In recent years the larger funds have increasingly tended to request supplementary comparisons



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based only on the other large participants, and in response to this the report of the Survey on the performances produced for 1982 showed certain of the results for the first time in three broad groupings according to size.

- 2.4** Against the background of the foregoing, the need has frequently arisen to express an opinion to clients on the issue of yield relative to the size of the fund. The enquiry could emanate from the trustees of a large fund who were contemplating split-funding as an apparent means of improving the overall yield. In other instances a proposal might be under consideration to merge the investment management of two or more separate funds, on the "bigger is better" philosophy.

In the absence (to the author's knowledge) of any published research into the matter in South Africa these enquiries have up to now had to be dealt with on general considerations. Coefficients of correlation between size and yield that have been calculated tend to support the overseas view that there is no significant association between these two elements. However, clients do not readily accept the evidence of a single, sophisticated statistic, and it became clear that a more fundamental analysis of the problem was needed. Such an investigation has therefore now been carried out, and as it was thought that the results might be of reasonably wide interest they were used as the basis for this paper.

- 2.5** Certain caveats must be recorded at the outset. Firstly, the investigation has had to be confined to data that were readily available (described in the next section). The author would fully agree that the use of more detailed information would have been desirable, but this was not possible within the various practical constraints applying. Nevertheless, it was felt that the data that were available, even with their shortcomings, could still provide a useful pointer to the answer that was being sought, and would indicate whether there would be anything to be gained by undertaking a more detailed data collecting process.

Secondly, the essential question considered was whether the size of the *fund* was a significant factor. It has been suggested that the size of the fund may not accurately reflect the volume of assets involved in a particular instance, for example if the investments of the fund were being managed by a merchant bank along with those of many other funds. The data available to the author for the purpose of this investigation unfortunately do not enable this alternative suggestion to be investigated in detail, but it is discussed later in general terms.

Thirdly, notwithstanding the aforementioned coefficients of correlation, the author has endeavoured to conduct this investigation with no preconceived ideas as to the result likely to emerge, or even whether a result would emerge at all. The approach has been to assemble the available figures in an appropriate form, and let them speak for themselves. No data have been excluded solely on the grounds of being "out of pattern".

Fourthly, every endeavour has been made to avoid introducing a subjective assessment of what constitutes a "small", a "medium" or a "large" fund. The concern has throughout been on the relativity of size, i.e. whether one fund is smaller or larger than another.

- 2.6** The paper first describes the data that were available for the purposes of the investigation; it then sets out the process that was applied to the data; the results of the investigation are given and commented upon; and finally various associated matters (such as "split-funding") are discussed.

3 DATA AVAILABLE

- 3.1** The investigation was based primarily upon data derived from the funds participating in the Investment Performance Survey. A certain amount of further data was, however, available to the author in respect of the managed pension fund investment portfolios of many of the life offices operating in this field in South Africa, and although in certain respects (for example, the basis of determination of market values) the method of operation of these is not entirely consistent with that of the Survey funds, these additional data were used as well in the interests of obtaining the maximum amount of experience. It was not considered that any such inconsistencies would invalidate the conclusions reached in this paper.

- 3.2** The pension funds participating in the Investment Performance Survey consist, as previously indicated, primarily of privately administered funds, although there are a few participants whose assets consist wholly or largely of investments in life office managed pension fund portfolios.

At the end of 1982 the Survey participants numbered 93, and the total of their monitored assets at market value was some R6 700 million. The life office data used covered 9 offices, with total managed fund assets having a market value of some R974 million at the end of 1982.

- 3.3** The pension funds participating in the Survey are mostly the clients of three firms of consulting actuaries operating in South Africa. Each firm deals with its own clients in respect of the collection and processing of the necessary data, and the individual firms' results are aggregated in the annual report published by the Survey.

In respect of Survey participants part of the data required for this investigation were readily available from Survey reports, and the aforementioned three firms agreed to supply the remaining data. The managed fund data were supplied to the author by the life offices concerned.

- 3.4** It has been suggested that the pension funds participating in the Investment Performance Survey are a "select" group, by virtue of having sufficient interest in optimising their investment results to justify incurring the cost of participation. This is undoubtedly true; there are obviously many more than 93 privately administered pension funds in South Africa.

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However, it is this very fact of selectivity that makes the Survey participants an ideal basis for this investigation into the relationship between size and yield, because the results of the investigation will not have been distorted by lack of interest on the part of the trustees of the funds.

And as far as managed funds are concerned, competition between life offices will ensure that there is no lack of interest in the competitiveness of the yields produced.

- 3.5 Each fund provides data on a quarterly basis in such form as to enable the "internal rate of return" for the quarter to be calculated. These quarterly yields are then compounded to produce the yields required over longer periods; in other words, over these longer periods the calculation produces the "linked internal rate of return", as a practical approximation to the "time weighted rate of return".
- 3.6 The data for the Survey are supplied separately in each of the categories gilts and semi-gilts, other fixed interest (e.g. debentures), equities, deposits and cash. Yields are calculated in respect of gilts and semi-gilts, other fixed interest, deposits, all fixed interest (i.e. the foregoing three categories combined), equities, and overall (i.e. all categories combined). The managed fund data are only supplied in total, covering the aforementioned investment categories as well as the additional category of property investments.
- 3.7 For the purpose of this investigation the overall yields achieved by the participating funds in each of the calendar years 1975 to 1982 inclusive were recorded, as well as the market value of the monitored assets of each fund as at the end of each of the calendar years 1974 to 1982 inclusive. The assets in question were those taken into account in calculating the overall yields, and as will have been seen, in the case of Survey funds these assets excluded direct property investments. Direct property investments have up to now had to be excluded from the Survey calculations because of the near impossibility of arriving at reliable and consistent market values to be used by all funds in respect of this category. Although it now appears that a solution to this problem is in sight, it has not been possible to take advantage of the available data.

Omitting the influence of direct property investments in the case of Survey funds could well play a part in the drawing of conclusions on the subject of this investigation because it tends to be the larger funds that are able to invest money in the area. The point will be returned to later on in this paper. The fact that the life office managed fund results include the effect of property investments was not seen as a significant drawback to their inclusion because the number of life office participants in this investigation is small in relation to the total.
- 3.8 The geometric mean annual overall yields on the participating funds over the five years up to the end of each of 1979, 1980, 1981 and 1982 were also recorded, in order that a further investigation could take place that reduced the

possibility of the results being distorted by temporary fluctuations over periods as short as one year.

4 PROCESS APPLIED

- 4.1 The basic process applied to the data assembled was to prepare, in respect of each measurement period involved, a schedule relating the overall yields achieved by the participating funds to the respective assets "exposed" to producing those yields. In the case of a life office, the "fund" in this context consisted of the investment portfolio applicable to all of the office's managed fund clients where the office has full investment discretion.

Thus in respect of each fund participating for the calendar year 1975, the arithmetic mean of the market values of the fund's monitored assets as at the beginning and the end of the year was calculated. These funds were then scheduled in ascending order of this mean market value, recording against each the corresponding overall yield for the year. The process was then repeated for each of the years 1976 to 1982 inclusive.

This process was also carried out using five-year annual geometric mean yields, the yields being related to one-fifth of the total of the mean market values in each of the five years concerned.

- 4.2 The mean market values were intended to represent the amount of assets "exposed" to producing the yields plotted against them. Although it would have been preferable to base a figure upon quarterly market values to be consistent with the basis of calculation of the yields, this was impracticable from the data collection point of view. It was felt that the simpler method that had to be used would not invalidate the trend, which was after all the object of the exercise.
- 4.3 The next step was to consider the aforementioned schedule relative to each measurement period, and then to determine the trend (if any) of the yield as the mean market values increased. Thereafter the trends exhibited by the various measurement periods were compared with each other to see if there was any consistency between them. The results are discussed in the next section.

5 RESULTS

5.1 The calendar year 1982

This measurement period was selected for detailed discussion, as it represents the period containing the maximum number of observations. The data for this period covered 102 funds, 93 from the investment performance Survey and 9 life office managed funds. The mean market values of these funds over 1982 totalled R6,7 billion.

The 1982 observations may be conveniently summarised as follows. The various tests that were applied of course dealt with the funds separately, not in groups.

Table I

Mean market value (Rm)	Number of funds	Mean yield %
0-10	32	27,1
10-20	16	22,9
20-30	15	27,4
30-40	3	25,1
40-50	3	29,4
50-60	4	27,1
60-70	4	28,9
70-80	4	21,9
80-90	1	22,7
90-100	3	27,7
100-110	3	26,5
110-120	1	37,2
120-130	1	26,6
Above 130	12	26,4
	102	26,3

The preponderance of smaller funds in the data for 1982 is unfortunately all too obvious from the above summary. An alternative summary in terms of yield, however, shows a somewhat more normal distribution, as illustrated by Table II.

Table II

Yield %	Number of funds
10,01-12,00	2
12,01-14,00	1
14,01-16,00	-
16,01-18,00	2
18,01-20,00	4
20,01-22,00	8
22,01-24,00	12
24,01-26,00	16
26,01-28,00	26
28,01-30,00	15
30,01-32,00	6
32,01-34,00	2
34,01-36,00	1
36,01-38,00	4
38,01-40,00	1
40,01-42,00	1
42,01-44,00	-
44,01-46,00	1
	102

Mean yield 26,3% Median yield 26,6%

The first point now to be considered is whether the volume of data available are sufficient to enable the drawing of reasonably sound conclusions. The weighting of the data towards the smaller funds is unfortunate in this regard; nevertheless 33 funds each represented assets of R50 m and greater, and at the risk of introducing a subjective assessment of what constitutes a large fund, it is suggested that the large funds are still suitably well represented. It seems safe to conclude that the 1982 data were sufficient for the purpose of this investigation.

From a consideration of Table I it would seem that there was no discernable trend of yield as the size of the funds increased. Visual conclusions can, however, be misleading, and it was

clearly necessary for these to be backed up with mathematical demonstrations.

An approach that had both visual and mathematical appeal was that of fitting a straight line to the observed yields, using a technique such as the method of least squares, and determining the slope of the line. This approach initially encountered the statistical objection that the method of least squares had an inherent assumption of normality of both variables, whereas, as will be seen from Tables I and II, only the yield was normally distributed – the market value was positively skewed. However, the author understands that there is a body of opinion that holds that a regression technique such as the method of least squares may still validly be used as long as the dependent variable (in this instance the yield) is normally distributed (which it is). Furthermore, it is also argued that the lack of normality of a variable only becomes significant if one is attempting to arrive at the parameters governing the population, and that it is not objectionable if the technique is merely being applied to determine the relationship between the variables.

On these grounds it was decided to fit a straight line as described. The line was defined by

$$Y_F^1 = \bar{Y} + \frac{\sum (M_F - \bar{M}) Y_F}{\sum (M_F - \bar{M})^2} * (M_F - \bar{M})$$

or more simply

$$Y_F^1 = \alpha + \beta * (M_F - \bar{M})$$

where Y_F = Overall yield achieved by the fund concerned over 1982,

M_F = Mean market value of the fund over 1982, and

\bar{Y} and \bar{M} = Mean values of Y_F and M_F respectively.

The significant element of the foregoing expression is the value of β , governing the slope of the straight line, because this indicates whether or not there is any correlation between size and yield. A β in the region of zero would indicate an absence of any noticeable degree of correlation; correspondingly the further β moves away from zero (positively or negatively) the stronger the indication of a positive or negative correlation respectively between size and yield.

In respect of 1982 the value of β was $-0,00369$, indicating that a change in the size of the fund exerted a minimal effect upon the yield, thereby confirming the lack of correlation in 1982 already indicated by a visual inspection of the data.

To eliminate any possibility that the objection to the use of a regression technique when the variables are not both normally distributed, might still be upheld, it was decided to apply a further, non-parametric, test to the data. The method chosen was the Spearman rank correlation coefficient, which was for a while used

by the Investment Performance Survey to determine whether there was any tendency for funds consistently to out-perform or under-perform others. In that instance the variables were the ranks of each fund in successive pairs of years; whereas for this investigation the variables were the rank of each fund according to mean market value and the corresponding rank of the fund's yield. For practical purposes no special adjustment was made to allow for ties.

The coefficient was defined by

$$1 - \frac{6 \sum (d_i)^2}{n(n^2-1)}$$

where d_i = (rank of mean market value minus rank of yield) of fund i and there are n funds. For 1982 the value of the coefficient was calculated to be 0,0209, and application of the appropriate decision rule (at the 95% confidence level) to this result led to the conclusion that the rank of the mean market value in 1982 was independent of the rank of the yield for that year; i.e. there was once again no correlation between the two variables indicated by this test.

The Spearman coefficient is widely accepted as being one of the most sensitive measures of association between two variables. For the sake of completeness, however, the normal coefficient of correlation between the actual values of the variables in 1982 – not their ranks – was also calculated; not surprisingly this emerged at the low figure of –0,09.

Returning to the question of applying a regression technique to the data, consideration was given to applying a logarithmic transformation to the data, to reduce the skewness, and then to apply the technique to the transformed data. It seemed, however, that the point had by now been sufficiently clearly established from the tests that had been applied – i.e. that correlation did not exist in 1982 to any significant extent – to make this further test superfluous.

So much for 1982; now for the other measurement periods.

5.2 The years 1975 to 1981

The data for these years were subjected to the same investigations as those described for 1982. The following summary will give the reader a feel of the nature and extent of the data:

Year	Number of funds	Total mean market value	Mean market value		Yield	
			Mean	Median	Mean	Median
		Rm	Rm	Rm	%	%
1975	22	175,90	8,00	6,25	9,13	9,10
1976	29	281,95	9,72	5,90	2,42	2,10
1977	40	423,80	10,59	7,20	20,50	20,75
1978	57	927,50	16,27	8,85	27,79	27,40
1979	69	1 838,50	26,64	13,05	36,29	35,70
1980	86	4 101,90	47,70	16,40	15,30	16,30
1981	98	5 330,40	54,39	19,85	10,03	9,90

Several features are readily apparent. One is that the data in 1975 and 1976 were rather sparse, and could thus be unreliable for the purpose of drawing any conclusions. There may even be a question mark over 1977. Another is that the steady growth in participation in the Investment Performance Survey (the primary source of the data) already referred to is clearly illustrated; in this context it will also be noticed, from the steadily widening gap between the median of the mean market values and the mean of these values, that the growth in participation was due primarily to the smaller funds, and this could lead to an interesting philosophical discussion. A third is that the feature of the data distribution for 1982 – market values skewed and yields normal – was present in the earlier years as well.

The tests applied to the 1982 data were also applied to these earlier years, and the results may be summarised as follows (with the 1982 results repeated for completeness):

Year	β	Spearman coefficient	Correlation coefficient
1975	0,15591	0,37662	0,37
1976	0,08999	0,24335	0,30
1977	0,08998	0,33360	0,29
1978	0,00914	0,24909	0,06
1979	-0,02105	-0,08897	-0,12
1980	-0,00986	-0,15579	-0,17
1981	0,00162	0,21947	0,05
1982	-0,00369	0,02090	-0,09

In the case of two of these years – 1977 and 1981 – the decision rule applied to the Spearman coefficient indicated that an element of correlation between the two variables could not be ruled out entirely, although the other measures seemed to be clear in reflecting a lack of correlation. In all of the other years the Spearman coefficient was such as to indicate an absence of correlation.



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5.3 The five-year periods

The data available may be summarised as follows:

Period	Number of funds	Total mean market value	Mean market value		Yield	
			Mean	Median	Mean	Median
		Rm	Rm	Rm	% p.a.	% p.a.
1975-1979	22	318,66	14,48	9,41	18,67	18,40
1976-1980	29	545,53	18,81	11,93	20,42	20,50
1977-1981	40	915,53	22,89	13,78	22,26	22,15
1978-1982	54	1 885,02	34,91	17,62	23,11	23,40

The tests applied to these data produced the following results:

Period	β	Spearman coefficient	Correlation coefficient
1975-1979	0,09169	0,61717	0,69
1976-1980	0,03552	0,38177	0,45
1977-1981	0,03232	0,33265	0,36
1978-1982	0,00607	0,23331	0,09

In respect of only one period - 1978 to 1982 - did the application of the decision rule to the Spearman coefficient indicate a clear absence of correlation between size and yield. In each of the other three periods the conclusion was that correlation could not entirely be ruled out, although the size of the β would seem to indicate that such correlation as might have existed was relatively mild.

5.4 General

The picture presented by the slightly crude approach of fitting a straight line to the yields plotted against mean market value, is generally one of lack of correlation between size and yield. The very fact that the slope of the line can vary from positive to negative itself confirms this impression.

The more sensitive Spearman coefficient, however, sounds a note of warning, and in a few instances indicates that correlation cannot be ruled out. These instances occur particularly when periods of five years are considered, and in addition are accompanied by small positive values of β ; in other words they tend to suggest that when longer periods of measurement are considered, larger funds may have a marginal edge over smaller funds.

5.5 Other considerations

Before endeavouring to draw final conclusions from the foregoing figures, however, there are certain other considerations that need to be discussed as they could well have a bearing. They are the investment climate in which the observed results were achieved; the degree of statistical "efficiency" in the South African ordinary share market; direct property investments; and the definition of the word "size". These are dealt with in the following four sections of this paper.

6 THE INVESTMENT CLIMATE

6.1 It is of interest to consider to what extent, if any, the investment climate obtaining in each year

of the investigation might have had the effect of distorting the theoretically true results. Clearly, if any of the periods considered were such that no particular degree of activity was required on the part of the investment manager in order to maximise the fund's yield, any inhibiting effect of size upon investment activity that might have existed would not have shown itself.

It is assumed in the following discussion that by definition an active investment policy should produce a better yield than a passive one.

6.2 During 1975 interest rates rose, and ideally activity was required in the fixed interest sector by way of an advance reduction in the outstanding term of these investments. Equities had mixed fortunes, with industrials rising and minings and mining financials falling. In short, a year in which activity theoretically held the possibility of improving yields.

However, at that stage there was little market available in the fixed interest sphere in South Africa, and thus such activity as was adopted would have been restricted to the equity area (where it was useful but not essential). Therefore, even if small funds were in fact able to be more active than large funds, their opportunities for proving this were limited and the investment results for 1975 are consequently not of much assistance in this investigation, quite apart from their paucity.

The standard deviation of the yields produced in 1975 by the Survey participants was 2,4 and the mean yield was 9,1%, indicating a reasonably wide distribution of the yields about their mean. This seems to confirm the earlier point that 1975 was not a year to be passive; had it been yields would have been more closely bunched about their mean.

6.3 In 1976 interest rates rose initially then levelled off. The equity market fell generally. Activity was thus desirable, mainly in the equity area, but considering the low mean yield of all participants in that year, it seems that for one reason or another activity was absent or unsuccessful. There was thus little test of the potentially inhibiting effect of size upon activity.

The standard deviation of the Survey yields in 1976 was 2,6 and the mean yield was 2,4%, indicating a very wide range of yields. The final comment on 1975 could be repeated here.

6.4 1977, 1978 and 1979 were an investment manager's dream. Interest rates declined steadily and the share market remained strong.

Good yields were possible with little or no effort; and even if there had been inherent differences between funds of different size, in terms of ability to implement an active investment policy, these would in the circumstances probably not have shown up during these three years.

The standard deviations of the Survey yields in these three years were respectively 2,9, 4,7 and 6,8 and the corresponding mean yields were respectively 20,5%, 27,8% and 36,3%; yields were thus reasonably bunched about their respective means, indicating that it was relatively immaterial whether one was active or passive. The results for these years were once again, but for a different reason, not of much assistance in this investigation; i.e. the investment climate could have been the primary reason for yields and market values to show little or no correlation, except perhaps to a mild degree in 1977.

- 6.5** In contrast 1980 was an investment manager's nightmare. Interest rates rose rapidly, and although the share market rose to a certain extent this was on an irregular basis. By this stage a market in fixed interest securities had begun to develop.

The mean Survey yield was 15,3% and the standard deviation 6,2. This reflected a return to the pattern of 1975 and 1976, where challenging investment conditions resulted in widely ranging results.

One would have thought that funds with the ability to practise an active investment policy would by now have begun to emerge as market leaders; but the results shown thus far are not indicative of any high-performing group emerging as yet.

- 6.6** 1981 was a continuation of the nightmare. Not only did interest rates continue to rise but the share market fell on an irregular basis. The Spearman coefficient suggested an element of correlation of size and yield, but the value of β did not support this.

The mean Survey yield was 10,0% and the standard deviation 3,5, once more indicating a wide distribution of yields.

- 6.7** In 1982 interest rates continued their rise until mid-year, then fell sharply. The fall in rates masked many a passive investment policy by virtue of the substantial improvement in fixed interest market values that this brought about. The ordinary share market by mid-year was well down on the position it held as at the end of 1981, but by the end of 1982 it had recovered – the gold sector was, by the end of December 1982, in fact well ahead of its December 1981, level.

In the first half of the year activity was rewarded, but in the second half even inactive portfolios performed well. The standard deviation of the 1982 Survey yields was 5,4 and the mean yield 26,3, reflecting a return to the bunching that seems to accompany favourable investment conditions (such as those that characterised the second half of the year).

- 6.8** The four five-year periods reflected the following means and standard deviations among Survey participants:

Period	Mean yield % p.a.	Standard deviation
1975–1979	18,7	1,4
1976–1980	20,4	1,3
1977–1981	22,3	1,9
1978–1982	23,1	2,7

These periods all included, to varying degrees, some favourable investment circumstances, in which event the low standard deviations relative to the mean yields are not surprising.

- 6.9** The answer to the question posed in paragraph 6.1 seems therefore to be that the results achieved could well have been influenced by the investment climate existing during the first five years of the investigation. However, the last three years provided a clearer opportunity for any correlation between size and yield to show itself, and one of those years – 1981 – produced an interesting Spearman coefficient.

7 THE EFFICIENCY OF THE SOUTH AFRICAN ORDINARY SHARE MARKET

- 7.1** The majority of pension funds in South Africa provide retirement benefits that are geared to the earnings being received by members at or near retirement, and to the extent that earnings levels are affected by currency depreciation the finances of pension funds will be similarly affected.

In order to counteract this factor the investment policy adopted by most pension funds has placed emphasis upon assets of an equity nature, specifically ordinary shares and property. After allowing for the investment that pension funds are required to make in prescribed securities (all of a fixed interest nature), up to 47% by balance sheet value of a fund's assets may be invested in the equity area, and the yield produced thereon can consequently exert a significant influence on the overall yield achieved.

This fact has prompted an enquiry as to whether the results revealed by this investigation were in any way affected by the degree of "efficiency" present in The Johannesburg Stock Exchange, and it is of interest to examine this possibility further. In other words, was the theoretical ability to outperform the market (by virtue of greater flexibility of movement or the possession of greater investment research facilities) nullified by the pricing mechanism of the JSE?

- 7.2** The efficiency market hypothesis (EMH) states generally that market prices of ordinary shares at any point of time fully reflect all available information⁽³⁾. A more detailed definition⁽⁴⁾ refers to three degrees of "efficiency", namely:

(a) The "weak" form, which applies when current share prices fully reflect the information implied by the historical sequence of past prices; in other words, a knowledge of past share price movements cannot in these

circumstances be used to predict future price changes, and technical analysis or charting cannot lead to superior portfolio performance.

- (b) The "semi-strong" form, which applies when current share prices fully reflect all publicly available information. This implies that an investor cannot earn superior returns by using information that is generally available.
- (c) The "strong" form, which applies when all information, not only publicly available information, is impounded in share prices. This means that there is no opportunity for any investor to earn superior returns based on inside information.

The implications of the foregoing are substantial. They mean that if efficiency is present, even if only in a weak form, the whole field of technical analysis could be of little value to investors – fundamental analysis such as the acquisition and analysis of company financial statements, directors' reports, earnings and dividend records, and the like cannot then be expected to result in superior investment performance⁽³⁾.

7.3 It is generally considered that the New York Stock Exchange is an efficient market, and there is substantial evidence that the London and Tokyo exchanges are also efficient⁽⁴⁾. The important question now is whether the JSE is an efficient market. As long as transaction costs are not prohibitive, information is readily available to a sufficient number of interested parties, and there is no evidence of consistently superior or inferior performance by investors, then efficiency can be regarded as being present⁽⁴⁾.

7.4 Various examinations of the experience of the JSE have been carried out in order to try to answer this question. Essentially the results achieved by mutual funds have been used for the purpose. Gilbertson and Roux⁽³⁾ studied these results over the period 30 June 1973 to 30 September 1976, found inter alia that no fund appeared able significantly to outperform the market, and concluded that this result was consistent with the argument that the JSE was an efficient capital market. Strebel⁽⁵⁾ contested this conclusion, and suggested that the evidence available indicated that at best the EMH applied only to half of the shares traded on the JSE. Gilbertson and Roux, in a subsequent article⁽⁶⁾, vigorously opposed Strebel's views and reaffirmed their conviction that the JSE was an efficient capital market. A particularly pertinent remark in their latter article was that "mutual funds, with large investment analysis resources at their disposal, are unable to achieve superior performance".

More recently Gilbertson and Vermaak⁽⁷⁾ examined the performances of mutual funds over the period 1974 to 1981, in particular on the basis of risk-adjusted measurements. They now concluded that "a degree of inefficiency exists in the pricing mechanism of shares listed

on the JSE". This conclusion was largely based on the fact that on a risk-adjusted basis, mutual funds had generally outperformed the market indexes against which they were compared, and that in addition one particular fund had consistently and significantly outperformed both the indexes and the other mutual funds.

7.5 These investigations were as indicated based upon the experience of mutual funds. From the Investment Performance Survey data it is possible to obtain further guidance, by comparing the ranking from year to year of the yield achieved on each participating fund's ordinary share portfolio and determining whether any tendency towards consistently outperforming or under-performing the other participants existed.

The parallel with mutual funds is not complete, because while mutual funds exist specifically to invest in equities, pension funds have the freedom to remain out of the market when they deem this to be desirable. In addition only a limited amount of risk-adjusted data is available in respect of pension funds, although as previously indicated, an investigation into risk profiles conducted by the Survey over the period 1978 to 1980 indicated little significant variation between the ordinary share portfolios of participating funds.

It is felt that despite the foregoing comments, the information obtained from this source can still provide a useful additional dimension.

7.6 The period 1977 to 1982 was chosen for this investigation, representing a compromise between the conflicting requirements of a suitably lengthy period and a sufficient volume of data. The method adopted was essentially that used by Gilbertson and Vermaak⁽⁷⁾.

The results were as follows:

Number of years (out of six observed) in which the fund beat the median	Number of funds
Six	–
Five	2
Four	8
Three	11
Two	4
One	1
None	2

The fact that 10 out of the 28 funds beat the median yield in four or more of the six years would seem to confirm the Gilbertson and Vermaak conclusion of the existence of a degree of inefficiency in the JSE. Unfortunately data were not available to determine whether these ten funds were all small, all large, or a mixture of small or large, in respect of their ordinary share portfolios.

7.7 Has the foregoing answered the question posed at the outset, i.e. whether the JSE is efficient? The debate in the Investment Analysts Journal, supplemented by the further results derived from the Investment Performance Survey data, seems on balance to suggest that there is a

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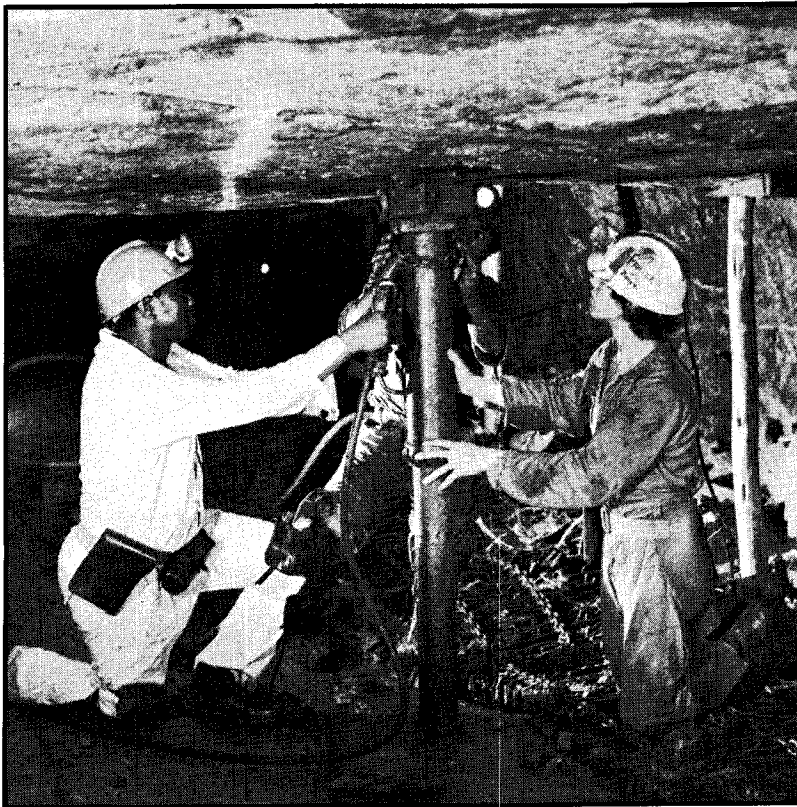
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degree of inefficiency in the JSE, and that consequently the opportunity to outperform the market is there. This would, however, *prima facie* only benefit the larger funds, because the investment research facilities necessary to take advantage of the situation may not be generally available to smaller funds. The significance of this is dealt with in the course of endeavouring to draw conclusions in section 10.

- 7.8 Although the foregoing discussion has dealt specifically with equity investment, it must also be borne in mind that a similar discussion could well take place on investments in the gilt sphere. In this area it has been suggested that efficiency has not as yet even reached the weak stage in South Africa, because of the lack of collection and distribution of historical data. The JSE Actuaries Fixed Interest indices should remedy this defect.

8 DIRECT PROPERTY INVESTMENTS

It was mentioned earlier that the results produced by the Investment Performance Survey have to date excluded the effect of direct investment in property, for the reasons given. As also stated it could normally be expected that this omission would only be of significance in the case of large funds.

Property has emerged in recent years in South Africa as a profitable area of investment of pension fund monies, not the least because of its growth element that is so important when one is endeavouring to invest in such a way as to match liabilities that are themselves largely geared to inflation. The greater ability of large funds to invest directly in property must therefore put such funds at an advantage over smaller funds, and the omission of the investment return on this sector from the data used for this investigation (except in the case of the "managed fund" data) is accordingly at first sight a deficiency in the data used in the investigation.

At the same time, however, property will normally only form a small part of a pension fund's assets in South Africa, in view of the Registrar of Pension Funds' limitation on the proportion of a pension fund's assets that may be invested in this area; and it can thus be expected that even if property could have been brought into the measurement of yields the conclusions reached earlier in this paper would not have been significantly different.

9 DEFINITION OF "SIZE"

As previously stated the investigation related the yield on a fund to the size of the fund.

It has been suggested that this definition of "size" may be misleading. The logic behind this suggestion is that – in South Africa at any rate – the investments of most privately administered pension funds are managed by merchant banks and similar institutional investment advisers, who may well adopt an "across the board" approach to managing client funds' investments and hence produce similar yields for funds of different size. In such event the question would be, not whether the individual fund was large or small, but whether the merchant bank, etc. managed a large or a small number of funds.

Funds whose investments are administered by life offices on a "managed fund" basis would also appear

to fall into this category of "across the board" management.

An investment adviser that only managed the investments of a few clients, on the other hand, is seen by this argument as being able to give close personal attention to each client, to treat clients individually, to be more active in his investment management, and possibly to produce better yields as a result.

Merchant banks that have been consulted deny emphatically that an "across the board" approach is adopted, and maintain that their client funds are managed individually within no more than a very general investment philosophy. They point to different performances being produced by different managers within the same organisation.

A certain amount of information is available from the Investment Performance Survey relating to the nature of the investment management of each participating fund, but there are too many grey areas in this information for it to provide any useful guidance on the question raised above. Whether the results obtained by using the size of the *fund* – the only data available – are in fact distorted by the substantial use of merchant banks and the like, or not, is thus at present still an open question, which is touched upon again in the next section of this paper.

10 CONCLUSION

- 10.1 Let us now attempt to draw final conclusions from the foregoing discussion.

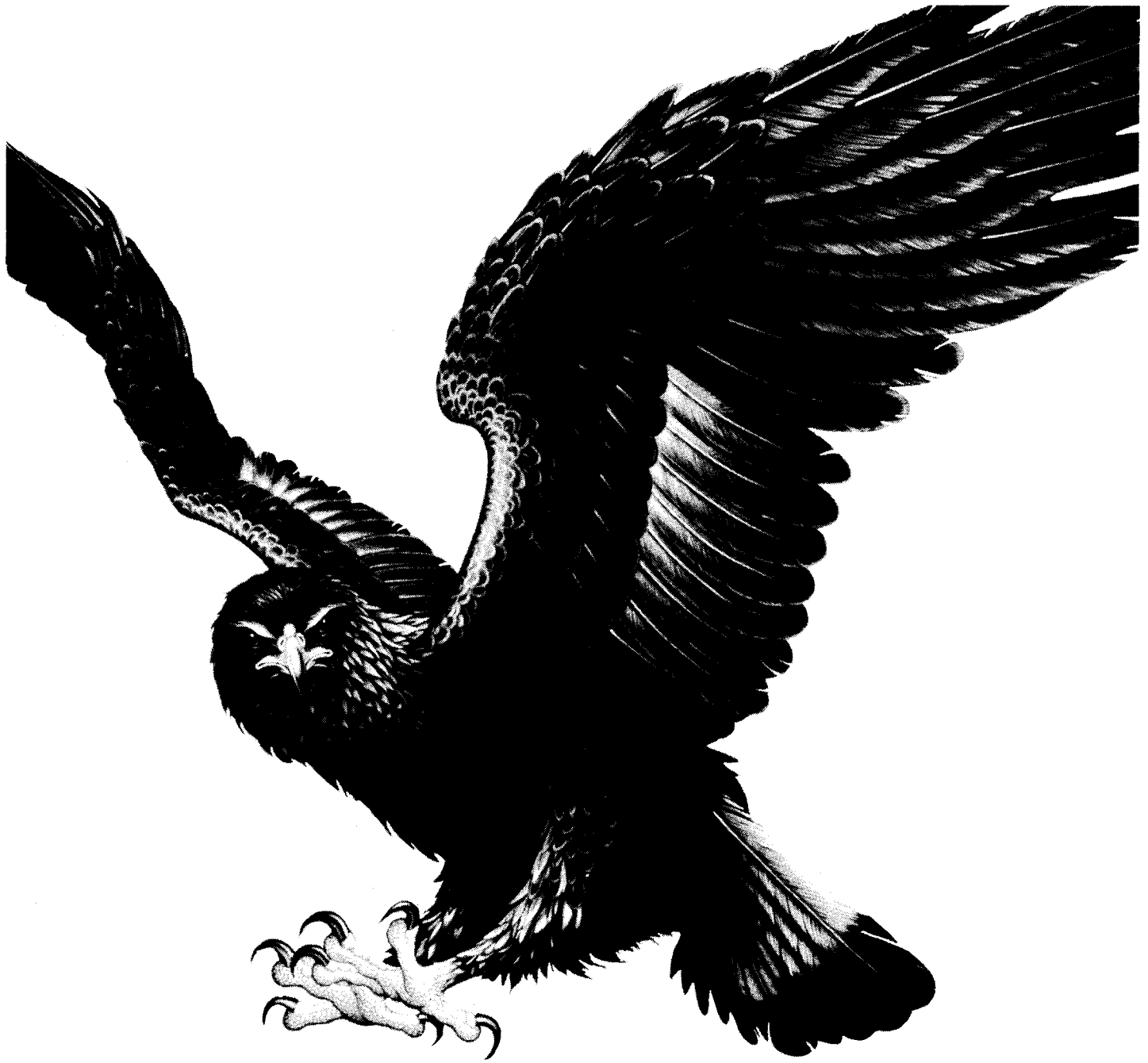
The volume of data available for the investigation was not as substantial as one would have liked, particularly in respect of the larger funds. However, except perhaps for the earlier years of the investigation it cannot on the other hand be said that the data were too sparse to permit reasonable conclusions to be drawn. For the primary purpose of this investigation, therefore, namely to gain an indication of the degree (if any) of correlation between size and yield, the data appear to be of not unreasonable volume.

Against that background the experience in South Africa over the eight years 1975 to 1982 has been such as to indicate that there is no noticeable degree of correlation between the size of a pension fund's assets and the investment yield achieved thereon. Smaller funds have shown themselves able to perform as well (or as badly) as larger funds.

This means that, in the South African context at any rate:

- (a) bigger has not necessarily meant better, as far as investment performance is concerned, and marketing based on this philosophy is fallacious; and
- (b) smaller investment units have not necessarily produced better investment returns than larger units, and one of the prime arguments seeking to justify split-funding is thus also fallacious.

- 10.2 That is the message of past experience in South Africa. However, the question now has to be asked whether that is the kind of result that



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could reasonably be expected from a well-managed investment movement; or whether it is an artificial result that conflicts with that which should theoretically emerge.

If it can convincingly be argued that the results obtained, i.e. the absence of correlation between size and yield, are those that can reasonably be expected, then the discussion is at an end – but the author would be most interested to hear those arguments!

If on the other hand it can correctly be argued that the foregoing results are artificial, and in conflict with those that theoretically should be produced, then a whole new area of debate opens up – namely, what steps should be taken to remove the artificiality and to ensure that the theoretically correct result is produced?

10.3 The author suggests that the results derived from the foregoing experience, while factual, are nevertheless artificial. In the following paragraphs the reasons for holding this view are described, and possible explanations are offered for the fact that in practice artificial results have been obtained.

10.4 The argument revolves essentially around the question of whether an active investment policy can be expected in the long term to produce better investment returns than a passive philosophy. The important words here are “in the long term” because as the discussion in section 6 of this paper showed, there were years during the period of the investigation in which investment conditions virtually took over and it was relatively immaterial whether one was active or not. Such periods should normally only occur occasionally, however, and in the long term one can expect to encounter other years when that situation did not apply.

The author takes it for granted that the preference for an active investment policy is fully accepted; for it to be otherwise would contain implications of a far-reaching nature, that would strike at the whole foundation of investment management. “Indexed funds” in the USA, which grew up on the theory that activity did not produce any better return, seem to have fallen out of favour and this presumably means that the basic premise has not been maintained.

10.5 Proceeding from that basic standpoint, the next consideration is whether size is or is not an inhibiting factor, as far as activity in investment management is concerned. Once again, there hardly seems to be any debate on the matter; the author has seen too many examples of large funds being totally locked in to their existing portfolios, to have any doubt on the practical inability of a large fund to implement an active investment policy. Some managers of large funds would have one believe that it is sufficient to be active in the direction of new monies becoming available for investment, while leaving the existing portfolio in its present form; but the author does not consider that suggestion even bears discussion. An investment policy that does not take account of the need for the existing portfolio also to maximise its return can hardly be called an active philosophy.

In short, therefore, smaller pension funds, with their greater freedom of movement to implement an active policy, should produce better yields than larger funds, and for this reason the author considers that the results produced in section 5 of this paper represent an artificial state of affairs.

10.6 We now turn to the question of possible explanations for the foregoing artificial situation having arisen. Alternatives that come to mind are the following:

- (a) Smaller funds may by definition not possess the quality of investment management that enables them to take advantage of the flexibility that they enjoy by virtue of their size.
- (b) Smaller funds may quite possibly for the most part be managed by merchant banks, and the like, along with all the other corresponding clients of those organisations; and the said organisations may well adopt an “across the board” approach which means that effectively the small to medium client is being handled as if he were part of a large client. In other words, the flexibility inherent in his size may be lost by this investment management vehicle.
- (c) Larger funds may enjoy advantages over smaller funds in other directions, to an extent that cancels out the flexibility of movement enjoyed by the smaller funds.

10.7 These possible explanations are now considered in more detail

(i) *Smaller funds and investment management*

This is probably the essence of the problem. Unless the business of the underlying employer is such that he has available on his staff persons with the necessary investment expertise to manage the assets of his fund, the danger is that without seeking outside assistance the investment management may be handled with more enthusiasm than investment ability. Immediately therefore, it would appear that part of the answer is in front of us, and this leads naturally into the second possible explanation.

(ii) *“Across-the-board” management*

The comment in (i) above indicates that in practice the investments of smaller funds will tend in general to be managed by merchant banks and similar organisations. This removes the problem discussed in (i), in that comprehensive investment expertise is now available even to the smallest funds; however, as has already been discussed, the question then arises as to whether in the process the advantages of being small are lost.

The reaction of merchant banks that the author has consulted has already been stated, but with the greatest of respect one wonders whether this principle of individual treatment is necessarily borne out in practice; in fact, one wonders

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whether it is practicable to expect individual attention to be given to small to medium clients of merchant banks, because of the administrative costs that would be involved if this were to be carried out completely.

The author suggests that this completes the answer initially suggested by (i) above; that despite the undoubted desire for individual attention, the investment management organisations that small to medium funds are virtually compelled to engage to manage their assets, are in practice unable to give them a degree of individual attention that can derive the maximum advantage from the flexibility of movement that their size carries with it.

In short, while in theory small funds are able to pursue an active investment policy in practice few if any are able to capitalise on this advantage.

The consequential question of whether this does not suggest a revision of the present facilities offered by institutional investment managers, is considered later.

(iii) *Advantages enjoyed by large funds*

Large funds enjoy undoubted advantages over small funds. The investment research facilities available to them are likely to be greater, and they may well have their own full-time staff engaged in this work; in the light of the foregoing discussion on the efficient market hypothesis, this presents an opportunity to outperform the ordinary share market that does not appear to be available to smaller funds that are genuinely managed on an individual basis.

The ability to invest directly in the property sphere is that much greater in the case of the larger funds. Attractive investment opportunities will tend to be offered first to the larger funds rather than to smaller funds.

The only disadvantage in fact seems to be the practical inability on the part of a large fund in South Africa to implement the active investment philosophy that its undoubted expertise tells it should be carried out, because of the practical problems of finding buyers or sellers (as the case may be) in sufficient quantities to cater for the large sums that by definition would be involved.

There seems little doubt therefore that the artificial investment performance results disclosed by the investigation in section 5 of this paper, are the net result of the advantages of smaller and larger funds respectively being offset by corresponding disadvantages. Smaller funds have the flexibility to pursue an active investment policy when this is called for by investment conditions, but are unable to capitalise on it; larger funds are inhibited by their size from implementing an active investment policy, but make up for this disadvantage through other advantages that their size brings.

10.8 The only aspect of the foregoing discussion that seems to point to an area of potential improvement, is the suggested "across-the-board" approach by the institutional investment managers generally consulted by small funds. If there were some way in which genuine freedom of individual managers within a single institutional investment organisation could be achieved, with each manager having access to the investment research facilities of the umbrella organisation, it would appear that small to medium funds could then have the best of both worlds and begin to produce the results that the author suggests are the ones that theoretically are the most reasonable. It can naturally be expected that relative investment management charges would be higher than at present under such an arrangement, but it can be expected that the funds concerned would be prepared to meet the higher costs if these were outweighed by correspondingly improved investment returns.

10.9 Short of a development along these lines, it would appear that despite all the theoretical arguments to the contrary, the status quo will continue; and a fresh investigation of yield in relation to size in a few years' time will probably still reflect no significant correlation. In such event the essential conclusion will continue to be that:

- (a) bigger does not necessarily mean better; and
- (b) split-funding is unlikely to improve the overall yield.

11 ASSOCIATED MATTERS

11.1 Split-funding

As stated, the foregoing results seem to disprove one of the prime arguments advanced in favour of split-funding, namely the suggested better performance of the smaller units involved.

This is of course not the only argument advanced in favour of split-funding, and for the sake of completeness it may be of interest to discuss the other contentions. One is that the element of competition that split-funding produces between the respective investment managers will lead to a better overall performance than otherwise. The author's view is that this "advantage" is also largely illusory, because no investment manager worth his salt should need that type of incentive to get him to produce his best. It may improve his public relations but it is hardly likely to improve his investment performance.

Another argument is that by means of split-funding one gains the benefit of a wider range of opinion and expertise than otherwise. The author had an interesting experience showing the kind of result that this philosophy can produce. A major client fund had split his portfolio between three investment managers, each having full discretion as to how to manage his portion. The overall yield on the fund was, however, distinctly unexciting, and an investigation was launched to probe the reasons. It was *inter alia* discovered that while each



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manager had assembled a portfolio of equities that he considered appropriate, there was very little over-lapping between the respective managers' equity portfolios – and the result was that the fund as a whole possessed an equity portfolio that mirrored the market as a whole and consequently achieved only an average equity yield! Investment risk was admittedly reduced, but at a price.

Sometimes a type of split-funding is adopted whereby one manager is selected say for his ability in equity investment, another for his property expertise, and a third for his knowledge of the fixed interest market. Where the overall strategy is controlled by a central party, who would vary the flow of new monies to and from each manager from time to time as he considered appropriate, this is not really split-funding; but where there is no such central party, and each manager receives a fixed proportion of new monies to invest in his particular sphere, this constitutes split-funding of a type that the author would consider to be somewhat dangerous because of its emphasis on selection to the detriment of strategy.

In short, the author suggests that the concept of split-funding is in practice of little value, and that it is useful only as a temporary measure (if indeed necessary) to enable a decision to be taken as to which of two or more candidates should be selected as the sole investment manager; or if a fund is willing to accept a lower yield in return for a greater degree of protection against investment risk.

11.2 Rate of growth

It has been suggested that the yield achieved by a pension fund in any one year could be influenced by the rate of inflow of new money to the fund over the year, relative to the size of the fund. The theory is that a substantial volume of new money relative to the amount of existing assets could place the fund in a particularly advantageous position in respect of new investment opportunities. The point was touched upon in Hager's paper².

In 1978 the Investment Performance Survey calculated the coefficient of correlation between the overall yield for the year and the rate of growth over the year in the book value of the assets, in respect of the funds participating in the Survey. The conclusion was that there was no significant correlation.

It would have been interesting to investigate the matter further in this paper; however, the data available permitted only the rate of

increase in market, as opposed to book, value to be determined, which would have produced a distorted result because of the underlying movement in capital values.

11.3 Trend in investment sectors

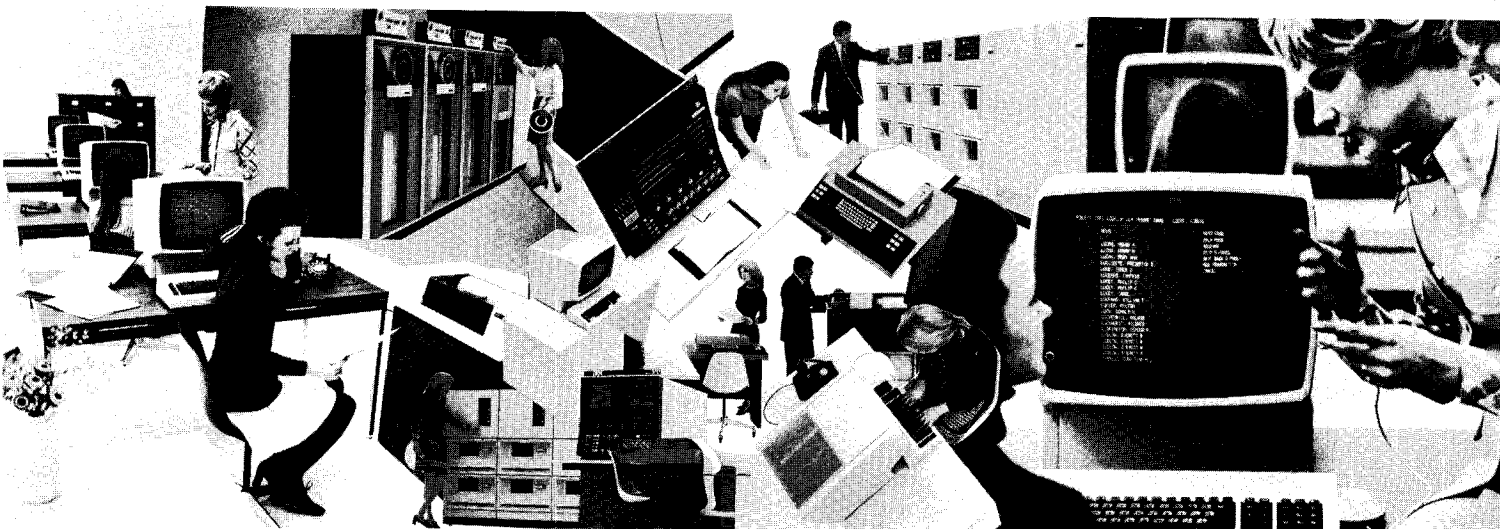
As indicated previously, the investigation considered the relation between the overall yield and the corresponding assets. A question that comes to mind is whether a different picture would be presented if the investigation had considered the yields in each sector (fixed interest, equities, etc.) relative to the size of the assets in that sector. This could be a most interesting investigation because it would introduce the subject of the extent of market activity available in each sector. Once again, however, this would require data in a degree of detail that has not hitherto been available.

12 ACKNOWLEDGEMENTS

The author records his gratitude for the considerable assistance afforded to him, in respect of the statistical aspects of the investigation, by Miss M. Kridiotis (of the University of the Witwatersrand) and Mrs R. Dawes (Statistician to the South African Insurance Association); and also to Mrs M. Brooker for attending to all of the data processing activities (which were far more extensive than would appear solely from the results quoted in the paper).

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The role of hedging in the marketing of gold

1 INTRODUCTION

South Africa's gold output has traditionally been and continues to be sold by the Reserve Bank in the main physical gold markets of Europe on a spot basis, i.e. at the dollar price prevailing on the date of sale. Formerly the Reserve Bank paid the gold mines the rand equivalent of these dollar spot transactions but since 5 September 1983 the mines have been paid in dollars. Until recently the mines were content to earn revenue on a spot basis in this manner. During the past year or two, however, many of them have sought to increase the stability of their revenues by entering into hedging arrangements tied to their sales of physical gold to the Reserve Bank. Because of wide fluctuations in the gold price, some of the gold marketed under these hedging arrangements has inevitably been sold forward at prices lower than those that would have been realised if the mines had not hedged. In consequence, strong criticism of hedging has been voiced in several quarters, including the financial press, and some have condemned the practice as a form of speculation hardly to be distinguished from gambling.

In view of the importance of the gold mining industry to the South African investment community and to the economy at large, it is hardly surprising that hedging has proved to be an emotive issue. The debate would have generated more light and less heat, however, if the protagonists had shared some common ground regarding the fundamental nature of speculative markets and hedging as viewed through the lens of modern finance theory. In this paper an attempt is made to present an outline of the relevant theory and to discuss its practical implications for the marketing of gold.

The task has been undertaken with some trepidation and at times the author has been reminded of that rather amusing definition of the amateur as one who believes that if something is worth doing it may well be worth doing badly. The author has set his sights higher than this but is all too conscious of the subtle difficulties of the subject, particularly the dangers posed by implicit assumptions regarding attitudes towards risk. It is hoped that the paper will stimulate others to develop a more rigorous treatment of a subject which, despite its peculiar importance in the South African context, seems to have received scant attention to date in local academic circles.

2 PRICE BEHAVIOUR IN SPECULATIVE MARKETS

The random walk hypothesis

Commodity and share markets are speculative in the sense that the price of what is traded is always fluctuating as buyers and sellers continually revise their estimates of value in the light of ever-changing information. Scientific enquiry into the behaviour of speculative prices may be said to have begun in 1900 with Bachelier⁽¹⁾, who concluded that absolute price changes were random and normally distributed. Bachelier's work went largely unnoticed and it was not until the publication of a paper by Kendall⁽²⁾ in 1953 that a major new

impetus was imparted to research into the theory of speculative prices. Seeking to isolate clear trends in the time-series of prices for a number of commodities, Kendall was astonished to discover that price changes over fairly short intervals of time were so large as to swamp any trend effect that might have been present and that each series appeared to be "a wandering one, almost as if once a week the Demon of Chance drew a random number . . . and added it to the price to determine the next week's price". The randomness of short-term movements in the prices of shares and commodities, including gold and other precious metals, has been demonstrated by rigorous statistical techniques in numerous later studies.^(3,4)

It was thought at first that the now well-documented phenomenon of the random behaviour of prices in speculative markets was evidence of irrationality. Only later did it come to be appreciated that randomness is evidence of market efficiency rather than irrationality. In a market characterised by semi-strong efficiency, such as the gold market, the current price of a commodity reflects fully the implications of all relevant public information and will change only in response to the advent of new information. But the new information is unpredictable – otherwise, by definition, it would not be new. Thus, the gold price is unpredictable because changes in the price are reactions to the random arrival of new information whose implications for the price may be any combination of large or small, positive or negative. The passage of the gold price through time is therefore in the nature of a random walk. An important corollary of the random walk hypothesis is that knowledge of past prices sheds no light on prices in the future and that consequently price-charting techniques have no predictive power.

The form of the statistical distribution of speculative prices

Bachelier's assumption that absolute price changes are normally distributed is unsatisfactory for a number of reasons, not least because it implies the possibility of negative prices. Later researchers, notably Osborne⁽⁵⁾, produced evidence that it is changes in the logarithms of prices that are normally distributed, which is a more intuitively appealing hypothesis because it precludes the possibility of negative prices and also makes the magnitude of price changes proportional to the price. Subsequent work by Mandelbrot⁽⁶⁾ and Fama⁽⁷⁾, however, indicated that empirical distributions of changes in the logarithms of prices exhibited significantly higher proportions of relatively large and relatively small observations than was consistent with the hypothesis of price lognormality and thus cast doubt on the validity of the highly convenient normal distribution as a model for describing these changes. The question of the correct distributional model is still unresolved. Recent work^(8,9) suggests that although changes in the logarithms of daily prices are non-normal those for longer periods are asymptotically normal, which is the assumption made in this paper.



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The relationship of spot and futures prices

Black⁽¹⁰⁾ defines the futures price of a commodity as that price (F) at which two parties can agree to buy and sell a certain quantity of the commodity at a given time in the future (t*) without putting up any money now (t). Although both parties are customarily required to provide collateral as a guarantee of their ability to fulfil the contract, the collateral is untouched as long as the futures price remains the same. Arbitrage ensures that the difference between spot and futures prices does not exceed the costs, mainly interest, of buying the commodity at time t and storing it for sale at time t*. Symbolically, $kS_t = F_{t,t^*}$ where $k = (1 + \text{holdings costs for the period in question})$ and $S = \text{current spot price}$. Because of this link, it follows that futures prices behave in the same random manner as do spot prices.

The following propositions put forward by Black are fundamental to an appreciation of the arguments developed in sections 5 and 6:

- (a) The mathematical expectation at time t of subsequent changes in the futures price for time t* is zero:

$$E(\Delta F_{t,t^*}) = 0 \tag{1}$$

Black derives this result by a novel application of the capital asset pricing model in which it is argued that the covariance of the change in the futures price with the return on the market portfolio tends to zero. By implication, the spot price increases towards the futures price with the passage of time because of the diminishing effect of the interest factor.

- (b) The mean of the distribution of possible futures prices at time t', where t' is between t and t*, is the current futures price, F_{t,t^*} .
- (c) The mean of the distribution of possible spot prices at time t*, $E(S_{t^*})$, is the current futures price, F_{t,t^*} . This result follows from the fact that $E(\Delta F_{t,t^*}) = 0$ and $F_{t,t} = S_t$ for all t.

3 HEDGING BY MEANS OF FUTURES AND FORWARD CONTRACTS

A gold producer wishing to hedge its proceeds from an ounce of gold which it expects to produce and sell in, say, a year's time may do so quite simply by entering into a futures contract to sell an ounce of gold through a commodity exchange at the current futures price quoted for delivery a year hence, F_{t,t^*} . On maturity of the contract, the producer honours the contract by buying and delivering an ounce of gold at the prevailing spot price, S_{t^*} , and at the same time sells the ounce it has physically produced through the Reserve Bank, also at S_{t^*} . The net revenue from these transactions is the original futures price, whatever the level of the spot price at maturity:

Profit or loss on futures contract	$F_{t,t^*} - S_{t^*}$
Revenue from Reserve Bank	S_{t^*}
Net revenue	F_{t,t^*}

In practice, of course, matters are somewhat more complicated than is indicated by the bare outline of mechanics given in the preceding paragraph. An important factor is that a futures contract to sell gold at a specified price and date through a commodity exchange, such as COMEX, obligates the purchaser to furnish col-

lateral in the form of an original margin, usually about 10% of the value of the contract. In addition, the purchaser is liable on a daily basis to provide a so-called maintenance margin to cover any excess of the value of the contract at the prevailing spot price over its value at the hedged price. With the blessing of the Reserve Bank, South African gold producers generally avoid the drawbacks of futures as a hedging medium by entering into forward contracts under principal-to-principal agreements with overseas banks or bullion dealers. Whereas a futures contract is a highly standardised instrument traded on an organised and highly-regulated commodity exchange, a forward contract is one in which two principals agree upon the purchase and sale of gold at a certain date and price under "customised" arrangements. Though conceptually the same as futures, forward contracts are more attractive for a number of reasons:

- (a) COMEX's onerous regulatory procedures are avoided.
- (b) There is more time in which to conduct transactions, whereas the overlap between COMEX's trading periods and local business hours is small.
- (c) The direct relationship between the parties encourages a freer flow of information and leads to greater operating flexibility.
- (d) Security is provided by means of relatively inexpensive bank guarantees instead of inconvenient and costly margins.

A useful reference regarding the practical aspects of this form of hedging is a recent article by Gidlow⁽¹¹⁾.

4 HEDGING BY MEANS OF OPTIONS

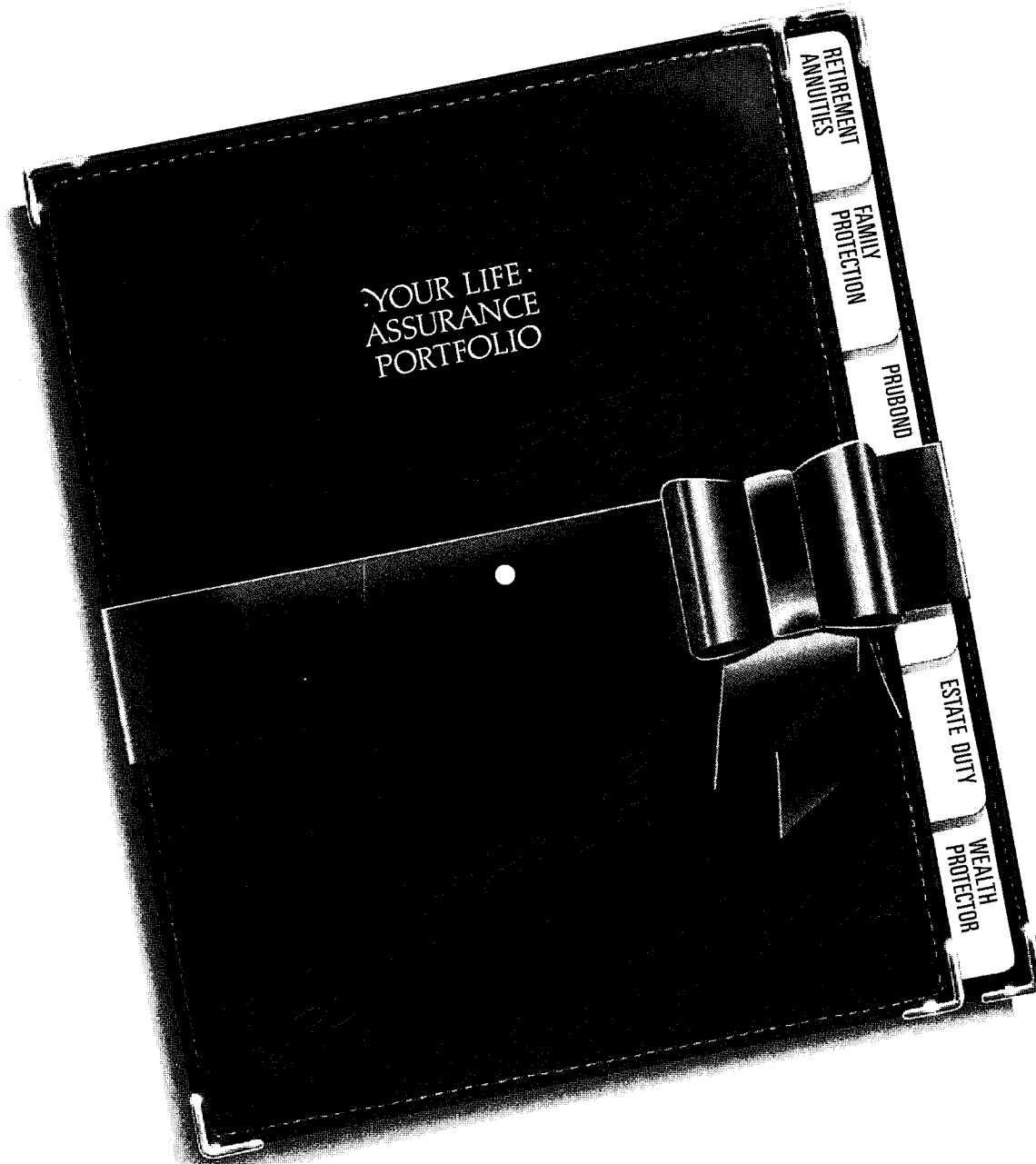
Definitions

A call option entitles, but does not obligate, the holder to purchase a certain quantity of, say, gold at a specified price, known as the exercise price, either on or by a specified date. Similarly, a put option entitles, but does not obligate, the holder to sell a certain quantity of gold at a specified exercise price either on or by a specified date. Options that may be exercised only on a specific date are known as European options; those that may be exercised either on or before a specific date are termed American options. The price paid by the purchaser (holder) of an option to the seller (writer) is known as the option premium. An American call is worth more than a European call because it confers all the rights of the latter and, in addition, the right of premature exercise. The extra cost of an American call is, however, generally slight. In this paper the term option refers to a European option.

The following notation is defined for convenience at this point:

t	the current date
t*	the expiration date of the option
T	the time to expiration (t* - t)
C	the price of a European call at t
P	the price of a European put at t
r	the continuously compounded risk-free interest rate per annum
S	the spot price of gold at t
X	the exercise price of the option
F	the futures price at t for t*

Starred variables – such as S^* , C^* , etc. – refer to values at t*, the expiration date of the option. Certain additional terms will be defined as and when required.



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Mechanics of hedging through options

As an alternative to purchasing a futures contract or negotiating a forward sale, a gold producer may hedge revenue by means of a put option. As always, the producer's output is sold for S^* through the Reserve Bank. If $S^* < X$, the producer exercises the put option, purchasing gold at S^* on the open market to make delivery. The producer's net revenue from the hedge is the sum of receipts from the Reserve Bank (S^*) plus the profit on the put ($X - S^*$) minus the cost of the put (P), which sum equals $X - P$. If $S^* \geq X$, the producer allows the option to lapse and earns a net revenue of $S^* - P$. Hence, the producer is assured of a minimum net revenue of $X - P$ and will receive more than this minimum if $S^* > X$.

A simplified model of option premiums

Consider first the question of the value of C , the call premium. It will be helpful to approach this question by means of a simple, one-period, two-state model that will bring the essential features to the fore. Assume that the current price of gold (S) is \$400 and that its price a year hence must be in one or other of two possible states, \$200 or \$800. A call option (C) is available at an exercise price (X) of, say, \$400 and the risk-free rate of interest is 10% per annum. If there is to be no profitable riskless arbitrage, this information is sufficient for the value of C to be determined. The reasoning is based on the fact that the option writer, by purchasing an appropriate quantity of gold and selling one call, can construct a completely riskless hedge whether the spot price rises or falls.

At t^* the difference between the two possible values of S^* is \$600 and that between the two possible values of C^* is \$400, as $C^* = 0$ if $S^* = \$200$ and $C^* = \$400$ if $S^* = \$800$. The riskless hedge ratio is therefore $\$400/\$600 = 2/3$. In other words, if the option writer buys two-thirds of an ounce of gold and sells one call, his net worth at t^* is the same whether the spot price falls to \$200 or rises to \$800:

Time = t^*	$S^* = \$200$	$S^* = \$800$
Value of gold	\$133,33	\$533,33
Less value of call	-	\$400,00
Net worth	\$133,33	\$133,33

At t the option writer's investment in the riskless hedge is the cost of buying two-thirds of an ounce of gold, namely \$266,67, minus the call premium, which is to be determined. As the hedge is riskless, the risk-free rate, assumed to be 10% per annum, must be used to equate the investment at t and the assured payoff at t^* . Thus:

$$\begin{aligned} \$266,67 - C &= \$133,33/1,1 \\ C &= \$145,46 \end{aligned}$$

The net investment at t is therefore \$121,21. If $S^* = \$200$ the option lapses and the gold is sold for \$133,33. If $S^* = \$800$ the option is exercised and the writer has to purchase another one-third of an ounce at a cost of \$266,67 to meet the call but receives the exercise price of \$400 and remains with a net worth of \$133,33. In either event, his profit is an assured \$12,12, which is equivalent to the risk-free rate on the initial investment. Had the writer financed the initial purchase of gold by raising a loan of \$121,21, his net worth at both t and t^* would have been zero and the net liquidation proceeds of \$133,33 would have just sufficed to repay the loan plus interest at the risk-free rate.

Given the value of a call, the value of the corresponding put may be derived by means of the put-call parity

theorem, which states that the value of the put equals the value of the call minus the spot price and plus the present value of the exercise price or, symbolically,

$$P = C - S + X e^{-rT} \tag{2}$$

where, to anticipate the usage of the remainder of this paper, continuous compounding is assumed and hence X is discounted by e^{-rT} rather than by $(1 + r)^{-T}$. The validity of the theorem is demonstrated in the following table, which shows that the outcome of buying a call is the same as the sum of the outcomes of buying the corresponding put, holding the underlying spot asset and borrowing the present value of the exercise price.

Put - call parity

Value at	t	t^*		
		$S^* < X$	$S^* = X$	$S^* > X$
<i>Portfolio 1</i>				
Buy a put	P	$X - S^*$	0	0
Buy spot asset	S	S^*	S^*	S^*
Borrow	$-Xe^{-rT}$	$-X$	$-X$	$-X$
	$P + S - Xe^{-rT}$	0	0	$S^* - X$
<i>Portfolio 2</i>				
Buy a call	C	0	0	$S^* - X$

The terminal values of the two portfolios are the same in all circumstances and therefore their initial values must be the same, otherwise arbitrage opportunities would exist.

The Black-Scholes option model

The single-period, two-state model may be generalised to a multi-period model, in which case the solution of C requires knowledge of T in addition to knowledge of the necessary and sufficient conditions for solving the single-period model, namely, X , r , S and the range of variation of S^* . The first complete general-equilibrium solution for C in continuous time, which the multi-period model reaches in the limit as the duration of each period is made indefinitely small, was developed in 1973 by Black and Scholes⁽¹²⁾, whose formula is:

$$C = SN(d_1) - Xe^{-rT} N(d_2) \tag{3}$$

where

$$d_1 = [\ln(S/X) + (r + \sigma^2/2)T] / \sigma T^{1/2}$$

$$d_2 = d_1 - \sigma T^{1/2}$$

$\ln(S/X)$ = the natural logarithm of S/X

r = the continuously compounded annual risk-free rate

σ = the standard deviation of the annual rate of return on the underlying asset. A commodity yields no income and therefore its return per period is $(S^* - S)/S$, which for returns of less than 15% is closely approximated by $\ln(S^*/S)$. The standard deviation for a number of, say, weekly returns may be computed and annualised.

$N(d)$ = a value drawn from the cumulative standard normal distribution. $N(d_1)$ is the riskless hedge ratio and $N(d_2)$ is the probability that S^* will exceed X .

Despite its rather forbidding appearance, the Black-Scholes formula is very easy to use. Assume that the

spot price of gold is \$400, the risk-free rate is 8% per annum and the annualised standard deviation of returns is 40%. The premiums for a three-month call and put ($T = 0,25$) at an exercise price of \$450 are calculated as follows:

$$d_1 = [\ln(\$400/\$450) + (0,08 + 0,4^2/2)0,25]/0,4 \times 0,25^{1/2}$$

$$= -0,38892$$

$$d_2 = d_1 - 0,4 \times 0,25^{1/2}$$

$$= -0,58892$$

From tables of the cumulative standard normal distribution:

$$N(d_1) = 0,34867$$

$$N(d_2) = 0,27796$$

Therefore:

$$C = \$400 \times 0,34867 - \$450 \times e^{-(0,08 \times 0,25)} \times 0,27796$$

$$= \$16,86$$

and, by the put-call parity theorem:

$$P = \$16,86 - \$400 + \$450/e^{(0,08 \times 0,25)}$$

$$= \$57,95$$

Black and Scholes derived their solution by means of the advanced techniques of stochastic calculus. A simpler approach is Smith's⁽¹³⁾, following Sprenkle⁽¹⁴⁾, but the most accessible proof is given by Cox, Ross and Rubinstein⁽¹⁵⁾, who derive the Black-Scholes model as a limiting case of the multi-period, two-state model, using only elementary mathematics, and who also provide a lucid account of the economic content of their model. Useful nomograms, covering a wide range of parameter values, are presented in Dimson⁽¹⁶⁾. A recent survey by Beenstock⁽¹⁷⁾ shows that the Black-Scholes model compares favourably with later models based on other stochastic processes.

5 THE EXPECTED NET REVENUE FROM SPOT SALES, FORWARD SALES AND PUT OPTIONS

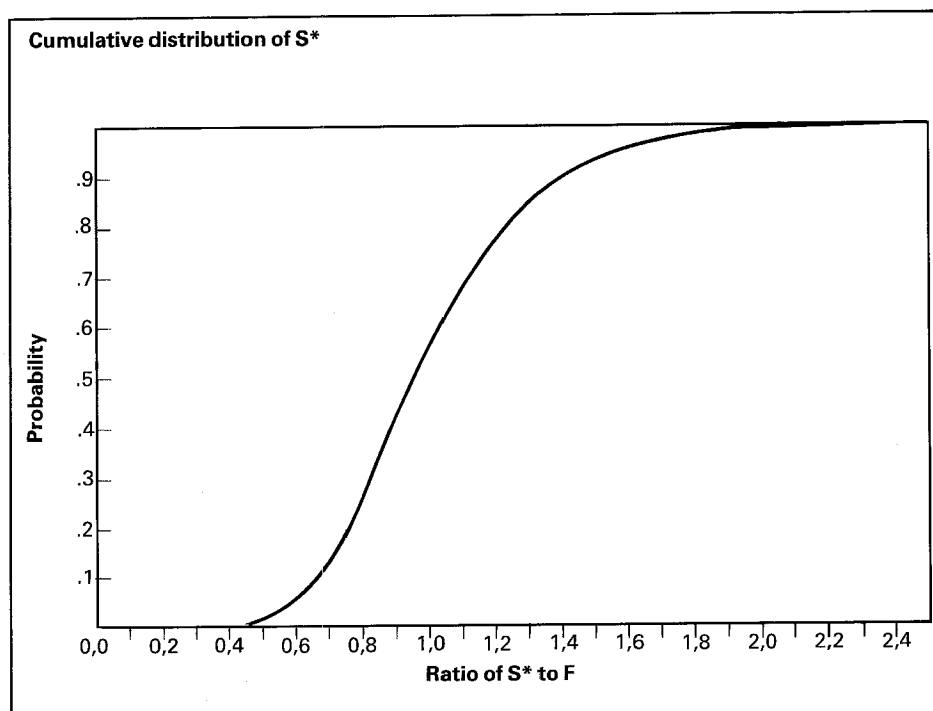
The distribution of S^*

It was argued in section 2 that the mean of the distribution of possible spot prices at t^* is the current futures price for t^* or, in notation, $E(S^*) = F$. On the basis of this argument – and given that $F = Se^{rT}$ and $p(S^* > X) = N(d_2)$ for all X , where p denotes the probability of $S^* > X$ – the cumulative distribution function of S^* may be derived by multiplying the Black-Scholes formula throughout by e^{rT} and then determining the values of $N(d_2)$ corresponding to different values of X .

By way of illustration, a hypothetical but not unrealistic distribution of possible spot prices for gold in six months' time is presented in the following graph. It is assumed that $r = 8\%$ and that $\sigma = 40\%$, which is its approximate value for the period from January 1979 to May 1983. S^* is expressed as a fraction of F and F has been equated to unity, which exploits the property of the lognormal distribution that the distribution of price ratios is independent of the price level. Given the assumed parameter values, it may be seen, for example, that there is approximately a 50% probability that in six months' time S^* will fall within the range of $0,8F$ to $1,2F$, whatever the current value of F may be. The possibility of defining probabilistic limits for S^* does not, of course, imply that it is meaningful to predict what S^* will be or even to predict whether it will be higher or lower than F . Gold price predictions, usually based on price-charting techniques or on broad generalisations from widely known information, appear frequently in the news media but those who make such predictions cannot achieve more than purely fortuitous success if, as is strongly suggested by the evidence, the behaviour of the gold price conforms to a random walk.

Comparison of expected net revenues

Let R_S , R_F and R_P denote respectively the net revenue for a gold producer from spot sales, forward sales at the



futures price and put options at any exercise price. $E(R_S) = F$, from the argument of section 2, and, by definition, $E(R_F) = F$. It remains to define the value of $E(R_p)$.

The effective cost of a put is Pe^{rT} at t^* . For a gold producer, net revenue equals $X - Pe^{rT}$ if $S^* \leq X$ and $S^* - Pe^{rT}$ if $S^* > X$. Hence, where p is the probability of $S^* > X$:

$$E(R_p) = E(S^* \text{ if } S^* > X)p + X(1-p) - Pe^{rT} \quad (4)$$

According to a certain interpretation of the Black-Scholes formula, $E(S^* \text{ if } S^* > X) = Se^{rT} N(d_1)/N(d_2)$ and $p = N(d_2)$. Hence, equation (4) may be rewritten as follows:

$$E(R_p) = Se^{rT} N(d_1) + X[1 - N(d_2)] - Pe^{rT} \quad (5)$$

$$= F$$

as $Pe^{rT} = Ce^{rT} - Se^{rT} + X$, from the put-call parity theorem, and $Ce^{rT} = Se^{rT} N(d_1) - X N(d_2)$, from the Black-Scholes formula. For a gold producer, therefore, the expected net revenues from spot sales, forward sales and put options are the same: the futures price.

At this point it is convenient to refer briefly to the so-called "free" put option. A "free" put position is established when the purchaser of the puts sells to the writer of the puts a lesser number of calls such that the premiums payable by each party cancel out. Assume, for example, that the premium on two puts at X_p is equal to the premium on one call at a higher exercise price, X_c . If $S^* < X_p$, the holder of the puts obtains a net revenue of $2X_p$. If $X_p < S^* < X_c$, the holder of the puts gets a net revenue of $2X_p + 2(S^* - X_p) = 2S^*$. If $S^* > X_c$, the call is exercised and the put holder earns $S^* + X_c$ while the call holder makes a profit of $S^* - X_c$. The distinctive features of "free" puts are that the holder avoids the inconvenience of cash premiums at the cost of sacrificing some of the upside potential in the gold price. If the distribution of returns is stable, it is easily shown that the sacrificed potential is equivalent to the cash premium. In other words, as postulated by the "Free lunch theorem", there are no free lunches.

Caveats

The results of this section depend upon the assumption of stability in the diffusion process governing the gold price. They seemingly also depend upon the assumption that the attitudes of speculators in the futures market are characterised by risk-neutrality. In other words, Black's proposition that $E(S^*) = F$ apparently presupposes that speculators are indifferent to risk, as argued by Sharpe⁽¹⁸⁾ in connection with the expectations hypothesis of speculative markets, which closely resembles Black's standpoint. The rationale for Sharpe's view is set out in part 3 of an elegant and wide-ranging paper by Cox and Ross⁽¹⁹⁾.

6 SOME THOUGHTS ON MARKETING STRATEGIES FOR GOLD

The case for a mixture of strategies

Although the three possible pure strategies – spot sales, forward sales at the futures price and hedging by means of put options – have the same expected net revenue if the gold price diffusion process is stable, their outcomes will differ, and may well differ substantially, in the short

run. If the outcomes are ranked, R_S and R_F could be first, second or third; R_p could never be higher than second and might be third.

If one knew that the gold price was going to fall one would sell forward; if one knew it was going to rise one would sell spot. But one does not have foreknowledge of the future movement of the gold price. In these circumstances, the adoption of any of the three possible strategies is in the nature of a gamble. The outcome of a spot strategy is unpredictable, except within wide limits. A forward sale ensures a certain price, but that price may prove embarrassingly low compared with the eventual spot price. A put option guarantees a minimum net revenue and retains upside potential but, in any given case, the premium may prove to have been expensive.

In the current debate on gold hedging, the proponents of what may be described as the traditional policy of spot sales claim in its favour that it is what shareholders are used to and presumably what they want. Therefore, hedging is admissible only in exceptional circumstances – for example, to provide temporary protection for the operations of a marginal producer.

The case for hedging is more general than the "traditionalists" concede. A pure spot strategy, because of its higher variance of returns, is a greater gamble in the short run than its alternatives. For a short life producer, there is a danger that a pure spot strategy could jeopardise its survival, which the "traditionalists" recognise, and there is also the danger that, in present value terms, a significant proportion of its limited resource may be sold at prices lower than those that could have been secured by hedging. For such producers, hedging may well be preferable to a pure spot strategy. A profitable, long-life producer, on the other hand, faces neither of these dangers and, according to the "traditionalists", it should not hedge sales because the size of its resource places it in a position to pursue a pure spot strategy in the reasonable belief that it will be in business long enough for the ups and downs of the gold price to even out. But the long run is made up of a succession of short runs and it remains true – even for a profitable, long-life producer – that in any given short-run period the fruits of a pure spot strategy are quite likely to be less than a hedge would have provided.

In view of the above, there is, in the author's opinion, a respectable case for employing a mixture of the three pure strategies in the marketing of gold.

Put options and instability of the diffusion process

A mixed marketing strategy would mean that for any given period some gold would be sold spot, some sold forward at the futures price and the balance sold under put options at, say, the futures price. If the long-term payoffs from each of the pure strategies are the same, it is perhaps reasonable to suggest that the same weighting should be attached to them.

It must be noted, however, that the three strategies will not have equivalent, long-run, net revenues unless the gold price diffusion process is stable and, in particular, the volatility of the gold price is a known factor. It is necessary to determine by statistical analysis whether the variance of gold returns is subject to unpredictable variation over time. The possibility that the variance is unstable may serve as a partial explanation of the growing popularity of "free" puts among option writers. It would appear that in such circumstances the share of

upside potential afforded by a "free" put would be a safer currency than the cash premium from a conventional put. Be that as it may, instability of the diffusion process must, in the author's opinion, enhance the attractiveness to a gold producer of put options as a form of prudent, two-way bet and increase the weighting that should be attached to them in an overall strategy for marketing gold.

7 CONCLUSION

As this paper has covered a fair amount of ground, albeit rather cursorily, the purpose of this section is to summarise the principal findings and to express some thoughts on the directions that further research might take.

The main conclusions are as follows:

- (a) There is substantial evidence that the gold market is characterised by semi-strong efficiency and that the price of the metal conforms to a random walk.
- (b) The best estimate of S^* is F , but it is a very imprecise estimate because the standard deviation of S^* is large.
- (c) There is some evidence that the distribution of S^* is asymptotically lognormal.
- (d) Probabilistic limits for S^* may be defined, given that the distribution of S^* is stable, but the fact that the gold price is subject to a random process means that attempts to predict relatively precise values for S^* or even to predict whether S^* will be higher or lower than F are most unlikely to achieve a statistically significant measure of success.
- (e) For a gold producer, the expected net revenues from spot and hedging strategies are the same – namely, the futures price – provided the distribution of S^* is stable for a sufficiently long period.
- (f) In the short run, the outcomes of spot and hedging strategies are almost certain to differ, perhaps substantially, and in any short-run period it is quite likely, but not predictable, that a hedging strategy would yield a higher net revenue than a spot strategy.
- (g) In view of the above, there is a strong case to be made in favour of marketing gold by means of a mixture of spot and hedging strategies.
- (h) From a gold producer's standpoint, put options are preferable to forward contracts if the distribution of S^* tends to be unstable and if this instability is not fully reflected in the option premiums.

Conclusions (a) to (d) are well supported by empirical studies. Conclusion (e) should be regarded as tentative, however, as it depends on the validity of the expectations hypothesis of the relationship between S^* and F . Tests of this hypothesis would thus appear to be an important item on any agenda for further research in this field. Conclusion (e) depends also on the assumption that the gold price is subject to a stable stochastic process, while the Black-Scholes model assumes that the process is not only stable but also lognormal. Further research is obviously required in order to shed light on the questions of whether the process is stable to a satisfactory degree and whether the lognormal model is the best one to use.

It should also be noted that the discussion has focused on revenue in dollars. At the end of the day, however, a South African gold producer is interested in revenue in rand. The producer's dollar receivables may be sold forward in the foreign exchange market or converted at

the spot rate prevailing when the dollars are received, a decision that poses essentially the same questions as those raised by the decision whether or not to hedge the sale of gold. The rand-dollar exchange rate is thus a critical factor in gold-marketing strategies and therefore a comprehensive model of such strategies would have to make allowance for the forces that govern this exchange rate. As pointed out by Barr and Kantor⁽²⁰⁾, there is a strong empirical relationship between the dollar gold price and the dollar-rand exchange rate. As the dollar gold price is subject to a random process, it follows to some, possibly substantial, extent that the dollar-rand exchange rate is influenced by random factors and hence may be far less predictable than some local foreign exchange market operators, advisers and commentators appear to believe.

In conclusion, stochastic theory is highly relevant to a better understanding of the gold and foreign exchange markets. In view of the major role of the gold mining industry in the South African economy, it is important that the application of stochastic theory to the study of these markets should enjoy more attention from local economists and financial experts than it has received to date.

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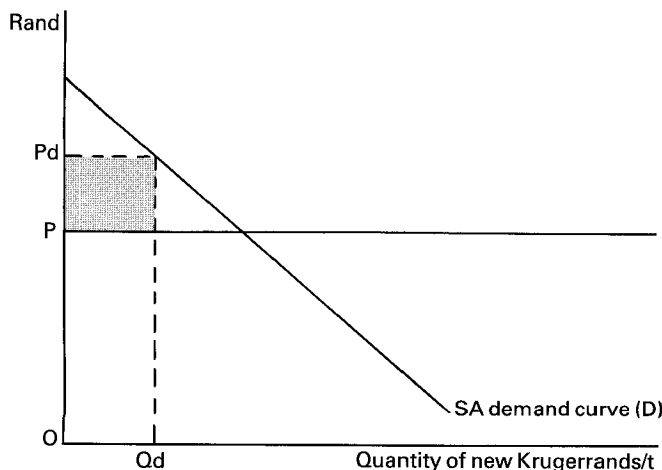
The Krugerrand premium – an optimal strategy for the Reserve Bank

The stated policy of the South African government is to abolish exchange control on South African residents gradually over a finite but unspecified time period.

Currently the Krugerrand sells in South Africa at a premium of about 17% over the ruling world gold price. A premium has persisted since the beginning of Krugerrand sales in South Africa, but its existence requires some explanation. Until the abolition of exchange control on non-residents in February 1983 it had been assumed by many that since the premium on gold shares was the inverse of the financial rand discount, the Krugerrand premium in the secondary market existed because gold shares and gold coins were close substitutes in the portfolios of South African investors. It was therefore to be supposed that the abolition of the financial rand would coincide with the disappearance of the Krugerrand premium in South Africa relative to world prices along with the premium on gold shares. The basis of this argument was the reasonable hypothesis that Krugerrands and gold shares were close substitutes in the South African investor's portfolio.

The persistence of the Krugerrand premium in the months following the abolition of the financial rand in February 1983 requires that a re-assessment be made of the situation. For some reason, good or bad, South African investors seem to exhibit a preference for gold in the form of gold coins rather than gold under the ground. The South African Reserve Bank is the monopoly supplier of new Krugerrands onto the South African market (importation is illegal) and is accordingly in a position to profit from this situation. Whether such profit-taking on the part of a government institution is either ethical or desirable depends on one's view of the desirability of exchange control generally, but clearly the strategy the Reserve Bank chooses to adopt has implications for South Africans who choose to hold Krugerrands as part of their portfolio. It will be explained that if the Reserve Bank decides to act as a profit maximising monopolist (the policy most in the interests of the South African taxpayer) the Krugerrand premium can be expected to vanish between now and the eventual date of exchange control abolition. Since this conclusion rests on a mathematical derivation which is not immediately obvious to non-mathematicians, a graphical exposition is initially presented.

Figure 1



Let the world price of gold in rands be P . In the absence of exchange control on residents this would also be the Krugerrand price ruling in South Africa. However, the Reserve Bank as monopoly supplier is able to restrict the quantity of Krugerrands available domestically and obtain a monopoly rent illustrated by the shaded area. The South African price of Krugerrands is, therefore, above the world price, say P_d . This static position is unstable, however, because unlike flowers or petrol, Krugerrands are durable goods. The quantity of Krugerrands held by South Africans tomorrow is closely related to how many Krugerrands are sold in South Africa today. The Reserve Bank can only increase sales beyond Q_d if it is prepared to reduce the price below P_d . The price in South Africa is a function of both the *stock* of Krugerrands held by South Africans and the *flow* of new Krugerrands entering the domestic market from the Reserve Bank. The situation is further complicated by the fact that the demand curve D is probably shifting outward to the right due to population and income growth within South Africa. At the same time the future must be discounted. Every time the Reserve Bank chooses not to sell a Krugerrand today it raises the market price it can obtain tomorrow but the Reserve Bank (and therefore the South African taxpayer) simultaneously forgoes interest on the revenue which could be obtained today. The problem for the Reserve Bank is therefore to select the flow of Krugerrands onto the domestic market, given the rate of discount and the shifts in the demand curve D , such as to maximise the profits earned on the South African market over time. It will be shown that the successful pursuit of such a strategy necessarily implies that the premium on Krugerrands must decline to zero between now and the time, T , when exchange control on South African residents is abolished.

Let the excess profit received by the Reserve Bank from the sale of Krugerrands in South Africa (i.e., the premium on the sale of coins locally over the world price) be $\pi(r(t), R(t))$ at time t , where r is the rate of flow of new Krugerrands onto the local market and R is the number of Krugerrands held in South Africa, i.e.

$$\frac{dR}{dt} = r \tag{1}$$

This excess profit function is itself a function of time, $f(t)$ which is a proxy for income and population growth. We assume a proportional relationship.

$$f(t) = \Pi(r, R)$$

The problem for the Reserve Bank is to maximise the net present value of this excess profit stream between the present ($t = 0$) and the time when exchange control is abolished ($t = T$) discounted at constant rate δ , i.e.

$$\max_{(r)} \int_0^T e^{-\delta t} f(t) \Pi(r, R) dt$$

Subject to (1), the Hamiltonian is:

$$H = e^{-\delta t} f(t) \Pi(r, R) + \lambda r$$

Taking partial differentials

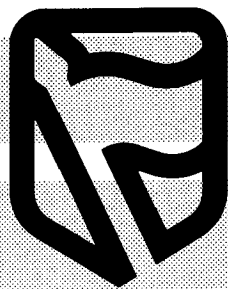
$$H_R = e^{-\delta t} f(t) \Pi_R = -\lambda \tag{2a}$$

$$H_r = e^{-\delta t} f(t) \Pi_r + \lambda = 0 \tag{2b}$$

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Differentiating (2b) with respect to time and substituting in (2a) we obtain:

$$\Pi_R = (f' / f - \delta)\Pi_r + \Pi_{rR}r + \Pi_{rr} dr / dt \quad (3)$$

We know that at time $t = T$, $H(T) = 0$ and $\lambda(T) = 0$ therefore from (2b)

$$\Pi_r = 0$$

and expression (3) becomes

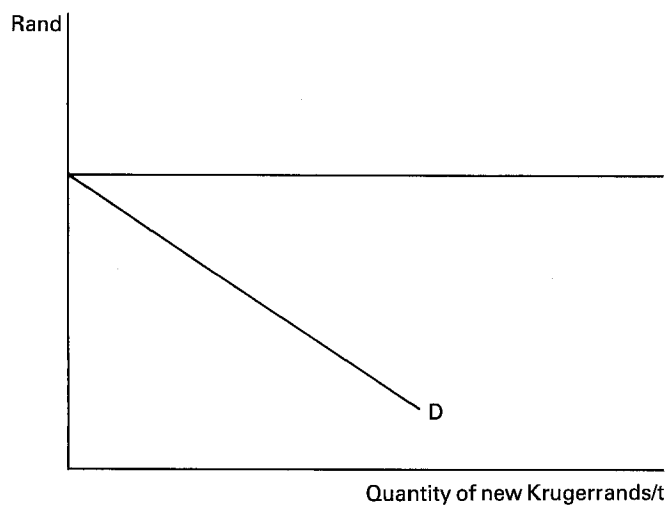
$$\Pi_R = \Pi_{rR}r + \Pi_{rr} dr / dt$$

This, however, is the same as the requirement that

$$\Pi / r = \Pi_r \quad (4)$$

or average excess profit = marginal excess profit. (This can be readily seen by differentiating (4) with respect to time.) Thus the solution at line $t = T$ must be as in Figure 2.

Figure 2



Whilst population growth and income growth may be shifting the demand curve to the right, the sale of Krugerrands which accumulate in investors' portfolios shifts the domestic demand curve to the left. The profit maximising strategy for the Reserve Bank is to sell Krugerrands in South Africa at a rate sufficient to cause a net leftward shift of the demand curve to the point where, at $t = T$ the premium has disappeared. This assumes that the authorities have at best some general idea of the likely value of T .

Such a policy, whilst in the interests of South African taxpayers, would clearly not be in the interests of South Africans who hold Krugerrands. However, the alternative strategy, to maintain the flow of Krugerrands onto the local market at such a level as to preserve the premium, must be equally disadvantageous to domestic holders of Krugerrands in the long run given the stated intention to abolish exchange control because when controls are abolished the Krugerrand premium must inevitably fall away.

Indeed, the readiness of South Africans to purchase Krugerrands poses many problems. Perhaps investors disbelieve the official statement regarding the eventual abolition of exchange control. (A related problem is to explain why anyone should be prepared to purchase a Krugerrand from a commercial bank at a greater premium than that ruling on The Johannesburg Stock Exchange.) It may be that investors are risk averse and discount the future at a rate which differs from δ , the rate used by the Reserve Bank. However, this does not alter the conclusion obtained above that the premium should fall away over time. If the Reserve Bank is pursuing a policy aimed at preserving the premium to protect existing Krugerrand holders then it is choosing to disregard the interests of the wider constituency of South African taxpayers and lining up Krugerrand holders for a nasty shock when exchange control is finally abolished.

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Interest rates, the exchange rate and money supply in South Africa

Paper delivered to the Economic Society of South Africa Conference 1983, 19/20 September

1 INTRODUCTION

In this paper we examine the workings of interest parity relationships under two different regimes. The first is one in which forward and spot exchange rates and interest rates are determined in free markets and capital is completely mobile; the second one in which the central bank manages the exchange rate system supported by exchange control, but borrowers still have access to foreign capital. The South African system follows the second example and by developing an exchange rate expectations model, we show how this system can give rise to net capital inflows or outflows and, hence, money supply effects depending on how these exchange rate expectations have compared with officially prescribed forward rates.

2 INTEREST PARITY UNDER FREE EXCHANGE RATE MARKETS

We consider the relationship between cost/rates of return in two financial centres which have unrestricted exchange rate markets and where there are no constraints on the mobility of capital between the two centres.

Treating the centres as "home" and "world" we have at some instant of time t ,

$$i_t^h = i_t^w + \frac{S_{t+1}^f - S_t}{S_t} \quad (1)$$

where: i_t^h is the rate of return/cost on/of an asset in the home money market in some risk class (annualised)

i_t^w is the rate of return/cost on/of an asset in the world money market in the same risk class (annualised)

S_t is the home/world exchange rate determined in the market at time t .

S_{t+1}^f is the forward home/world exchange rate determined in the market at time t representing the cost now of buying foreign exchange for delivery at time $t+1$ and it is assumed that the contracts on which the returns are i_t^h (or i_t^w) run for 1 time period.

The quantity $\frac{S_{t+1}^f - S_t}{S_t}$ is expressed in annualised terms.

Note, for example, that when this quantity is positive, forward foreign currency stands at a premium to the local currency.

Such a relationship will hold for all money or capital markets linked by mobile capital and which have efficient spot and forward exchange rate markets. Any deviation from these relationships will present opportunities to

make profit through arbitrage. Thus, for example, if i_t^h dropped so that the right hand side of (1) was less than the left hand side, one could borrow at i_t^h and lend at i_t^w covering the future foreign currency receipt and have a money-making machine.

S_{t+1}^f , the forward rate of exchange determined in the market, is closely related to the expected value of the market's perceived distribution of S_{t+1} at time t but will tend to be somewhat lower because of the risks of holding currency forward and transaction costs.

Thus:

$$S_{t+1}^f = E[\tilde{S}_{t+1}] \text{ adjusted for risk and costs quoted}$$

where: \tilde{S}_{t+1} is the perceived distribution of S at time $t+1$ in the market, given all available information.

In general, then, when the foreign currency is expected to appreciate against the local currency, it will stand at a forward premium (usually expressed in per cent per annum) to the local currency and when the foreign currency is expected to depreciate against the local currency it will stand at a forward discount.

Interest parity is, as indicated, an identity for efficient interest and exchange rate markets. It follows from maximising behaviour, specifically from attempts to borrow where costs are (expected to be) lowest or to lend where returns are (expected to be) greatest. Any deviations from interest parity will lead to adjustments of foreign or local interest rates or to spot or forward exchange rates.

3 INTEREST PARITY CONSIDERATIONS UNDER CENTRAL BANK MANAGEMENT

If the central bank should manage the spot and forward exchange rate markets, then firstly differences between local and foreign interest rates may not equal the exchange rate premium/discount as determined by the central bank and, secondly, this quoted premium/discount may imply a future exchange rate which differs considerably from what the market believes the exchange rate will be at the end of the relevant time period. We consider these situations, which are not mutually exclusive, in turn below.

In equilibrium for a managed exchange rate regime, the interest rate parity relationship with quoted forward rates will be of the following form:

$$i_t^h = i_t^w + \frac{S_{t+1}^f - S_t}{S_t} \quad (2)$$



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This forward quoted rate allows a borrower to have access to two risk-free transactions to obtain funds at different costs. He may borrow locally at i_t^h or he may borrow on overseas markets at i_w but cover his foreign currency liabilities forward by buying forward foreign currency at a fixed price. For the class of risk-free transactions a borrower will thus borrow locally if

$$i_t^h < i_w + \frac{S_{t+1}^f - S_t}{S_t},$$

and borrow overseas if

$$i_t^h > i_w + \frac{S_{t+1}^f - S_t}{S_t}.$$

The trader is, however, not committed to obtaining forward cover and he may not do this if his exchange rate expectations deviate sufficiently from S_{t+1}^f .

In equilibrium for the managed regime our interest rate parity relationship with expected market rates will have the following form

$$i_t^h = i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \quad (3)$$

where S_{t+1} is the distribution of S at time $t+1$ adjusted for risk and costs based on all available information at time t (note that part of this information will be the central bank's management record, i.e. it is a distribution *given expected intervention*).

As before, a borrower who has access to either local or uncovered foreign funds will borrow locally if

$$i_t^h < i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t},$$

and borrow overseas if

$$i_t^h > i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t}$$

(2) and (3) are both equilibrium conditions for risk-free and at-risk finance respectively. For a borrower to be indifferent to local or overseas sources of finance, both (2) and (3) must hold.

When either of the two equilibrium conditions do not hold, the borrower takes local finance if

$$i_t^h < \min \left[i_w + \frac{S_{t+1}^f - S_t}{S_t}, i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \right]$$

covered overseas finance if

$$i_w + \frac{S_{t+1}^f - S_t}{S_t} < \min \left[i_t^h, i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} \right]$$

uncovered overseas finance if

$$i_w + \frac{E[\tilde{S}_{t+1}] - S_t}{S_t} < \min \left[i_t^h, i_w + \frac{S_{t+1}^f - S_t}{S_t} \right]$$

It is seen that the central bank may adjust its quoted rate and provide forward currency at artificially low costs in order to increase the volume of capital account inflows and thus its foreign exchange reserves. This strategy is, however, generally assymetrical in that if it is attempting to stem an inflow of funds due to the market expecting exchange rate appreciation it will be unable to do this, unless it allows local private investors foreign investment avenues (and discounts forward prices of the local currency). This is to say, allows domestic interest rates to fall.

4 MONEY SUPPLY CONTROL UNDER MANAGED EXCHANGE RATES

These capital flows will generally have domestic money supply effects unless the central bank is able to conduct open market operations that simultaneously offset the impact of the balance of payments on the cash reserves of the domestic banking system. If the central bank is successful in this and the difference between the managed and market exchange rates persisted, the foreign exchange reserves of the banks would increase (or decrease) while their domestic asset holdings decline (or grow) proportionately. There are, however, limits to such intervention by the central bank. If the exchange rates are set so as to encourage off-shore borrowing, the limits will be the foreign borrowing capacity of domestic borrowers, but the incentive to borrow will exist as long as the central bank can prevent the money supply from increasing and domestic rates from falling, while at the same time preventing the undervalued managed rate from appreciating. If they are set so as to encourage repayment of foreign debt, the limiting factor will be the central bank stock of foreign exchange reserves, with market participants active until interest rates are allowed to rise and the exchange rate to fall.

Giving borrowers access to foreign markets will enormously complicate the difficulties the monetary authorities will have in using interest rates as instruments of money supply control. In the closed economy, the successful use of interest rates as instruments of money supply control requires accurate predictions of income and the income elasticity demand for money. In the open economy context, interest rates cannot be viewed independently of exchange rate expectations and foreign interest rates. This is because the central bank is not the only source of cash reserves for the banking system and thus the authorities have to predict the income and interest rate elasticities of capital flows.

The object of central bank intervention in the money and exchange rate markets may not, of course, be the control of the money supply but rather follow from a concern for the level of interest or exchange rates themselves or the level of foreign exchange reserves. Such considerations are obviously not consistent with money supply control.

5 THE MODELLING OF CAPITAL ACCOUNT FLOWS AND INTEREST RATES UNDER MANAGED EXCHANGE RATES IN SOUTH AFRICA

The exchange rate management by the South African Reserve Bank clearly parallels the illustration outlined above. We will show below how, by using a model to obtain exchange rate expectations, we can construct the spectrum of cost-of-finance possibilities and indicate how their implications for the direction of capital flows have been consistent with the South African experience. We consider the period January 1980–April 1983, and for that period compute the costs of local, covered overseas and uncovered overseas finance. The overseas

rate is taken to be the rate on New York three-month bankers' acceptances. The local rate is taken as the South African three-month bankers' acceptance rate. The overseas covered rate was computed as the overseas rate plus the all in three-month forward dollar premium/discount. The expected cost of uncovered finance was computed as the overseas rate plus the expected forward dollar adjusted for risk.

6 GENERATION OF THE EXCHANGE RATE EXPECTATION SERIES

A series of exchange rate expectations were generated by computing regressions (variables in log form) of the exchange rate (\$/R) against the gold price in dollars over a moving period of 12 months. This is assumed to capture market expectations of the Reserve Bank's management of the exchange rate, relative to the gold price. The expectation of the exchange for a particular month is then taken as the estimated value from the regression covering the preceding 12 months, calculated by substituting into the equation the average gold price for that month. The percentage deviation between the expected and actual exchange rate is taken as the expected premium/discount. The (out of period) variance of this estimate is estimated by its mean square error.*

The square root of this value is taken as a proxy for the risk associated with an exchange rate speculation, and this value in percentage form is added to the forward premium/discount to represent the increased perceived cost due to the risk. For example, if the variables are distributed normally and the Reserve bank's management of the exchange rate, relative to the gold price, remains the same, the uncovered borrower has an 82% chance of the cost of exchange rate movements over the contract costing him less than the estimate, i.e. the cost is put conservatively high.

The table on the following page gives the values for the various covered and expected uncovered forward premiums and hence finance costs.

This exercise is particularly instructive in how it demonstrates the gains to be had for South African borrowers with access to uncovered offshore finance from about August 1982. The Reserve Bank official forward rate which was implicitly predicting a decline in the rand was obviously out of line for an exchange rate, which had not moved from about 0,87 \$/R and a gold price which had increased by \$130. The effects on money supply over this period were, of course, moderated by massive open market operations by the Reserve Bank. The sudden decline in the gold price in late February 1983 reversed the exchange rate expectations and the expected cost of uncovered finance rose above local sources. The net inflows on capital account were thus transformed into outflows.

7 CONCLUSION

It is clear from the acceleration in the rate of growth of the money supply from approximately mid-1982 that exchange rate management over this period proved incompatible with stated money supply growth objectives. The association between changes in the gold price and changes in money supply growth over this recent period parallels developments throughout the 70s. That is,

since the gold price began to fluctuate and the rand became a floating currency managed by the Reserve Bank. The association between changes in the gold price and changes in the rate of growth of the money supply between 1971 and 1983 cannot be satisfactorily explained other than in terms of deviations from expected interest parity. An analysis of the determination of such deviations has been presented above.

Gold price changes impinge on the foreign exchange reserves of the central bank and the cash reserves of the banks through the trade account and the capital account of the balance of payments. It is the net flows of funds that are of importance. If interest parity relationships held continuously, there would be no net effects of the balance of payments on the money supply. Any change in the balance of payments or in expectations of the balance of payments, would lead to simultaneous adjustments of interest rates and exchange rates to equalise the supply and demand for foreign currency. The current and capital accounts of the balance of payments would sum to zero and the central bank would neither stimulate nor run down its foreign exchange reserves.

Variables in table

1. Exchange rate in US dollars/rand
2. Gold price in US dollars
3. Expected exchange rate in US dollars/rand
4. Expected premium discount on 3 month forward dollars (per cent annualised)
5. Quoted premium/discount on 3 month forward dollars (per cent annualised)
6. Expected premium/discount adjusted for risk (per cent annualised)
7. Rate on 3-month RSA bankers' acceptances (annualised)
8. Rate on 3-month New York bankers' acceptances (annualised)
9. Rate on covered New York finance
10. Expected rate on uncovered New York finance adjusted for risk (per cent annualised)
11. Decision taken by local borrower
12. Year-on-year growth in money supply (per cent)

* If X is the n X 2 matrix of the constant term and the gold price (n = 13) in the equation

$$\hat{y} = X\hat{\beta}$$

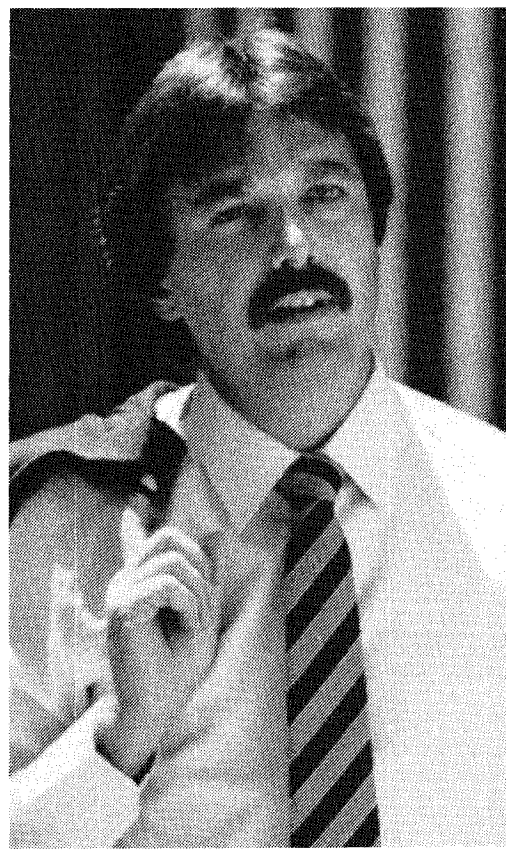
$$\text{M.S.E.}(\hat{y}) = E(\underline{y} - \hat{y})(\underline{y} - \hat{y})' = \sigma^2(1 - X(X'X)^{-1}X')$$

the 13th diagonal element of this matrix is the M.S.E. of the out-of-period gold price estimate of the exchange rate.

Interest rates, the exchange rate and money supply in South Africa

Table

	1	2	3	4	5	6	7	8	9	10	11	12	
January 1980	1,22	674	1,26	-3,52	-2,50	-2,81	4,40	13,24	10,74	10,43	Local	13,90	
	1,23	665	1,23	0,24	-2,50	0,81	4,80	14,65	12,15	15,46	Local	14,26	
	1,24	553	1,22	1,70	-2,50	2,13	4,80	17,29	14,79	19,42	Local	15,58	
	1,24	517	1,21	2,04	-9,75	2,67	5,40	14,39	4,64	17,06	Cover off	14,95	
	1,27	514	1,22	3,80	-4,50	4,64	5,10	8,42	3,92	13,06	Cover off	17,36	
	1,29	599	1,23	4,41	-4,25	5,76	5,00	8,33	4,08	14,09	Cover off	22,33	
	1,31	645	1,25	4,51	-4,50	6,30	4,70	11,37	6,87	17,67	Local	24,39	
	1,32	626	1,26	4,52	-5,75	6,66	4,80	8,44	2,69	15,10	Cover off	23,84	
	1,33	675	1,28	3,94	-7,75	6,41	4,90	10,77	3,02	17,18	Cover off	27,05	
	1,33	661	1,28	3,84	-8,25	6,49	5,20	13,71	5,46	20,20	Local	28,07	
	1,33	623	1,28	4,15	-9,40	7,00	6,10	16,58	7,18	23,58	Local	28,67	
	1,33	595	1,27	4,18	-11,32	7,28	7,00	13,30	1,98	20,58	Cover off	27,44	
	January 1981	1,34	558	1,27	4,65	-9,40	7,89	8,25	16,40	7,00	24,29	Coveroff	32,85
		1,29	500	1,26	2,28	-7,03	5,12	9,50	14,90	7,87	20,02	Cover off	34,14
1,27		499	1,27	0,01	-5,08	2,08	9,75	13,50	8,42	15,58	Cover off	34,54	
1,23		496	1,27	-2,99	-5,36	-1,33	9,60	15,40	10,04	14,07	Local	41,89	
1,20		480	1,26	-5,80	-7,13	-4,16	12,00	16,90	9,77	12,74	Cover off	37,75	
1,15		459	1,24	-7,50	-2,21	-5,32	14,50	16,10	13,89	10,78	Uncover off	34,07	
1,09		409	1,18	-9,08	-1,63	-6,25	15,50	17,20	15,57	10,95	Uncover off	32,04	
1,05		410	1,15	-9,47	-3,76	-5,94	14,25	17,17	13,41	11,23	Uncoveroff	31,02	
1,06		443	1,16	-9,80	-3,22	-5,61	13,75	15,39	12,17	9,78	Uncover off	26,09	
1,05		437	1,13	-8,24	-1,78	-3,84	13,75	14,53	12,75	10,69	Uncover off	25,77	
1,04		413	1,08	-3,77	1,39	0,53	14,25	11,10	12,49	11,63	Uncover off	25,34	
1,03		410	1,06	-2,28	2,32	1,70	15,25	12,70	15,02	14,40	Uncover off	25,12	
January 1982		1,04	384	0,98	5,23	1,90	8,47	15,75	13,60	15,50	22,07	Cover off	22,20
		1,02	374	0,97	5,42	1,24	8,99	17,25	13,50	14,74	22,49	Cover off	22,55
	0,98	330	0,90	7,99	3,82	11,40	18,00	14,30	18,12	25,70	Local	23,98	
	0,95	350	0,97	-2,55	2,28	0,98	17,00	14,10	16,38	15,08	Uncover off	16,26	
	0,94	334	0,95	-1,36	2,65	1,74	16,70	13,10	15,75	14,84	Uncover off	15,19	
	0,90	314	0,94	-4,36	1,54	-1,59	17,20	14,80	16,34	13,21	Uncover off	17,77	
	0,87	338	0,96	-10,00	2,95	-7,34	17,40	11,90	14,85	4,56	Uncover off	15,36	
	0,87	363	0,98	-12,25	6,06	-9,02	16,90	10,20	16,26	1,18	Uncover off	17,78	
	0,87	437	1,06	-21,82	6,10	-17,50	16,30	10,20	16,30	-7,30	Uncover off	18,84	
	0,86	422	1,00	-15,56	6,94	-9,32	16,10	9,10	16,04	-0,22	Uncover off	18,99	
	0,88	415	0,96	-9,04	7,15	-1,85	15,00	8,60	15,75	6,75	Uncover off	18,19	
	0,92	444	0,95	-3,46	7,01	5,04	14,60	8,70	15,71	13,74	Uncover off	17,41	
	January 1983	0,94	481	0,96	-1,84	6,16	6,16	12,30	8,50	14,66	14,66	Local	19,25
		0,91	492	0,94	-2,92	3,27	3,83	10,20	8,10	11,37	11,93	Local	17,20
0,92		420	0,89	2,99	1,43	8,89	11,80	8,90	10,33	17,79	Cover off	17,40	
0,92		433	0,90	1,32	2,47	4,71	11,60	8,40	10,87	13,11	Cover off	19,41	



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Popular myths: Gilt switching

Synopsis

Current methods of evaluating switches are inadequate to the extent of being misleading. Many make oversimplified assumptions regarding capital gains while all ignore the timing of the coupon payments and the accumulated interest from their reinvestment. If these factors are taken into account so that the switch is correctly evaluated the distinctions made between the various methods are unnecessary. Not surprisingly, the calculations required to evaluate a switch accurately also identify the stocks that will yield maximum returns and are all that are needed to construct optimum portfolios.

In gilt markets a switch is an exchange between two stocks that is intended to be reversed at a profit after a limited period. Various methods of identifying switching opportunities are applied. The main approaches in SA are:

1 YIELD ANOMALIES

Here deviations from the yield curve are used to pinpoint "cheap" and "expensive" stocks. Gilts with yields to redemption that lie above the curve are regarded as bargains while those with yields below are considered dear. The underlying assumption is that the deviations will only be temporary so that if a switch out of an expensive stock into a cheap stock is made it will be reversible at a profit. Of course, this is not necessarily true as some stocks always remain at a premium or discount. Other disadvantages are that no attempt is made to quantify the likely profit and coupon payments together with the interests from their reinvestment are ignored. Also, switches between stocks with yields which lie on the yield curve but which may ultimately yield higher profits are not considered.

2 YIELD DIFFERENTIALS

This approach exploits fluctuations in the difference in yields to redemption between pairs of stocks. When the yield differential is high the opening of the switch from the lower to the higher yielding stock is signalled. It is assumed that for the switch to be closed at a profit this differential must remain the same or, better still, narrow. Again no attempt is made to quantify profits and a heavy emphasis is placed on the size of the initial differential, rather than the extent to which it will change, as an indicator of potential capital gains. As with yield anomalies no attention is given to coupon payments or their timing.

3 PRICE RATIOS

The disadvantage the above yield signals have in not quantifying the capital gains can be avoided by using instead the present and expected future ratios of the clean prices of pairs of stocks. If a ratio is forecasted to increase by 10% a capital profit of this amount is indicated. Clean prices are used as total prices would produce distortions due to either accumulated interest or ex-dividend effects. Unfortunately clean prices still completely ignore the influence of coupon payments so that again the total profit from the switch is not actually indicated.

4 POLICY SWITCHES

Policy switches are identified by comparing the likely return from each stock over a fixed period of time known as the horizon period. Switches are then made from stocks with low expected horizon returns to those with high expected horizon returns. These expected horizon returns are calculated by taking into account the total purchase price, the expected total selling price at the end of the horizon period and the coupon payments during the period. Thus, if a switch is made from a stock with an expected horizon return of 10% per annum to one with an expected horizon return of 15%, the likely gain is 5%.

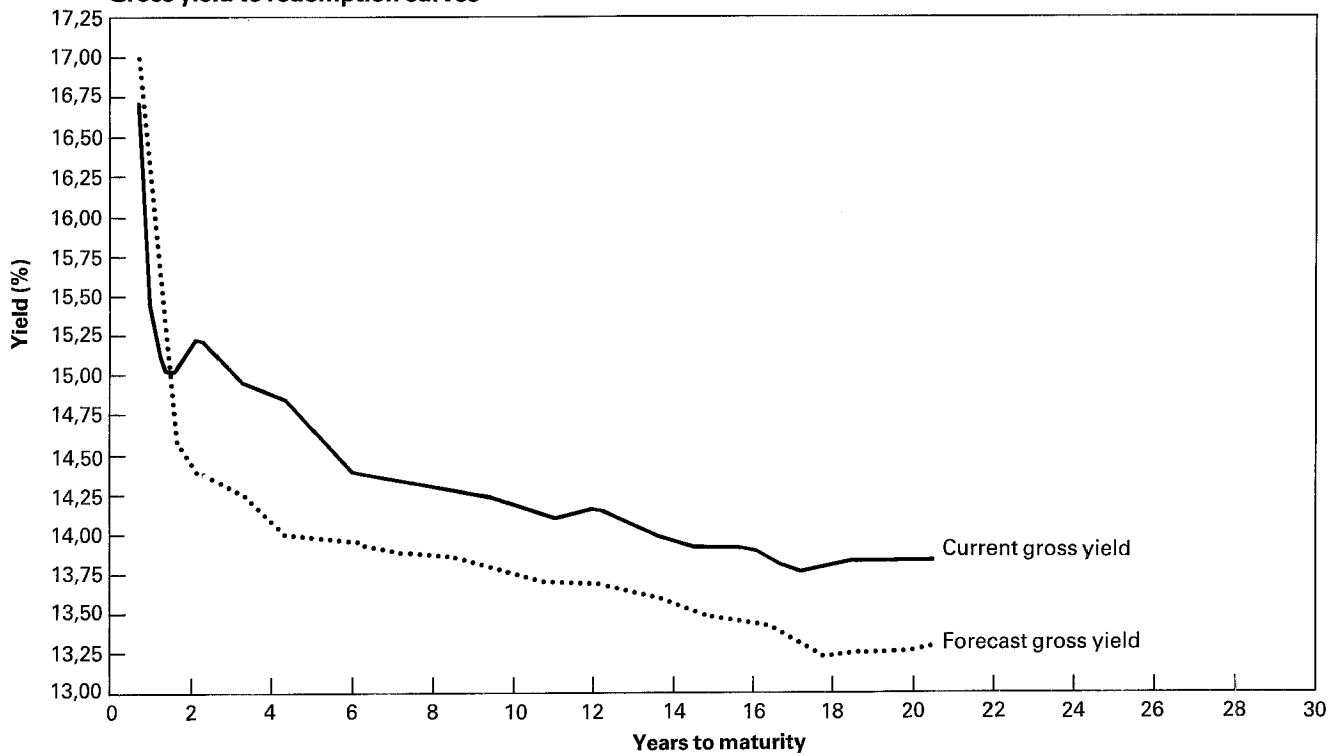
The only factor which is ignored in this approach is the timing of the coupon payments during the horizon period. This affects the interest that can be earned by reinvesting the coupon payment and should not be omitted.

From the above descriptions it is readily apparent that each of the above switching methods involves exactly the same variables. However, the last approach (the policy switch) quantifies more of the factors that can affect the profitability of a switch than any of the others. It, therefore, presents the more rational basis of choice and must be recommended above the other techniques. Nevertheless, we know that it, too, is not perfect as it does not take into account the interest that can be earned by reinvesting the coupon payments. If this final factor is also included a completely fair method of comparison would result.

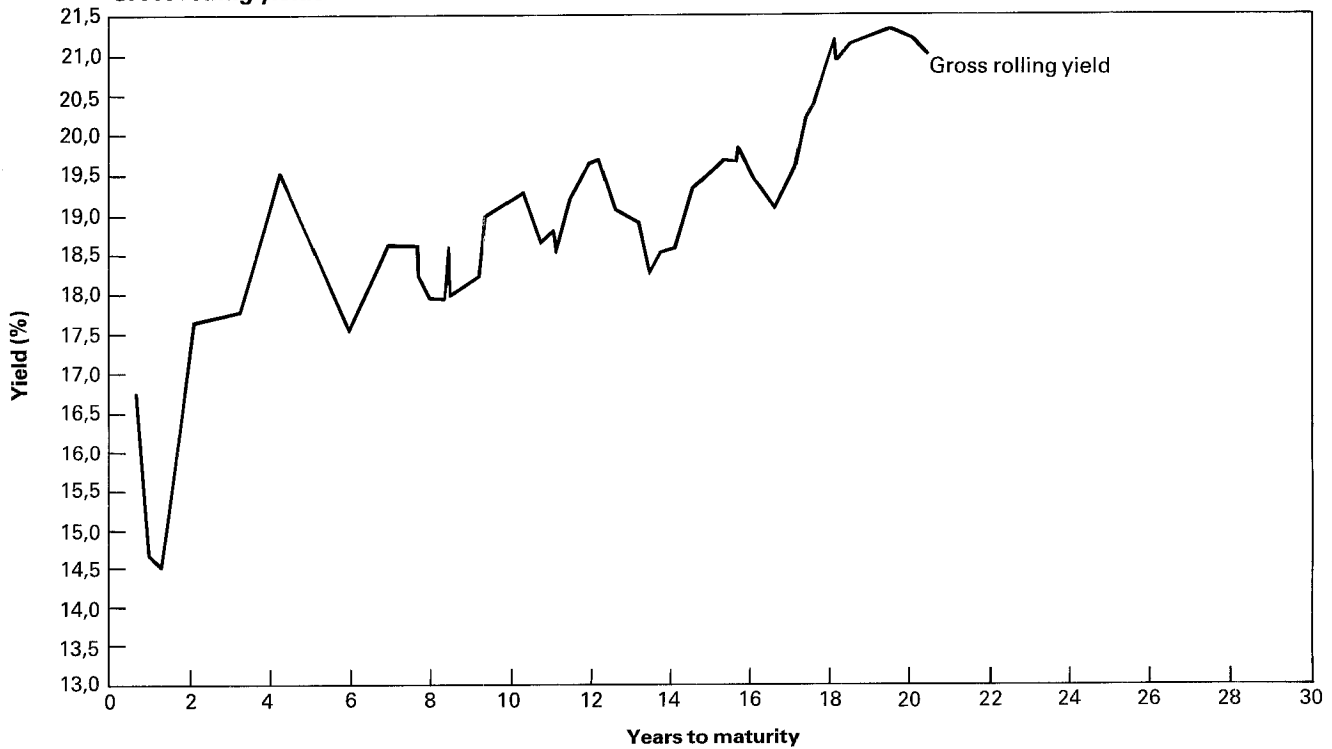
Such a comparison is offered by the expected rolling yield. The concept of the rolling yield was developed to assist in determining the optimum maturities from which to construct a portfolio. It, therefore, also provides the best method of choosing a switch. As with the policy switch, the expected rolling yield takes into account the purchase price, the expected selling price and the coupon payments but, in addition, includes an estimate of the accumulated interest from their reinvestment. In order to calculate the expected rolling yield for a particular stock it is, therefore, necessary to know the purchase yield to redemption at the beginning of the horizon period, the reinvestment rate expected at the date of each coupon payment and the anticipated sale yield to redemption at the end of the horizon period.

When forecasting the sale yield to redemption, it is practical to include an appropriate discount to ensure marketability for the less popular stocks so that the expected rolling yields are realistic. Plotting these expected rolling yields for the various maturities of the stocks in a particular category will provide the expected rolling yield curve for the specified horizon period. The expected rolling yield curves for the different categories then provide an easy method of identifying the best switches. The maximum point on any curve identifies the stock with the highest expected rolling yield and this is the best stock to hold or switch into over the horizon period. Conversely, the best stock to sell or switch from is the one with the lowest expected rolling yield and this will correspond to the minimum point on a curve. For any switch the difference between the expected rolling yields of the two stocks involved provides an exact and convenient estimate of the potential profit. Tax effects on expected rolling yields depend on the tax category of the purchaser but will not be considered here.

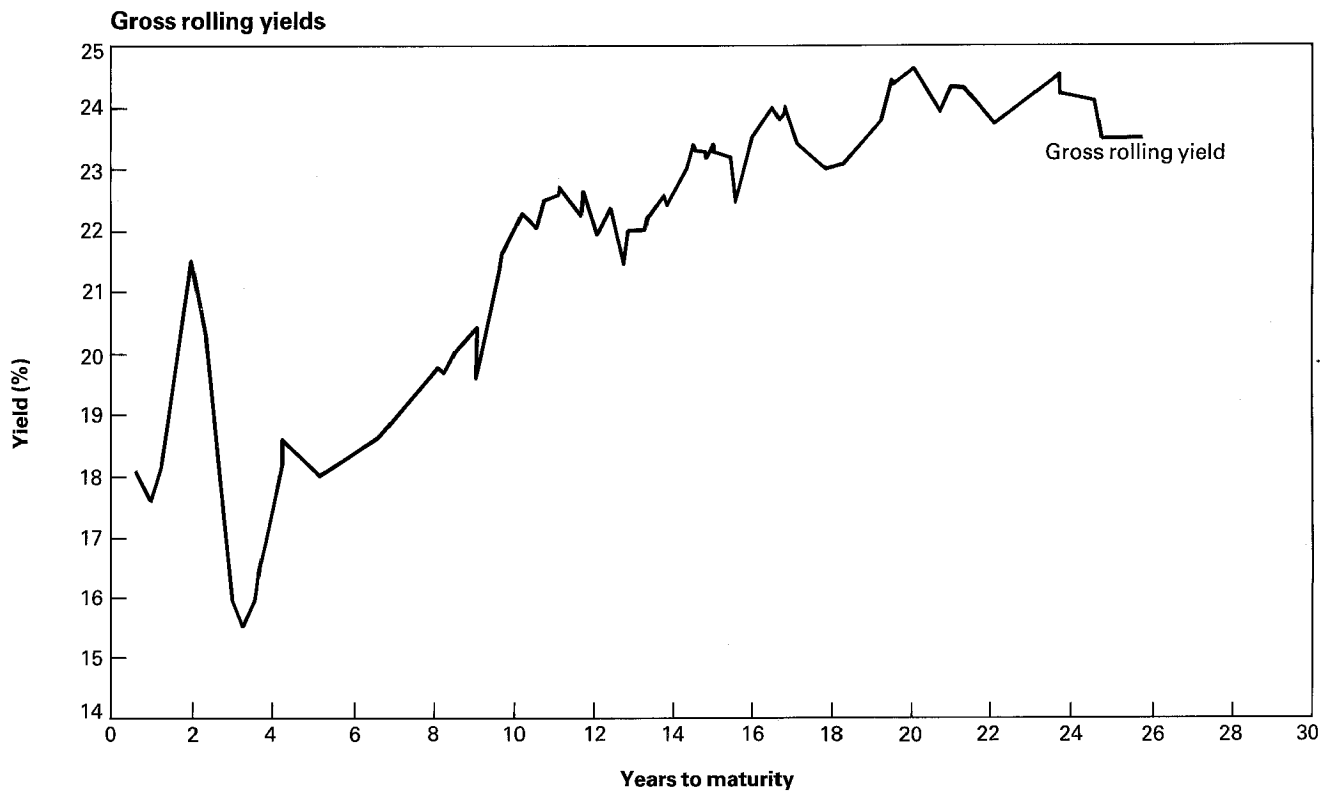
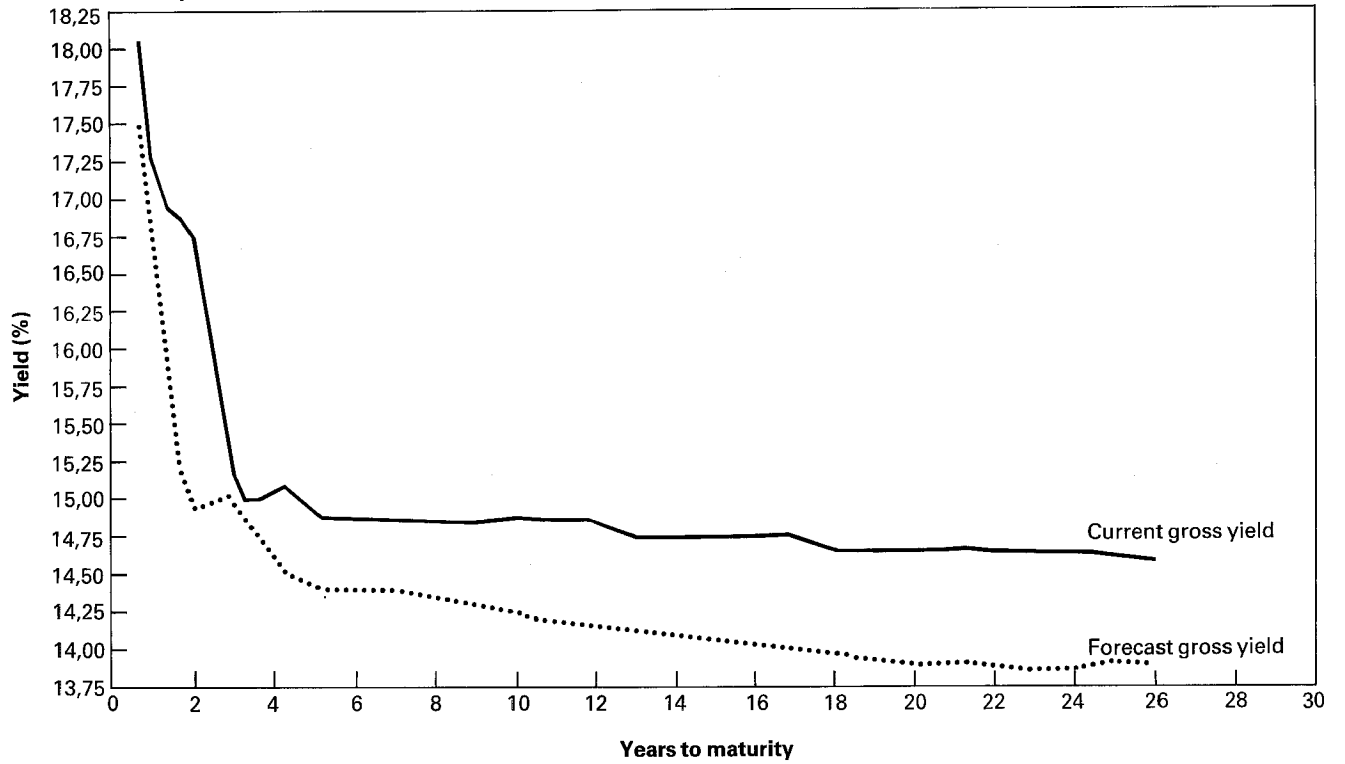
Republic of South Africa
 Horizon period: 7 months 17 February 1984 to 4 September 1984
 Gross yield to redemption curves



Gross rolling yields



Escom
Horizon period: 7 months 17 February 1984 to 4 September 1984
Gross yield to redemption curves



convenient estimate of the potential profit. Tax effects on expected rolling yields depend on the tax category of the purchaser but will not be considered here.

The graphs below show gross (ie before tax) expected rolling yield curves for R.S.A. and Escom stocks over a 7 month horizon period. Above these curves the corresponding purchase and forecasted selling yield curves used to calculate the expected rolling yields are also given. The rates at which the coupon payments have been assumed to be reinvested differ according to the timing of the payment and are based on expected call rates. (It can be assumed that coupon payments are reinvested in a stock. In this case coupon payments from the reinvested coupons must be taken into account and the calculations become more complex). Aside from reinvested income, coupon levels also affect capital gains or losses and so contribute significantly to the jagged shape of the expected rolling yield curves.

A glance at the two expected rolling yield curves shows that the highest returns (around 24%) are likely to be earned from Escom stocks with maturities of between 19 and 25 years and these are the best stocks to switch into or hold over the period. The lowest points (less than 16%) on both curves indicate that, in particular, some of the shorter dated R.S.A.s and Escoms should be switched out of or sold. Obviously, these are not the only switches that need be considered. Any switch which leads to an improvement in expected rolling yield is a step in the right direction.

In order to quantify the switches visually identified from the expected rolling yield curves more accurately, the actual stocks and returns used to construct the graphs are needed. The relevant points for our example are shown below:

Highest returns				Gross expected rolling yield
Stock description Type	coupon %	Maturity date	Years to maturity	% per annum
Escom	11,300	31/05/2003	19,283	23,809
Escom	10,750	31/05/2003	19,283	23,883
Escom	9,700	31/08/2003	19,535	24,466
Escom	10,250	31/08/2003	19,535	24,374
Escom	9,150	01/03/2004	20,036	24,618
Escom	8,650	01/03/2004	20,036	24,717
Escom	10,950	01/11/2004	20,706	23,975
Escom	9,550	01/02/2005	20,958	24,271
Escom	9,050	01/02/2005	20,958	24,356
Escom	9,550	01/06/2005	21,287	24,303
Escom	9,050	01/06/2005	21,287	24,386
Escom	12,950	01/04/2006	22,119	23,756
Escom	10,000	01/11/2007	23,704	24,550
Escom	13,200	01/11/2007	23,704	24,245
Escom	12,000	01/09/2008	24,539	24,136

Lowest returns				Gross expected rolling yield
Stock description Type	coupon %	Maturity date	Years to maturity	% per annum
R.S.A.	6,500	01/02/1985	0,958	14,679
R.S.A.	7,000	01/02/1985	0,958	14,682
R.S.A.	15,000	15/04/1985	1,158	14,579
R.S.A.	5,500	15/06/1985	1,325	14,482
Escom	6,125	28/02/1987	3,031	15,943
Escom	8,100	01/06/1987	3,285	15,471

These figures show the best switch would be from the R.S.A. 5,5% 1985 to the Escom 8,65% 2004 yielding an expected improvement of 10,235% (24,717%–14,482%) per annum over the 7 month period. Even a switch from say the Escom 12,950% 2006 to the Escom 9,150% 2004 would increase returns by 0,862% (24,618%–23,756%) which is a worthwhile improvement even for amounts of R1 million.

Finally, a note of caution. An optimum switch under one interest rate scenario may perform badly under another. It is, therefore, imprudent to carry out switches without first investigating the sensitivity of the expected rolling yields to changes in the forecasted selling yields and reinvestment rates. In this way, switches that perform well even under pessimistic assumptions can be identified and the downside risk reduced.