

The  
Investment  
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Journal

Number 22 December 1983

Die  
Beleggings-  
Navorsers  
Tydskrif

Nommer 22 Desember 1983

# The Investment Analysts Journal

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# Die Beleggings- Navorsers Tydskrif

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# Inhoud

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## This issue in brief

### **Keynes' theory of investment in retrospect**

This is the first of two articles intended to form part of a dedication in the centenary year of the birth of John Maynard Keynes. The article deals with the main features of Keynes' theory of investment but also examines it in the light of more recent developments in the field of portfolio theory and capital asset pricing. In its penultimate section, it considers Keynes' theory from an Austrian point of view. One of the principal criticisms of the Austrian school of neoclassical economics has to do with the unreality of general equilibrium analysis. Although this criticism can be levelled at Keynes too, the article finds that there are redeeming features in his treatment of investment which will ensure its continued relevance to future economists.

### **Keynes and the stabilisation of economic activity**

The second of our two articles on Keynes deals with stabilisation policy. This is a subject of continuing controversy between Keynesians and monetarists and, thus, has an intense contemporary relevance. The attitude of Keynesians has been that governmental intervention is justified when the free market is unable to produce the level of employment desired by the community. The attitude of monetarists has been that attempts at stabilisation are not necessary, and if initiated, are more likely to increase instability than to reduce it. Indeed, some monetarists would say that governments should not interfere with market freedom on principle, whatever the likelihood that their attempts at stabilisation will be successful. Dr Cloete discusses Keynes' approach to the matter fully, dealing, in particular, with problems concerning the relationship between saving, investment, interest rates and job creation.

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#### **A microcomputer database for a notional index fund**

The development of portfolio theory in the 1960s and 1970s represented an important conceptual advance, but in the area of portfolio management only organisations that could afford mainframe computers could contemplate its applied uses. Research undertaken in the Department of Business Science at the University of Cape Town, has attempted to fill the gap between data base availability and the use of microcomputers. This paper describes the building of a notional index fund that can be easily used by microcomputer users. Problems are identified and discussed, and the benefits to be derived from the construction of such a fund are made clear.

#### **The 'hidden' costs and benefits associated with different loan repayment frequencies**

This contribution from Australia sets out to analyse, mathematically, the costs and benefits associated with different loan repayment frequencies, depending on whether one is a borrower or a lender. Clearly, the nominal rate of interest charged need not provide the true indication of cheapness when other loan conditions are different.

#### **An introduction to gold mining tax – Part 3**

Ian Davies' concluding article on the subject of gold mining tax is contained in our Investment Basics section.

Financial Nightmare No. 6 - The Ex-Executive



**My financial nightmares put Bill Johnson right off his food.** Your company's going to be deep in the mire if any of your top guys disappear, I said. Your sales go for a loop, there's nobody to run production and goodness only knows who'd look after the finances. I was doing a beautiful job. Then somebody suggested talking to L&GV. They gave him this Business Income Benefit.

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# The Investment Analysts Journal

# Die Beleggings-Navorsers Tydskrif

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Twenty-second issue  
November 1983

There can be little doubt that John Maynard Keynes, who was born on 5 June 1883 and whose centenary, thus, is celebrated this year, was both a great economist and a great man. Even his most vehement academic critics would not deny that he helped change the world and that the change with which he was concerned was not without its positive aspects when it comes to considering matters of social improvement. If he is criticised today, it is more for what has been done in his name by others or because what he advocated was applicable to social circumstances that were different from those currently obtaining. As a result of Keynes' writings, thinking about economic theory was altered, and in a permanent way, and so was thinking about economic policy. Indeed, Keynes' real greatness resides in the fact that his influence was equally felt by men of contemplation and action.

Keynes had been born into an academic setting. His father, John Neville Keynes, was a Cambridge man, an economist of eminence in his own time, whose work on the methodology of economics survives to this day as an authoritative reference. The child, Maynard, not infrequently, was present when famous visitors to 6 Harvey Road, called to discuss matters of theory and policy with his father. Maynard, who died in 1946 at the age of 63, was survived by both his parents, and throughout his often tempestuous life, Harrod tells us, he was able to return to the house of his origins, to nourish its memories and serenity.

Schooling at Eton provided Keynes' first break with Cambridge, but it was a break of formality not substance. Spiritually, he remained true to Cambridge and its tradition of academic excellence and liberalism. Despite his advocacy of an extended government role in the economy, as a response to the withdrawal of private sector investment, it was on the Liberal benches of the House of Lords that he took his seat when, near the end of his life, he was made a peer. He had been critical of Lloyd George over the Versailles peace treaty (the polemic *The Economic Consequences of the Peace*, was a major attack on the British Government of the day), but returned to support him later, answering criticism of inconsistency that the reason was simple. He opposed Lloyd George when he was wrong, but that did not preclude his supporting him when he (Lloyd George) was right. What better could summarise the liberal ethic. Keynes was a liberal, but he was a liberal who believed that men held their destiny in their own hands. It was wrong to believe that *laissez-faire* required that they should abandon themselves helplessly to dark forces over which they could exercise no control. And who can doubt that in this he was right?

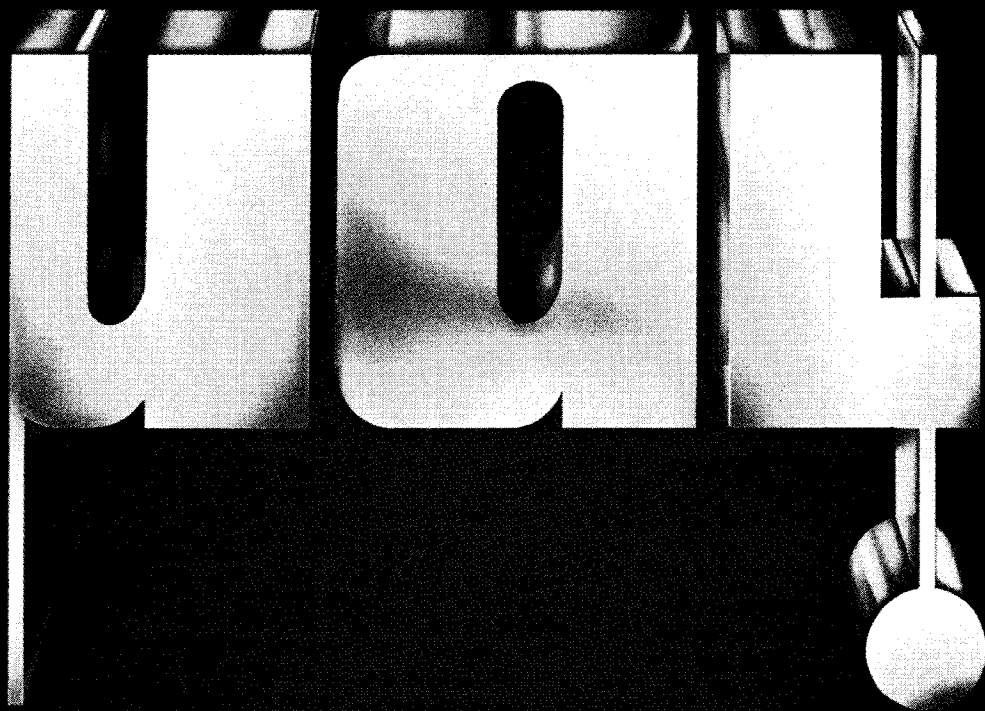
The interesting thing about Keynes was the diversity of his experience and concerns. At Cambridge he quickly,

Twee en twintigste uitgawe  
November 1983

Dit ly min twyfel dat John Maynard Keynes, wat op 5 Junie 1983 gebore is en wie se honderdste geboortedagherdenking dus vanjaar gevier word, 'n groot ekonoom en persoonlikheid was. Selfs sy heftigste kritici sal nie ontken dat hy gehelp het om die wêreld te verander nie en dat die verandering waarmee hy gemoeid was nie sonder positiewe aspekte was wat aangeleenthede soos maatskaplike verbetering betref nie. As hy vandag gekritiseer word, is dit eerder omrede dit wat in sy naam deur andere gedoen is of omdat dit wat hy bepleit het van toepassing was op sosiale omstandighede wat verskil het van dié wat vandag heers. As gevolg van Keynes se geskifte is denke oor ekonomiese teorie verander, en wel permanent, en so ook is denke oor ekonomiese beleid verander. Trouens, Keynes se grootheid is daaraan toe te skryf dat sy invloed eweneens deur denkers en daders bemerk is.

Keynes is in 'n akademiese omgewing gebore. Sy vader, John Neville Keynes, was 'n Cambridge-man, 'n ekonoom wat in sy eie tyd uitgestyg het en wie se werk oor die metodologie van die leer van die ekonomie tot vandag toe as gesaghebbende naslaanwerk bly voortbestaan. Die kind, Maynard, was dikwels teenwoordig wanneer beroemde besoekers by Harveyweg 6 aangedoen het om teorie- en beleidsake met sy vader te bespreek. Maynard, wat in 1946 op die ouderdom van 63 heengegaan het, is deur albei sy ouers oorleef, en volgens Harrod kon hy dwarsdeur sy dikwels stormagtige lewe na sy ouerhuis met sy herinneringe en kalmte terugkeer.

Sy skoolopleiding aan Eton het meegebring dat Keynes se bande met Cambridge die eerste keer verbreek is, maar dit was 'n formele, nie wesentlike, breuk nie. In die gees het hy getrou gebly aan Cambridge met sy tradisie van akademiese voortrefflikheid en liberalisme. Ondanks die feit dat hy die uitgebreide rol van die regering in die ekonomie voorgestaan het, as reaksie op die onttrekking van privaatsektorbelegging, het hy sy plek ingeneem tussen die Liberale in die Britse Hoërhuis toe hy kort voor sy dood tot lord verhef is. Hy het verskil van Lloyd George oor die vredesverdrag van Versailles (die polemiek *The Economic Consequences of the Peace* was 'n sterk aanval op die Britse regering van destyds), maar het hom later ondersteun en op aantygings van teenstrydigheid geantwoord dat die rede eenvoudig was. Hy het Lloyd George teengestaan toe hy verkeerd was, maar dit het hom nie daarvan weerhou om hom te ondersteun toe hy (Lloyd George) gelyk gehad het nie. Dis 'n onverbeterlike opsomming van die etiek van liberalisme. Keynes was 'n liberaal, maar hy was 'n liberaal wat geglo het dat die mens self oor sy lotgevallen beskik. Dit was verkeerd om te meen dat dit 'n vereiste van die *laissez faire*-houding was dat hulle hul hulpeloos



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and naturally, found himself involved with a generation of young, brilliant thinkers amongst whom Lytton Strachey was perhaps the most outstanding. Perhaps unnaturally, there was homosexual involvement, although this needs to be understood against the intellectual background of the group. Robert Skidelsky, who has just published the first volume of a new Keynes' biography, asserts that it was not that they believed women to be inferior in mind and body, rather it was young ladies who they despised. "Ladies spelt the destruction of truthful conversation . . . (they) . . . involved the rituals of wooing and of female coquetry and male display of plumage: the female pretending to be alarmed and repelled when in fact allured and predatory and the man becoming entangled in the falsities of gallantry, the affair ending in what they regarded as the squalor of settlements and dowries."\*

Out of Cambridge came Bloomsbury and eventual marriage to the famous Russian ballerina Lydia Lopokova. The small group of personalities that made up the Bloomsbury set, including Virginia Woolf and her sister Vanessa Bell, Duncan Grant, Clive Bell and Roger Fry, as well as Lytton Strachey, were among the most important of the artistic personalities of England in the post-World War I period. One has the feeling that Maynard's concern with economics and money may have been regarded with a measure of disdain in this esoteric company but he, certainly, did not allow materialistic interests to displace his involvement in literature and the arts. His writing has a powerful quality, and in quotability he rivals Winston Churchill. He was a patron of the ballet and a collector of both books and contemporary art.

From the point of view of the economist, what makes Keynes stand out is his preoccupation with flesh and blood investors and economic agents. The world of mathematical economics, where everything is reduced to a series of simultaneous equations, and time and uncertainty are excluded, is rejected. What has gone wrong with theory if it cannot explain why millions of men are out of work when, quite evidently, they are able and willing, at almost any price, to do so? This is the question for which Keynes sought to find an answer. It is to his credit that he assumed that it was the economic theory of the time that was incorrect and that the fault was not to be found in the real world. All along, with Keynes, when theory did not work in practice, it was theory which had to give ground. How different from the contemporary assertions of economic elitism: "No matter whether it works in practice, the question is 'Does it work in theory?'" It is when this confusion of the cart and the horse takes place that the way is opened for ideological dogmatism.

To be a successful investor, dogmatism of any kind must be shunned, and Keynes was a successful investor. He shored the German mark when he was convinced that errors of economic policy would lead to its collapse, and had the courage to stick with his judgement though things at first went against him. In the end he made a lot of money. He made a lot of money too for King's College, Cambridge, whose finances he assisted in managing as First Bursar. One has the picture of Keynes lying in bed of a morning going through the daily papers and other

moes oorgee aan die duister magte waaroor hulle geen beheer kon uitoefen nie. En kan daar enige twyfel daaroor bestaan dat hy, wat dit betref, gelyk gehad het?

Wat so interessant was omtrent Keynes was die veelsydigheid van sy ervaring en belangstellings. Dit was bloot natuurlik dat hy op Cambridge heel gou betrokke was by 'n geslag jong, briljante denkers van wie Lytton Strachey miskien die mees uitstaande persoonlikheid was. Daar was, miskien onnatuurlik, homoseksuele betrokkenheid, maar dit moet teen die intellektuele agtergrond van die groep gesien word. Robert Skidelsky, wat so pas die eerste deel van 'n nuwe Keynes-biografie die lig laat sien het, beweer dat dit nie was omdat hulle gemeen het dat vroue geestelik en liggaamlik minderwaardig was nie, maar eerder dat hulle jong dames verag het. "Ladies spelt the destruction of truthful conversation . . . (they) . . . involved the rituals of wooing and of female coquetry and male display of plumage: the female pretending to be alarmed and repelled when in fact allured and predatory and the man becoming entangled in the falsities of gallantry, the affair ending in what they regarded as the squalor of settlements and dowries".\*

Cambridge het tot Bloomsbury en sy uiteindelijke huwelik met Lydia Lopokova, die beroemde Russiese ballerina, gelei. Die groepie persoonlikhede wat die Bloomsbury-kring uitgemaak het, waaronder Virginia Woolf en haar suster Vanessa Bell, Duncan Grant, Clive Bell en Roger Fry, asook Lytton Strachey, was van die belangrikste kunstenaarspersoonlikhede in Engeland in die tydperk na die Eerste Wêreldoorlog. Mens kry die gevoel dat Maynard se betrokkenheid by die leer van die ekonomie en geld in dié esoteriese geselskap met veragting bejeën sou word, maar hy het beslis nie toegelaat dat materiële belangstellings sy betrokkenheid by die letterkunde en kunste verdring nie. Sy geskrifte word deur kragtigheid gekenmerk en wat pittigheid betref, steek hy Winston Churchill na die kroon. Hy was 'n beskermheer van die ballet en versamelaar van boeke en kontemporêre kunswerke.

Wat Keynes as ekonoom laat uittroon, is sy gemoeidheid met beleggers en ekonomie-agente van vlees en bloed. Die wêreld van wiskundige ekonomie waar alles tot 'n reeks gelyktydige vergelykings gereduseer word en tyd en onsekerheid uitgeskakel word, word verwerp. Wat het verkeerd geloop met teorie wat nie kan verduidelik waarom miljoene mense sonder werk sit en dit terwyl hulle klaarblyklik bekwaam en bereid is – feitlik tot elke prys – om te werk nie. Op dié vraag het Keynes 'n antwoord probeer vind. Dit streek hom tot eer dat hy veronderstel het dat dit die ekonomiese teorie van destyds was wat verkeerd was en dat die fout nie by die werklike wêreld gelê het nie. By Keynes moes die teorie altyd wyk as dit nie in die praktyk kon werk nie. Dit verskil hemels-breed van die hedendaagse stellings van ekonomiese elitisme: "Dit maak nie saak of dit in die praktyk werk nie, die vraag is 'Werk dit in die teorie?'" Sodra hierdie soort verwarring tussen die kar en die perd ontstaan, is die weg oop vir ideologiese dogmatisme.

Om 'n suksesvolle belegger te kan wees, moet dogmatisme van enige aard vermy word, en Keynes was 'n suksesvolle belegger. Hy het weggebly van die Duitse mark toe hy oortuig was dat foutiewe ekonomiese beleid tot

(\* Noel Annan. Young Maynard. A review of Skidelsky's book *John Maynard Keynes: Hope Betrayed 1883-1920*. Financial Times, London, 5 November 1983.)

(\* Noel Annan. Young Maynard. 'n Resensie van Skidelsky se boek *John Maynard Keynes: Hope Betrayed 1883-1920*. Financial Times, Londen, 5 November 1983.)



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documents before making his routine investment decisions. This was his habit. Only then did he get up to go to work in the City or to attend the affairs of State.

But it was in the realm of international finance that Keynes played his most important role. As the leader of the British delegation to the Bretton Woods conference in 1944, he was instrumental in designing the International Monetary Fund, though the plan he proposed was rejected in favour of that of Harry White, his United States counterpart. It is an irony that the inadequacies of the White plan, to which Keynes drew eloquent attention, are the inadequacies which today are at the heart of our current problems regarding the international financial system. Perhaps, had Keynes lived, these problems would not have been so threatening to our future economic stability as they now appear.

We dedicate this issue of the Investment Analysts Journal to John Maynard Keynes, a trustee not of civilisation, but of the possibilities of civilisation, words he so appropriately used in toasting his colleagues of the Royal Economic Society. They are words which most truly fit the man himself.

**The editor**

die ineenstorting van dié geldeenheid sou lei en hy het die moed gehad om hom by sy besluit te hou toe hy aanvanklik teenkanting ondervind het. Op die ou end het hy baie geld gemaak. Hy het ook baie geld gemaak vir King's College, Cambridge, waar hy as hoofleser met die finansies behulpsaam was. Dit was Keynes se gewoonte om die koerante en ander dokumente soggens in die bed te lees en sy roetine-beleggingsbesluite ook daar te neem. Dan eers het hy opgestaan om in die Stad te gaan werk of na staatsake om te sien.

Dit was egter op die gebied van internasionale finansies dat Keynes sy belangrikste rol vervul het. As leier van die Britse afvaardiging na die Bretton Woods-konferensie van 1944, was hy behulpsaam met die beplanning van die Internasionale Monetêre Fonds. Die plan wat hy voorgestaan het, is egter ten gunste van dié van Harry White, sy eweknie in die Verenigde State, verwerp. Dit is ironies dat die ontoereikendheid van die White-plan, waarop Keynes met welsprekendheid die aandag gevestig het, juis die ontoereikendheid is wat vandag onderliggend is aan ons huidige probleme met betrekking tot die internasionale finansiële stelsel. As Keynes nog geleef het, sou dié probleme miskien nie so 'n groot bedreiging, soos wat vandag die geval blyk te wees, vir ons toekomstige ekonomiese stabiliteit ingehou het nie.

Ons dra hierdie uitgawe van Die Beleggingsnavorsers Tydskrif op aan John Maynard Keynes, 'n trustee, nie van die beskawing nie, maar van die moontlikhede van die beskawing – gepaste woorde wat hy eenkeer gebesig het toe hy 'n heildronk op sy kollegas van die Royal Economic Society ingestel het. Dié woorde beskryf die man self ten beste.

**Die redakteur**

# G By ons blink meer as net Goud

Die grootste groeiende myn- en industriële groep in Suid-Afrika, met 'n omset van papier, pulp en papier. Hierdie maatskappy se omset het in die laaste vyf jaar met 128% verbeter. Sy wins na belasting het in dieselfde tydperk met 200% toegeneem.

Sappi het onlangs met 'n uitbreidingsprogram ter waarde van R800 miljoen begin – die grootste enkele projek in sy soort in die papierbedryf ter wêreld. Op die keper beskou, 'n winsbelegging.

Dieselfde geld vir Trek, ons oliemaatskappy. Dit geld vir Unicorn, die skeepvaartonderneming wat deur ons beheer word. Ook vir die boerdery- en voedselgroep Kanhym, waar ons omset binne die bestek van twee jaar van R48 miljoen tot R952 miljoen gestyg het.

Maar ons breë grondslag bly nog steeds die mynbedryf. Meer as 67% van ons belange is daarop toegespits – in goud, uraan, platina, steenkool en onedelminerale.

Die sukses van Gencor kan nie bloot aan diversifikasie toegeskryf word nie. Dit is ook die eindresultaat van 'n rasionele en selektiewe uitbreidingsprogram. Gerugsteun deur 'n beleid van sterk, gedesentraliseerde bestuur.

Gencor is vandag een van die voorste myn- en industriële groepe in Suid-Afrika, met 'n geraamde jaarlikse omset van R5 biljoen en 'n standhoudende verdienstegroei van 29% per jaar oor die laaste tien jaar.

**Deel in ons groei.**



General Mining Union Corporation Beperk

# Keynes' Theory of Investment in retrospect

## INTRODUCTION

In his introductory chapter to the *General Theory*<sup>(1)</sup>, Keynes explains the reasons for his attack on the classical school of economic thought<sup>(2)</sup> which, until then (1935) had tended to dominate both the governing and academic classes of his generation. The trouble with classical theory was that it applied only to the special case of full employment equilibrium. Given the unemployment and disequilibrium of the interwar period, this made its teachings "misleading and disastrous" if it was attempted to apply them to the facts of experience.<sup>(3)</sup>

It is an irony that in our time the criticism of a lack of relevance to the problems of the real world should have come to be levelled at Keynes himself though, in no small measure, the changed situation we enjoy today is the result of the success of policies he advocated in dealing with involuntary joblessness. Just as the irrelevance of classical economics can, in part, be explained by the fact that the world had changed, so what current irrelevance can be attributed to Keynes can also be explained the same way. The world of 1983 is a vastly different one from the world of 1933 not just because inflation has replaced deflation as the focus of public concern, but also because, in structural terms, the world today is different. The affluence of the West is vastly greater and its influence more widespread. International trade is conducted on a scale much larger and the economic interdependence of nations is a fact even more inescapable. And this is so not just because technological advance has made a reality of the global village but also because self-sufficiency, even for the United States, has ceased to be possible. Today, within national boundaries, massive corporations have emerged, partly under the dictates of the economies of scale, and the scope of competition has been reduced. But in a world context, competition has increased, and so world trade has become essential to the preservation of the market place and, therefore, also of consumer freedom. This is not how things looked fifty years ago. However, it is a measure of the greatness of Keynes, and particularly of his theory of investment, that so much of what he wrote remains true in our time and of value to the search for the solution of contemporary problems.

The purpose of this paper will be to examine the main features of Keynes' theory of investment and the way in which theoretical advance, especially since 1950, has come to change modern perceptions. However, it will also deal with the limitations of post-Keynesian thought and will attempt to provide a wider perspective.

## THE MARGINAL EFFICIENCY OF CAPITAL

Two ideas dominate Keynes' theory of investment: the idea of the marginal efficiency of capital and the idea of liquidity preference. These deal, respectively, with investors' expectations of return and the cost against which that return must be measured before a decision to commit capital funds can be taken. As will be discussed below, the Keynesian theory of the rate of interest, makes the rate of interest that factor which equalises the desire to hold wealth in a liquid form with the available supply of money.<sup>(4)</sup> This is something different from the classical notion which defined the rate of interest simply as the price which equated the demand for investment funds with the supply of savings.<sup>(5)</sup>

Despite the impression created by many Keynesians, the concept of the marginal efficiency of capital has a long

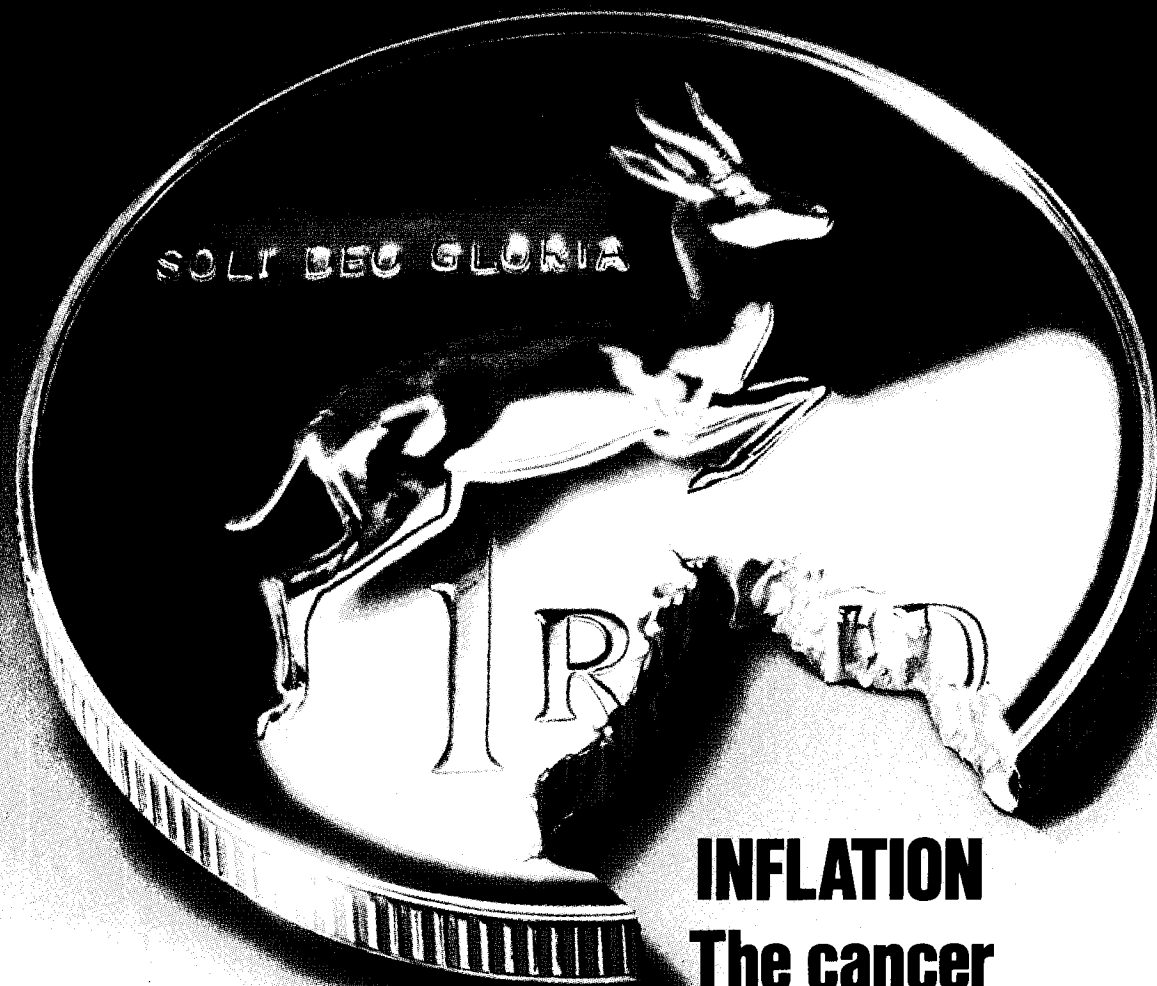
history in classical theory. For example, Henry Thornton (1802) provided one of the earliest explanations of investment in terms of the difference between the money rate of interest and the return to be gained from "enterprise". The same idea was formalised by Wicksell in distinguishing between the money rate and the natural rate of interest. With such an analysis investment takes place as long as the incremental return on existing capital exceeds the cost of putting relevant additional machinery and equipment in place. In the Keynesian system, what is important is not the return on existing assets but the return **expected** at the margin as a consequence of the expansion of the capital stock. The Keynesian system, therefore, is interesting because it introduces a dynamic factor. Expectations become primary in the chain of causality in respect of investment. But expectations may be influenced by indeterminate psychological factors. The classical system was mechanistic and its process of adjustment dominated by deterministic forces. That is, the money rate of interest always adjusted to a unique natural rate so as to generate a full employment equilibrium. In Keynes, there is no unique natural rate and the money rate of interest may, in deflationary conditions, set a point of effective demand at which unemployment exists in the long-run.<sup>(6)</sup> In this system, the separation in time between decision and outcome is also crucial. Once that separation is admitted, so too is risk and uncertainty. These are factors which had only a limited place in classical theory.

We will have more to say about Keynes' method in Section 5 below. For the moment it will suffice to observe that although Keynes introduced dynamics to his analysis, he did not do so completely. As Shackle once observed, Keynes attempted to deal with the question of dynamics using the tools of comparative statics.<sup>(7)</sup>

Nothing demonstrates the limits of Keynesian dynamics more than the concept of risk that it implies. Keynes' notion of the marginal efficiency of capital corresponds to what, in terms of current financial theory, is known as the internal rate of return or the discounted cash flow (DCF) rate. This is the rate which, when applied as a discount factor, brings projected cash receipts and payments to exact equality with each other in present value terms. Clearly, if the internal rate of return of a project is greater than its cost of financing, something positive will be added to the value of the firm by undertaking it, and conversely. Risk is acknowledged in such a scheme by allowing for variations in the discount factor. Thus, a more risky project will attract a higher discount rate compared with a less risky project, although no objective way is suggested as to how the different discount rates should be determined. This is left to the subjective judgement of management, a factor which adds to the indeterminacy of expected net returns. It was not until the development of the capital asset pricing model (CAPM) in the 1960s and 1970s that this problem was solved, at least conceptually.

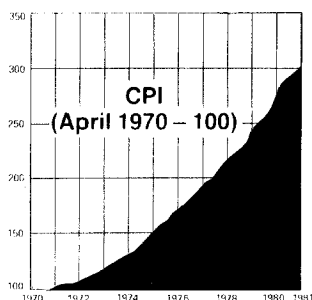
In terms of the CAPM, a firm's cost of capital is derived from its market evaluation, and it is this what gives it objectivity. In theory, the cost of capital can be defined as the minimum rate of return that must be earned on capital employed in order to leave unchanged the market price of its ordinary shares. The model takes the following general form:

$$R_j = i + \left( \frac{R_m - i}{\sigma^2_m} \right) (r_{jm} \sigma_j \sigma_m)$$



# INFLATION

## The cancer and the cure



The graph illustrates the escalation in the cost of living since 1970 as measured by the S.A. Consumer Price Index.

	PRICE 1970	PRICE 1981	PRICE 1991
Litre of petrol	9,2c	61,0c	?
Small car	R2 315	R7 795	?
Loaf of bread	9,4c	42,0c	?
Carton of milk	17,0c	38,0c	?

Examples of the alarming rate at which the purchasing power of money has reduced.

Assuming	1981	1986	1991
7 1/2% pa	R10 000	R6 966	R4 852
10% pa	R10 000	R6 209	R3 855
12 1/2% pa	R10 000	R5 549	R3 079

The purchasing power of R10 000 will reduce as follows, assuming various rates of inflation.

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where  $R_j$  = the return on security  $j$ ;  
 $i$  = the risk-free rate of interest (eg the yield on government stock);  
 $R_m$  = the expected return on the market portfolio;  
 $\sigma_m$  = the standard deviation of the probability distribution of market returns;  
 $\sigma_j$  = the standard deviation of the probability distribution of returns on security  $j$ ;  
 and  $r_{jm}$  = the correlation coefficient of the returns of security  $j$  and the market.<sup>(8)</sup>

The last term of the expression represents the covariance of the security's returns with those of the market. Clearly, the greater the covariance, the greater the return required from the security in question, and conversely. It can also be seen that the model implies a value in a low covariance of returns. This would be so because a low covariance permits a reduction of risk through diversification.

Using the standard deviation of returns as a surrogate for risk (a procedure justified when the distribution of historical returns is symmetrical around their mean value),<sup>(9)</sup> it has been empirically demonstrated by Wagner and Lau, that risk declines as the number of shares in a portfolio increases, and that the rate of risk decline is directly linked to the issue of covariance.<sup>(10)</sup> Obviously, the lower the covariance of return with two securities, the more risk will be reduced through their mixing in portfolio holdings. However, what Wagner and Lau's research also confirms is that a point is reached beyond which risk cannot be reduced any further. In CAPM terms, the risk which can be washed away through diversification (unsystematic risk) can be disregarded when determining a company's cost of capital, and what matters is that risk (systematic risk) which remains. By definition, systematic risk is the risk of the variability of all shares taken together. It is not peculiar to particular securities.

If what has been described above is accepted, the CAPM can be reformulated as follows:

$$R_j = i + (R_m - i) \beta_j$$

Where  $R_j$ ,  $R_m$  and  $i$  are as defined previously and  $\beta_j$  is the regression coefficient of the returns of security  $j$  against the returns of the market. In short,  $\beta$  replaces  $\sigma$  as the risk surrogate.

What is of interest to us in this discussion, are the dual dimensions of risk. Clearly, the fact that unsystematic risk can be reduced is important to equity valuation and this should not be disregarded. In the traditional system, in which it is fair to include Keynes' concept of the marginal efficiency of capital, no distinction between systematic and unsystematic risk is made.

### LIQUIDITY PREFERENCE

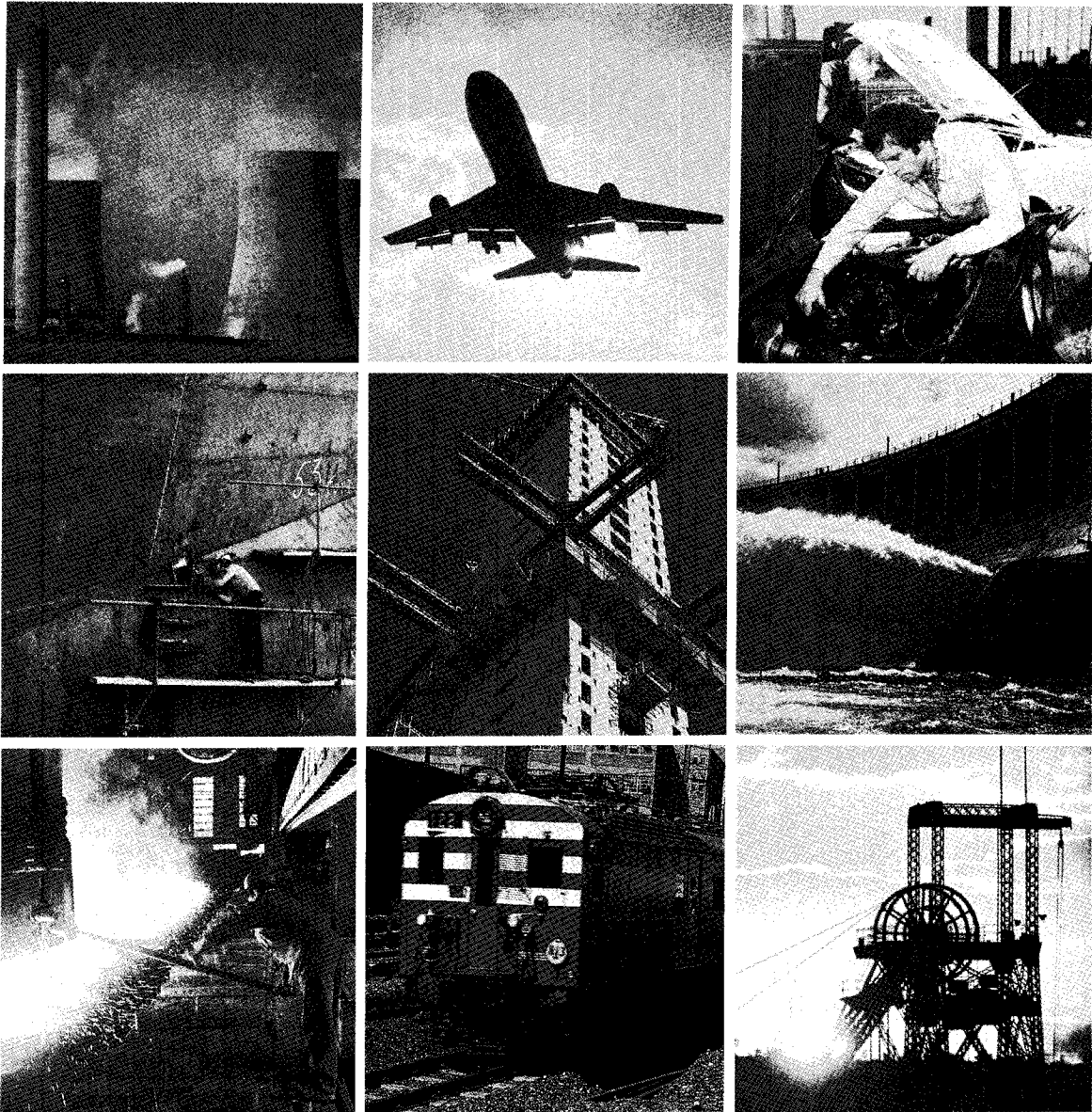
The second idea upon which Keynes' theory of investment rests is liquidity preference, and as already noted, this is important because it concerns the rate of interest. Given the supply of money, the rate of interest can be determined once the schedule of the community's willingness to hold cash balances is known. Keynes identified three basic motives for holding cash in the General Theory, namely, the transactions motive, the precautionary motive and the speculative motive. Space does not permit a detailed discussion of them here but it is

necessary to observe that it is only the speculative motive that is concerned with **changes** in interest rates.<sup>(11)</sup> The transactions demand for cash is predominantly a function of income, and so too, essentially, is the precautionary demand for it.<sup>(12)</sup> With the speculative motive, cash balances are varied according to expectations regarding security prices. If these are expected to decline, the demand for liquidity will increase, while an expectation of a rise in prices will be associated, *cet. par.*, with a reduction in liquidity preference.

In the classical system, the rate of interest was the compensation paid to consumers for postponing acts of consumption and this was linked directly to the productivity of investment. In other words, as Chick notes, buyers of financial assets were not concerned with market psychology but only with prospective "real" returns. This unfortunately does not describe how investors behave in the world of actuality. Even professional portfolio managers cannot ignore the conventions upon which market valuations are based and are judged on their ability in anticipating changes in such conventions. "... it is not sensible to pay 25 for an investment of which you believe the prospective yield to justify a value of 30, if you also believe that the market will value it at 20, three months hence."<sup>(13)</sup> Chartists, the users of technical analysis,<sup>(14)</sup> will sympathise with this. We are face to face with the famous problem of the beauty competition where the objective is to select not the faces of those girls who one genuinely thinks the prettiest but those one thinks average opinion thinks the prettiest when all other competitors in the selection process are approaching the problem from the same point of view. "We have reached the third degree where we devote our intelligences to anticipating what average opinion expects average opinion to be."<sup>(15)</sup> This is hardly a mechanism for ensuring the efficient allocation of scarce resources in the economy.

However, while Keynes' notion of liquidity preference represented an important advance on the thinking of the classical school, it, too, failed fully to describe how investors behave in the real world because it ignored the matter of the diversification of portfolio holdings. In simple, Keynesian formulations, investors hold either cash, bonds or equities, but the link between their decisions and real investment, runs aground on the shoals of the capital debate.<sup>(16)</sup> We have not yet arrived at the destination where choice has to do really with what combination of cash, bonds and equities are most suited to the needs of a particular investor with a specified aversion for risk and requirement of return. Nor is the matter of the composition of equity holdings even considered. And the fault is not difficult to find.

Under the traditional scheme of things, where risk has but one dimension and one rate of discount is used for each separate investment evaluation, though differences in risk are allowed for, as between choices, something important – one might say crucial – is left out. Taken to its logical conclusion, the traditional system confronts the investor with ranked alternatives, and he should, logically, choose that **one** investment which, risk having been taken account of, offers him the largest premium of present value over ruling market price. But that is not the choice the real world investor makes. He confounds us by declining to be an optimiser but, instead, makes a selection, which may include all the alternatives available, that best satisfies his requirements of security and income. Either explicitly or intuitively, he behaves in a Markowitzian<sup>(17)</sup> manner, diversifying his holdings, not putting all his eggs in one basket.



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In discussing Tobin (an acknowledged Keynesian), Chick has argued that portfolio theory should not be seen as a development of, or as an advance upon, Keynes' liquidity preference notion. Rather it should be seen as an entirely different theory relating to transactors with different motives and patterns of behaviour.<sup>(18)</sup> This, however, ignores the extent to which portfolio theory (whether we are talking about Tobin, or about Markowitz and Sharpe) builds on classical foundations. It also ignores the confusion that exists in the General Theory itself regarding the characteristics of speculation and investment. While Keynes' definitions of these two variables are unambiguous, his discussion of professional investment suggests that this, strictly, is not investment at all. The confusion originates in the basic assumptions of the classical system from which Keynes had not really freed himself. The classical economic agent is an optimiser, either of utility or of profit. Real world economic agents are not optimisers. They are risk averse satisficers, seeking positions that trade-off often conflicting objectives. The fact is, however, that portfolio theory is itself not free from the basic assumptions of the classical system and, thus, also fails in the quest for greater practical relevance.

### PORTFOLIO THEORY

We referred above in Section 2, to the CAPM providing at least a conceptual solution to the problem of the cost of capital. In the traditional scheme this is left to the subjective determination of management. It is not an objectively determinable factor. The beauty of the CAPM is that it removes the calculation of the cost of capital from the subjective arena and places it squarely in the arena of objectivity – but alas only in theory. Two problems have still to be confronted and these prove to be insurmountable.

The first problem relates to technical difficulties in quantifying expected returns and betas. The CAPM is an elegant construct and its deductive consistency is impressive. However, it rests entirely on the notion of expected return and this cannot be measured. It also rests on the notion of the beta coefficient as a surrogate for risk, but the beta proves in practice to be an uncooperative concept. It frequently fails to exhibit the statistical stability or stationarity necessary for its application to probabilistic problem solving. If neither of the two pillars upon which the CAPM rests can be relied upon, the whole construct of the hypothesis must be questionable.

But the matter goes further even than this. We have referred already to the dependence of portfolio theory on the basic assumptions of the classical system. This must now be examined in greater detail, albeit only briefly. At the heart of the problem is the notion of equilibrium and the rationality it implies of market participants. The risk-return trade-off of portfolio theory and the differentiation between systematic and unsystematic risk, leads in the context of static equilibrium to the idea of portfolio efficiency. One portfolio is said to be more efficient than another if, for a given level of risk, it is able to provide a greater return. Or alternatively, one portfolio will be said to be more efficient than another if, for a given level of return, it is able to provide a lower level of risk. This produces diagrammatically the so-called efficient frontier composed of those portfolios which are not dominated by any others. The investor's optimum position is to be found, according to his curves of indifference between risk and return, along that line which links the risk-free

rate of interest with a point of tangency on the efficient frontier itself.

Sharpe, who was responsible together with Lintner and others for the development of the CAPM in the mid-1960s and who later refined Markowitz's system into something that could be handled by modern computer technology, acknowledges the restrictions that limit the reality of such a scheme.<sup>(19)</sup> It depends, firstly, on agreement as to the prospective earnings of companies and the implications of such earnings for share prices. It depends on investors being able to borrow and lend without limit at a common pure rate of interest. And it depends, also, on the absence of taxation. When these restrictions are removed, the whole scheme collapses. There is, too, the matter of the famous separation theorem which relates to the idea that the investor's expectation of returns, and his calculation of the risk of individual securities or portfolios, can be separated from his own utility function. Clearly, this cannot hold in the real world.

### AN AUSTRIAN VIEW OF KEYNES

Methodologically, Keynes' analysis presents problems. It clearly still has its roots in the classical past, but at the same time it introduces a quality which belongs to the future. It is at one and the same time equilibrium and disequilibrium, static and dynamic. This must complicate the response from an Austrian point of view.

The criticism of the Austrian School of neoclassical method has to do, essentially, with general equilibrium, for from this all other criticisms flow. For example, it is through a concentration on general equilibrium that sight is lost of the origins of causality in economics. These must reside with the individual whose decisions combine to provide the appearance of macroeconomic phenomena. However, what motivates the individual and what causes his expectations to change cannot be determined, and it is this that makes the building of predictive models a near impossible task. As Grinler has observed, it is only through subjective states of valuation as they manifest themselves in choice that economic phenomena can be explained.<sup>(20)</sup>

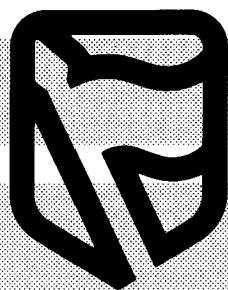
It needs to be emphasised that the Austrian objection is to the notion of general equilibrium, not to the notion of equilibrium as such. Lachmann, thus, notes that equilibrium can be a useful concept when applied to the analysis of microeconomic phenomena.<sup>(21)</sup> It may be helpful, for example, to an understanding of individual behaviour, and also to an understanding of the behaviour of the firm, because the consistency of action which it implies with both, is credible. However, there can be no credibility in the notion of general equilibrium because it is inconceivable that all the individuals and firms that go to make up a modern industrial economy can share the same information and expectations. Indeed, in a market economy, it is the divergence rather than the convergence of expectations which characterises the process of exchange. Disequilibrium is the product of divergent expectations, and disequilibrium, and the malinvestment and readjustment that it implies, is an outstanding feature of economic life. It can do neoclassical theory no good to define it out of existence. Equilibrating forces may be there, but they are not always overwhelming.<sup>(22)</sup>

To the extent to which the General Theory is an exercise in general equilibrium, albeit less than full employment equilibrium, it is open to this criticism. And yet the General Theory is very much more than that for it makes

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the breakthrough of placing expectations at the heart of the economic debate. Keynes also eschews the attempt, characteristic of the econometrics of our time, to reduce human behaviour to mathematical formulae.<sup>(23)</sup> It is a logical conclusion of general equilibrium analysis that everything in the economy should be brought into simultaneous adjustment. But this means excluding time and the separation that necessarily must exist between the decision to produce and the ultimate sale of output. It is out of that separation that risk and uncertainty (key factors in any entrepreneurial decision, operational or strategic) emerge.

### CONCLUSION

It can be said that in economics old theories are seldom wrong, they just become irrelevant.<sup>(24)</sup> That, however, is only part of the truth we have to face in considering Keynes' theory of investment. To the extent to which all theory is abstraction because reality is too complex to fully comprehend, theory serves a role that transcends explanation. We need to impose a structure on complexity in order to understand, even if that structure is the construct of our own imagination. Without structure, understanding, indeed perception itself, is impossible. From this point of view, a good theory is one which serves the purposes of understanding well, provided, also, that it can withstand empirical testing. In terms of such criteria, Keynes' theory of investment has displayed remarkable durability and this alone stands as testimony to the genius of its author. It is a fair guess that it will survive for a while yet to be read by future generations of economists not merely for its curiosity value but for its relevance, too, to practical men struggling with issues of the unknowable but not unimaginable future.

### References

- 1 Keynes, John Maynard. *The General Theory of Employment Interest and Money*. Macmillan, 1947.
- 2 This includes the line of economists stretching from Ricardo to Pigou and including J. S. Mill, Marshall and Edgeworth. *Ibid.* p. 3. It should be pointed out that from the perspective of economic theory, Keynes combines both Classical and neoclassical theory under the label classical.
- 3 *Ibid.* p. 3.
- 4 Chick, Victoria. *Macroeconomics After Keynes: A Reconsideration of the General Theory*. Philip Allan, 1983, p. 219.
- 5 This analysis of saving and investment makes sense in a simple agricultural economy where saving consists of, say, the corn output that is not consumed. Seed corn not consumed then forms the investment for the next season's crop.
- 6 Keynes is often interpreted as being concerned with the short-run rather than with the long-run. It needs, however, to be observed that his famous comment about our all being dead in the long-run, was made to convey his particular disquiet about traditional treatment of short-run issues which were regarded as being secondary to the matter of long-run equilibrium. It should not be seen as a rejection of long-run equilibrium *per se*. The comment itself is to be found in the Tract on Monetary Reform (1923) which predated the General Theory by thirteen years. The General Theory is concerned with the danger of a long-run equilibrium being established which sets full employment at a level significantly below the proportion of the economically active population that is willing and able to work, though it (the General Theory) is also remindful of the importance of short-run problems.

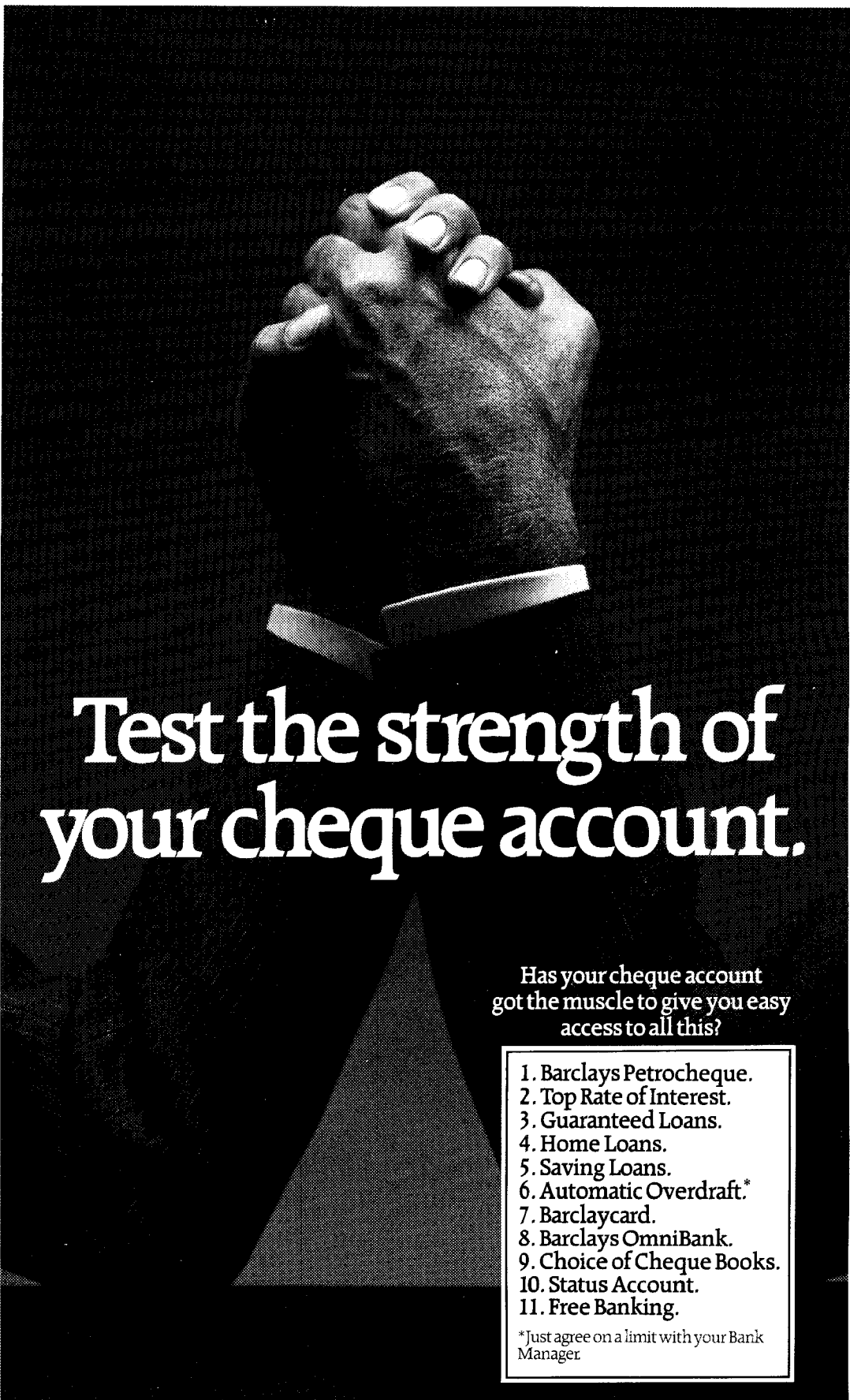
- 7 Shackle, G. L. S. *Keynesian Kaleidics*. Edinburgh University Press, 1974.
- 8 See Van Horne, James C. *Financial Management and Policy*. Prentice-Hall, Fifth Edition, 1980, p. 221.
- 9 In the United States, empirical research has tended to support such a procedure.
- 10 Wagner, Wayne H., and Lau, Sheila. The Effect of Diversification on Risk. *Financial Analysts Journal*, Vol. 26, November–December 1971.
- 11 Chick notes that the larger the income is, the more likely is it that a given rate of interest will compensate for the brokerage and nuisance costs of moving into and then out of non-money assets when cash is required. *Op.Cit.* p. 197.
- 12 Chick. *Op.cit.* p. 196.
- 13 Keynes. *Op.cit.* p. 155.
- 14 The system of share selection based on the analysis of price trends. It is to be contrasted with fundamental analysis which determines investment choice according to the comparison of market price and intrinsic value.
- 15 Keynes. *Op.cit.* p. 156.
- 16 What was suggested by Keynes has been severely truncated and transformed by Keynesians. Instead of a general theory of asset holding, Keynesians, like Tobin, concentrated on a narrow range of assets. Also, their approach to the analysis of investment has been essentially neoclassical rather than dynamic (ie allowing for time and uncertainty) and it is this quality in Keynes which really deserves emphasis. In the neoclassical scheme of things, there exist two crucial requirements, namely, (a) the existence of an equilibrium solution, and (b) the stability of that solution. But neither of these requirements can be met in terms of the neoclassical conception of capital and investment.
- 17 Markowitz can rightly be described as the founder of portfolio theory. His seminal paper on the subject was published in 1952, six years before Tobin's article on liquidity preference first appeared. Markowitz's article on portfolio selection was followed by a more detailed exposition of his ideas which appeared in book form in 1959. See references at the end of this paper for details of the Markowitz and Tobin articles.
- 18 *Op.cit.* p. 213.
- 19 Sharpe, William F. *Portfolio Theory and Capital Markets*. McGraw-Hill, 1970, p. 112.
- 20 Grinder, Walter E. In Pursuit of the Subjective Paradigm. Introduction to *Capital, Expectations, and the Market Process: Essays on the Theory of the Market Economy*. Lachmann, Ludwig M. Sheed Andrews and McMeel, 1977, p. 3.
- 21 *Ibid.* p. 37.
- 22 *Ibid.* p. 39.
- 23 "Too large a proportion of recent 'mathematical' economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols." Keynes. *Op.cit.* p. 298. This observation carries more weight coming from one who graduated first in mathematics himself and was the author of a treatise on probability.
- 24 Chick. *Op.cit.* p. 2.

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- Tobin, J. Liquidity Preference as Behaviour Towards Risk. *Review of Economic Studies*, Vol. XXV(2) No. 67, February 1958.



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# Keynes and the stabilisation of economic activity

John Maynard Keynes was born one hundred years ago on 5 June 1883, in the same year that another famous economist, Karl Marx, died. But, while Marx predicted that the capitalistic economic system would pursue a path of ever greater capital accumulation and concentration of business which would lead to its ultimate breakdown, Keynes was not hostile to capitalism. On the contrary, he valued the capitalistic economy for the liberty and independence which it bestows on the members of society and, while he criticised the classical scheme of economic thought, he explicitly accepted the classical price system as an indispensable tool for optimally allocating scarce productive resources among competing ends.

"To put the point concretely," Keynes wrote in his famous book, *The General Theory of Employment Interest and Money* (Macmillan, 1936), in which it can be said that he had summarised his thoughts of a lifetime on the way in which the modern industrialised money-using economy operates, "I see no reason to suppose that the existing system seriously misemploys the factors of production which are in use. There are, of course, errors of foresight; but these would not be avoided by centralising decisions. When 9 000 000 men are employed out of 10 000 000 willing and able to work, there is no evidence that the labour of these 9 000 000 men is misdirected. The complaint against the present system is not that these 9 000 000 men ought to be employed on different tasks, but that tasks should be available for the remaining 1 000 000 men. It is in determining the volume, not the direction, of actual employment that the existing system has broken down."

Keynes went on: "Thus I agree with Gesell that the result of filling in the gaps in the classical theory is not to dispose of the 'Manchester System', but to indicate the nature of the environment which the free play of economic forces requires if it is to realise the full potentialities of production. The central controls necessary to ensure full employment will, of course, involve a large extension of the traditional functions of government. Furthermore, the modern classical theory has itself called attention to various conditions in which the free play of economic forces may need to be curbed or guided. But there will still remain a wide field for the exercise of private initiative and responsibility. Within this field the traditional advantages of individualism will still hold good."

## MAIN CONTRIBUTIONS

Thus, when unprecedented levels of unemployment developed in the 1930s and threatened to destroy the world's capitalistic economies, Keynes set about finding ways to repair the weaknesses in the system that had given rise to the malady. In order to do this, he first had to explain what it was in the functioning of the capitalistic system that led to millions of workers who wanted to work not being able to find employment; and having found an explanation for this involuntary unemployment generated by the system, he then had to propose an appropriate remedy.

In going about these tasks, Keynes made contributions which had an all pervasive impact both on economic theory and policy. More specifically, Keynes provided us with a classification of macroeconomic magnitudes (consumption expenditure, investment expenditure, savings and their determinants) which makes it possible

for us to study and to analyse such problems as unemployment (or more generally the determination of the aggregate level of employment and output), inflation and the appropriate level of the money supply and of interest rates: problems which are associated with the economy as a whole or with large sections of it. In this process, he also integrated monetary theory or the theory explaining how the general price level and the general level of interest rates are determined with the main body of macroeconomic theory or the theory explaining how the aggregate level of employment and of output is determined.

## REASON FOR UNEMPLOYMENT EQUILIBRIUM

Keynes argued that, fundamentally, there could only be one reason for the large-scale unemployment that afflicted the industrial economies in the 1930s, namely, that for one or another reason, total demand was insufficient to allow these economies to produce goods and services at a level that fully absorbed all the available resources of labour and of productive capacity. According to classical economic theory, a situation of unemployment and of idle production capacity could not persist for any length of time because nominal money wages as well as the prices of goods and services would fall until all the available labour was taken into employment (at the lower wage level) and all the unused capacity was absorbed. Taking a macroeconomic view of the matter, however, it can be seen that falling wages and falling prices in a significant part of the economy will not leave the level of total income and total demand unchanged but will simultaneously reduce total income and total expenditure.

Thus, starting from a position where there is a shortfall in demand in certain sectors of the economy, a general deficiency of total demand can develop which the price system or downward adjustments in wages and in prices cannot rectify. On the contrary, as wages are bid down by unemployed workers and as product prices and hence profits are reduced in an effort to increase sales, such a deficiency in total demand will tend to become progressively larger and the economy could well fall into a state of unemployment and depression from which it is unable to recover unless steps are taken to raise total demand by means other than continued downward adjustments in wages and prices. This was, in fact, the situation in which the industrial economies found themselves in the 1930s.

Under what circumstances would a general state of deficient demand develop in an economy? Keynes found the answer to this question in the possibility that savings in the current period can exceed investment and that, hence, the total output of consumption and of capital goods currently being produced might not be bought in the current period. Both consumers and producers are swayed by expectations about future incomes and profits which are changeable and which can significantly influence the propensity to consume (or save) and to invest in the current period. Investment expenditure (ie the acquisition of new capital goods or of additional stocks) is particularly volatile, while the investors in the economy are not necessarily the same parties and are not necessarily influenced by the same motives as the savers, ie those firms and individuals who decide to save part of their current incomes and profits (out of which current new investment must be provided or financed).



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Thousands of Rand	1978 31 Dec.	1979 31 Dec.	1980 31 Dec.	1982 30 Apr. (see note)	1983 30 Apr.
Share capital and reserves	10 212	11 789	13 581	19 862	27 202
Total group assets	57 508	76 307	86 573	142 428	218 286
<b>Short term business</b>					
Gross premiums	56 700	68 402	74 599	171 443	208 407
Composition of gross premiums	%	%	%	%	%
Motor	38,9	41,7	42,4	40,3	40,4
Fire	19,4	22,1	20,0	24,8	24,5
Accident	19,1	19,5	23,4	26,2	26,4
Marine & aviation	2,4	2,0	2,1	3,2	3,9
Compulsory third party	20,2	14,7	12,1	5,5	4,8
	100	100	100	100	100
Premium income after reinsurance	38 971	50 201	56 754	116 790	162 089
Underwriting profits (losses)	93	533	(435)	(5 153)	1 663
Investment income	2 377	2 525	3 061	5 396	5 820
Profit before Tax	2 491	3 011	2 339	92	6 889
Profit after Tax	1 414	1 985	1 747	726	4 593
Insurance funds	16 009	20 157	22 089	34 376	56 753
<b>Long term business: (See Note)</b>					
Premium income after reinsurance	3 170	3 450	4 279	11 912	13 452
Payments to policyholders	1 064	969	1 505	3 936	3 877
Investment income	1 400	1 682	2 039	5 192	6 063
Life funds	14 545	21 880	28 075	45 020	76 251
Long term assets	17 025	24 952	31 285	50 782	83 436

**Note:** The 1982 column covers a 16 month period for all categories except for NZISA (13 months).

In other words, business firms as well as individuals might well save and not consume a larger part of total current output than investors are prepared to take up in the form of additions to their productive capacity or to their stocks. In that event, unwanted stocks of capital goods produced in the current period and of inventories would accumulate and producers of these goods can be expected to curtail their production and hence the number of workers employed to produce them in the next period. This, however, would reduce total incomes and hence also total expenditure and employment in the next period and, in this way, the general level of economic activity and of employment can be reduced to an ever lower level.

It is, of course, also possible for savings out of current production to fall short of the new capital goods or additional stocks which investors wish to acquire in the current period. This would induce producers of these goods to step up their production in response to the unsatiated demand, thereby pushing up total incomes, expenditure and employment in the next period. In this way, a process of increased economic activity can eventuate which, if taken beyond the point where full employment of the available labour and capital resources has been attained, will lead to inflation.

Thus, Keynes showed that total savings and total investment in the current period, or, what amounts to the same thing, total demand and total supply, although necessarily always equal in an accounting period, can diverge in the sense that neither of these two magnitudes (or sides of the equation) is at a level desired by the community. This, in turn, will induce producers and consumers to take action that will simultaneously push both magnitudes to a lower or higher level.

But even more important, the total demand and total supply curves in the economy can cross (ie can equal each other) in a position where all the available labour and capital resources are not being fully employed, a situation which cannot be rectified by price or wage adjustments (or movements along these curves) but only by shifting both curves towards the right, ie by increasing what Keynes called total effective demand in the current period.

Similarly, the two curves can cross in a position above full employment of the available labour and capital resources, in which case a constantly higher rate of inflation will result. This is a situation which requires both curves to be shifted towards the left or for total effective demand to be reduced in the current period.

### **LIQUIDITY PREFERENCE AND THE RÔLE OF MONEY AND INTEREST RATES**

Classical economic theory maintained that it was not possible for savings and investment to diverge for any length of time, as interest rates would fall to remove an excess of savings over investment and would rise to remove a shortfall. Keynes pointed out, however, that money was not merely a medium of exchange as classical economic theory had tended to assume. It is also valued for its own sake because it provides the holder with security against unforeseen future commitments and because it possesses liquidity (ie it represents uncommitted purchasing power) which enables the holder to take advantage of profitable investment and business opportunities that might arise in the future. Money accordingly commands a price in the form of the rate of interest which must be paid to the holder to persuade him to part with his liquid purchasing power

and which the borrower is prepared to pay because of the benefits and advantages conferred on him by the generalised purchasing power embodied in the money that he borrows.

The interest rate or the price commanded by money at any particular point in time might well be higher than that which investors or the borrowers of money are prepared to pay. In that event, the community's savings will not be converted into investment expenditure and there will be a divergence between current savings and current investments. This will be particularly the case in a situation where investors (not satisfied with current profits or with future profit prospects) revise downwards their expected future returns or profits, or what Keynes called the marginal efficiency of new capital investment, and start to curtail their investment expenditure. This would reduce the interest rate which they are prepared to pay on borrowed money, while this is normally also a situation in which the banks who are the large lenders of money are disinclined to bring down their lending rates too much because of the increased uncertainty surrounding business and profit prospects. It was precisely this kind of situation that pertained in the 1930s, when Keynes wrote the *General Theory*. The "market" rate of interest charged by the banks amidst the uncertainties of deepening recession remained well above the rate which borrowers felt they could afford to pay in the face of a considerable deterioration in their future profit prospects. The result was a wide divergence between current savings and current investments, with disastrous consequences for employment and for the general level of economic activity.

In making interest rates dependent on the demand for money (for purposes of liquidity) and the supply of money (which is under the control of the central bank) and by bringing in interest rates, in turn, as one of the determinants of investment expenditure together with the marginal efficiency of capital, it can be seen that Keynes integrated monetary theory and the rôle of money with general macroeconomic theory embodying and explaining all the various factors determining the total level of employment and output in the economy.

### **ECONOMIC STABILISATION POLICY**

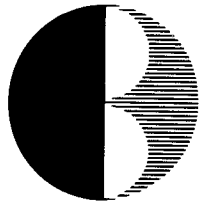
Keynes did not provide any detailed policy prescriptions in the general theory as to how to deal with the sharp cyclical fluctuations and the prolonged episodes of serious unemployment to which the capitalistic economy is susceptible and which mainly arise from the rather tenuous link between savings and investment. But matters of economic policy were really his main concern throughout his life.

As far back as 1924, Keynes already advocated that the problem of prolonged unemployment should be tackled through public works undertaken by the government and financed on loan account. With the world economy showing little signs of recovery by 1933, he returned to this theme. In a pamphlet entitled "The Road to Prosperity", he used the idea of the multiplier (which had been developed shortly before by a close associate of his at Cambridge University, Richard Kahn) to show how government expenditure on public works, even if financed out of loans and even if there should be leakages out of the economy in the form of increased imports, would nevertheless raise total employment because of the fact that the increased incomes initially received from the government are re-spent and hence there is a multiplied effect on employment and on income. Keynes accordingly proposed increased government expenditure

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financed by loans, as well as a remission of tax to deal with the unemployment situation. He also supported the idea of a double budget, one for current expenditure and the other for capital expenditure, which should be manipulated in accordance with the trade cycle.

In his book "The Life of John Maynard Keynes" (Macmillan, 1951), R. F. Harrod observed that "we began here to get the first inkling of an idea, more radical than anything recommended so far, that the Chancellor of the Exchequer should pump in additional purchasing power, not only by financing public works through loans, but also by remitting taxation without reducing current expenditure. This is almost 'deficit' financing in the full sense."

Thus, Keynes' solution to the problem of persistent unemployment and recession was government expenditure and public works financed out of loan funds, with reliance on the multiplier to boost the impact of these measures on the economy. Indeed, Keynes would probably not have objected to deficit financing proper but for him government borrowing was "... essentially inflationary whenever it exceeded the amount that people would have been willing to lend *in the absence of a rise of prices.*" (Harrod, *The Life of Keynes*).

In his book "How to Pay for the War", which was published in 1940, Keynes applied his theories about savings and investment and effective demand to the problem of economies in which demand was excessive, ie the problem of how to prevent the total stream of effective demand from exceeding the resources available to meet it at existing prices. In this situation, he suggested the opposite policy, namely, a reduction in government expenditure on capital works, together with an increase in taxation (he actually suggested forced saving through a scheme of deferred pay to prevent excessive consumption expenditure in Britain during World War II). In other words, the government should run a budget surplus during periods of excessive effective demand.

### MONETARY POLICY AND PRICE STABILITY

Keynes was not a strong believer in the efficacy of monetary policy as a means of stabilising output and employment probably partly because he was mainly concerned with the problem of unemployment and recession, a situation in which the marginal efficiency of capital is typically very depressed and in which it is accordingly very difficult to reduce interest rates through monetary policy to a level sufficiently low to generate new investment expenditure and employment.

But, while Keynes gave preference to fiscal policy as the principal instrument for stabilising the level of general economic activity, he was certainly also very much concerned with the need for price stability and a stable value of money. In fact, Keynes stood for deliberate management of the economy so as to keep it reasonably close to full employment at all times but with prices stable.

In his book "A Tract on Monetary Reform" (1923), he came out in favour of managed money by the central bank, both over the domestic supply of currency and credit with a view to maintaining stability of the internal price level and over the supply of foreign exchange so as to avoid purely temporary fluctuations in the relation between the internal and the external price level.

As Harrod pointed out in "The Life of Keynes", the question for him was not so much one of whether we should have managed money or an automatic money

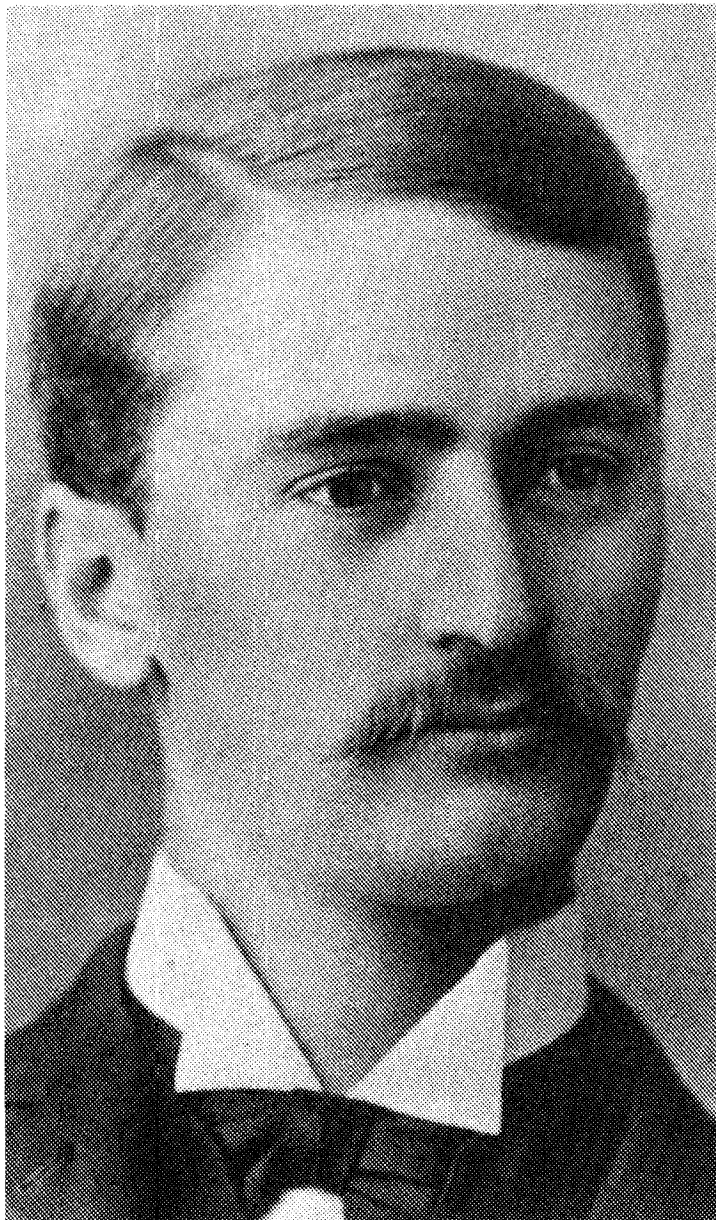
standard such as the gold standard, as the latter had in any case already ceased to operate in practice by the 1920s. The question was rather whether our currency should be managed so as to secure a stable external value (eg to maintain, say, a fixed dollar parity) or whether it should be managed so as to secure a stable internal price level. Keynes was in favour of the latter, which seems to imply that he accepted a flexible exchange rate. Internal price stability, however, can be reconciled with a relatively stable exchange rate, as the internal economic discipline required by the former (and enforced through appropriate fiscal policy measures, supported by an appropriate level of domestic interest rates established by the central bank) also automatically tends to preserve equilibrium on the balance of payments.

At the Bretton Woods conference in 1944, which provided for the establishment of the International Monetary Fund, and in the formation of which Keynes played a major rôle, the decision was then also to adopt a system of fixed exchange rates, whereby member countries were expected to maintain dollar parities for their currencies within a narrow band and, while they could devalue or revalue when faced with fundamental balance of payments disequilibrium, they then had to take steps to impose the necessary internal discipline on their economies to defend the new parities. Member countries could really only conform to these rules given the maintenance of a good measure of internal price stability.

Following the dissolution of the Bretton Woods system of fixed exchange rates in 1971, and what in effect amounted to an abandonment of the dollar standard used by the world economy since 1944, both exchange rates and domestic price levels have fluctuated considerably. Both types of fluctuations have imposed considerable costs on the world economy in the form of under-employment of labour and of capital and consequent loss of production, and the problem of how to restore external and internal price stability is probably the most pressing economic problem facing the world at the present time.

It seems it is not possible to achieve or to maintain a reasonable measure of external price stability without at the same time maintaining a reasonable measure of internal price stability. Thus, it seems that if exchange rate stability and a stable international standard of value are to be restored, then the United States, whose currency serves as the principal means of international payments as well as the main abode of foreign exchange reserves for other countries, must in the first place restore and return to a stable internal value of the dollar, together with a proper balance between total domestic demand and supply that goes with this. If the dollar should on occasion become too strong for reasons other than economic (as seems to be the case at the present time), other countries can then depreciate their currencies against the dollar, to the extent necessary, and then take action to stabilise their internal price levels and their domestic economic situation as a whole at their new exchange rates to the dollar.

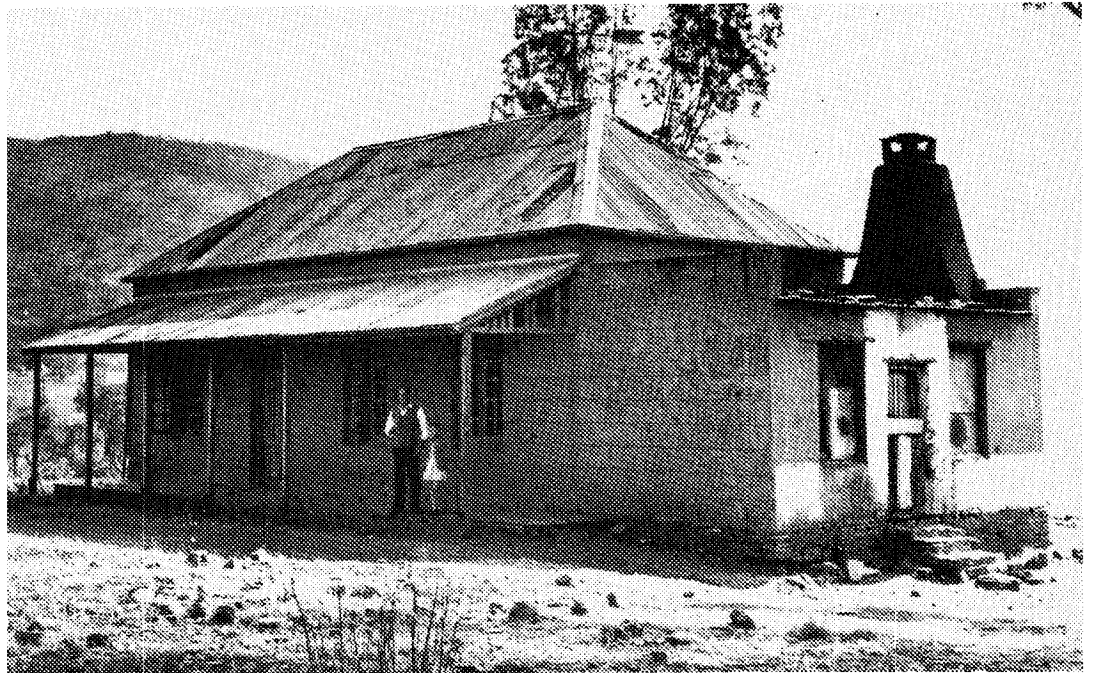
If it should prove that American trade and the American money and capital markets are simply no longer dominant enough in international money transactions for what amounts to a return to a dollar standard, then the only other alternative appears to be that other leading economies should also strive to maintain the external stability of their currencies through appropriate domestic policies making for internal price stability and,



He explored the soul of the white ant and the ape. And untied the bonds to release a new language.  
*O koud is die windjie  
en skraal,  
En blink in die dof-lig  
en kaal . . .*

*In 1905, the evocative beauty of Winternag thundered across South Africa. Eugène Marais had dared to mould a struggling language into literature. And proved its power of expression conclusively.*

*If Eugène Marais had aimed for a seat in history, he would have settled down into it. Instead, he went ahead to explore possibilities far beyond the realms of the everyday. Titles such as journalist, poet, advocate, and naturalist are pitifully inadequate to describe him. Does a naturalist get publicly arrested for quarrelling with the Kruger regime? Does a poet smuggle medicine and explosives to Boer commandoes?*





*Does an advocate see universal significance in a white ant? His freedom of thought, his unfettered spirit and unconventional actions refuse the shackles of conformist labels.*

*From day to day, people busy themselves with thoughts of survival. They oversimplify the awesome world to make it easier to digest. But their lives light up momentarily when men like Eugène Marais force them to witness some basic truths: Man possesses a mind and a will. The world is not meaningless. If man fights the erosion of competence, and stops following the path of least resistance, it is possible to be more than a mere accidental appendage to society.*

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in this way, share the responsibility for maintaining stability in the international currency markets with the United States.

### THE PROBLEM OF PERSISTENT INFLATION

While Keynes favoured "managed" money, both internally and externally, he did seem to assume, at least implicitly, that inflation or instability of the domestic price level would be largely of a cyclical nature, ie prices would increase during the business cycle upswing as the resources of production become more fully employed and their prices are bid up; and they would decline again during the subsequent business cycle downswing as the resources of production become unemployed. Keynes in effect assumed that the general wage level (and so prices) would remain stable over the business cycle as a whole and that, hence, deliberate fiscal and, for that matter, monetary policy could be used to create additional demand, when necessary, in order to operate the economy reasonably close to full employment without running the risk that the price level would be destabilised and that persistent inflation would be generated.

Keynes' assumption of a stable wage level was, of course, also not unrealistic in the circumstances prevailing in the 1930s during which he wrote the General Theory. In the decades following World War II, however, wages lost their inertia and persistent wage and cost push inflation has become general throughout the Western world following the oil price increases in the early 1970s in particular. In fact, the stage has now been reached where, although there is a considerable deficiency of total demand and the world economy is consequently experiencing large-scale unemployment and idle capacity, the Keynesian remedy of raising effective demand through expansionary fiscal and monetary policy can no longer be very effectively applied, as injections of additional money tend to be used to finance still further wage and price increases rather than increases in output and employment.

Keynes was not unaware of the problem that trade union power and an unstable wage level would pose for domestic as well as international price stability and, in this respect, it is revealing that when someone raised this possibility shortly before his death in 1946, he replied that in that event the trade unions rather than the central bank would have to assume responsibility for the stability of the price level and for inflation. It is also significant to note that disciplined wage (and hence price) behaviour on the part of organised labour and their employers has contributed to an important extent to the moderate inflation rates experienced in such countries as West Germany and Japan in recent years.

Meanwhile, as Sir John Hicks pointed out in a recent article in "The Economist", marking the centenary of the birth of Keynes, the world economy has in effect been on a labour standard of value, with all its inherent fragility, since the collapse of the Bretton Woods system in 1971. And, even a return to a dollar standard (of the kind operated under the Bretton Woods system) also appears to require a return to reasonable wage stability (at least in the United States) in the first place in order to achieve the internal price stability needed for exchange rate stability. This, in turn, calls for self-discipline on the part of organised labour and large employers with regard to wage and price increases for, under the impact of the political power wielded by labour in particular, no central

bank in the world has in practice been able to impose the necessary discipline over the money supply to avoid financing the persistent wage and price increases that organised labour and their oligopolistic and monopolistic employers have, in fact, been negotiating between themselves and which these bargaining groups have apparently felt they are entitled to (and hence have been voting to themselves) irrespective of whether or not there have been corresponding productivity increases.

### CONCLUSION

In his presidential address to the American Economic Association in 1976, Franco Modigliani said that in his view the fundamental practical message which Keynes had conveyed to us in the General Theory was the following: "... that a private enterprise economy using an intangible money *needs* to be stabilised, *can* be stabilised and therefore *should* be stabilised by appropriate monetary and fiscal policies." Thus far, lack of the necessary political will has probably been mainly responsible for our rather limited success in stabilising output and employment or, for that matter, prices and exchange rates. We should accordingly concentrate our best efforts in the future to foster and to harness the necessary political will and the necessary international co-operation in an endeavour to make stabilisation policies more effective in the years ahead than they have been in the past.

Keynes was widely criticised by his contemporaries and is still being criticised today for his philosophy of deliberate management of the economy. In the General Theory, he defended his position on this score in the following words: "Whilst, therefore, an enlargement of the functions of government, involved in the task of adjusting to one another the propensity to consume and the inducement to invest, would seem to a nineteenth-century publicist or to a contemporary American financier to be a terrific encroachment on individualism, I defend it, on the contrary, both as the only practicable means of avoiding the destruction of existing economic forms in their entirety and as the condition of the successful functioning of individual initiative.

"For if effective demand is deficient, not only is the public scandal of wasted resources intolerable, but the individual enterpriser who seeks to bring these resources into action is operating with the odds loaded against him. The game of hazard which he plays is furnished with many zeros, so that the players *as a whole* will lose if they have the energy and hope to deal all the cards. Hitherto the increment of the world's wealth has fallen short of the aggregate of positive individual savings; and the difference has been made up by the losses of those whose courage and initiative have not been supplemented by exceptional skill or unusual good fortune. But if effective demand is adequate, average skill and average good fortune will be enough."

"The authoritarian state systems of today seem to solve the problem of unemployment at the expense of efficiency and of freedom. It is certain that the world will not much longer tolerate the unemployment which, apart from brief intervals of excitement, is associated – and, in my opinion, inevitably associated – with present-day capitalistic individualism. But it may be possible by a right analysis of the problem to cure the disease whilst preserving efficiency and freedom."

# A microcomputer database for a notional index fund

## INTRODUCTION

In the past two decades the financial community has experienced an explosion of research relating to security analysis and portfolio selection culminating in what has come to be known as the Capital Asset Pricing Model (CAPM). (Sharpe, Fama, Treynor, Jensen. Ref. 1, 2, 3, 4).

Among the implications of the CAPM is the idea that the investor is able to select a portfolio of securities with a given set of risk and return characteristics by combining the correct proportions of risky and risk free assets. Given the acceptance of some government security such as the Treasury bill as a surrogate for the risk free security, the problem then reduces to one of finding fully diversified portfolios with similar characteristics to that of the market itself. These portfolios would then in a sense act as an index of the market. Such portfolios can be constructed without actually buying the securities. A notional index fund of this kind could be tested to see if it did track the market reasonably well and if so could be used as part of fund management strategy. One of the objectives of our research was to construct such a notional index fund.

Although the origins of this research have been traced back to the work of Bachelier in France around 1900 (Bachelier, 5), much of the recent work was made possible by the existence of large databases and statistical programme packages on mainframe computers (Fogler, 6). The use of these databases and analysis packages was restricted to academics and members of large organisations with expensive mainframe computers. The advent of cheap, widely available microcomputers in the mid-1970s brought about the possibility that these facilities could be made available to a far broader group of people. The sudden availability of the hardware was not enough. In order for these benefits to flow into business education generally, similar databases applicable to South African companies would have to become available on the microcomputer. The second and perhaps more important objective of our research over the past few years has been to seek to help to fill that gap. We have constructed a microcomputer database as reported below and have used it to generate notional portfolios for the selection of diversified index funds which can serve as the efficient risky asset in an overall portfolio. If we were only interested in the single objective of data capture for testing index funds or beta analysis on its own, we could have achieved this without considering database problems. However, such an approach would have restricted the use of the data to just one kind of enquiry. Instead, the database has been constructed in a manner which is sufficiently general for it to be used in many other types of financial analysis.

## PORTFOLIO SELECTION

Modern portfolio analysis is based on four basic assumptions (Francis & Archer, 7).

- (1) Investors maximise one period expected utility and exhibit diminishing marginal utility of wealth. The implication here is that investors view their investment opportunities as being represented by a probability distribution of additions to their wealth over some period.
- (2) The variability of expected returns is used as a measure of risk.

(3) Investors are willing to base their decisions solely in terms of expected return and risk. Thus, utility ( $U$ ) is a function of variability of return ( $z$ ) and expected return ( $E(r)$ ). In symbols  $U=f(z, E(r))$ .

(4) For a given level of risk investors prefer higher returns to lower returns or for a given level of return they prefer a lower level of risk.

Symbolically  $du/de(r) > 0$  and  $dU/dz < 0$ .

These assumptions apply to all of our discussions regarding portfolio analysis and the CAPM. An efficient portfolio will be one where investors have pursued the preferences stated above.

## RISK, COVARIANCE PROBLEMS AND BETAS

The word risk as defined here could equally well be called dispersion of outcomes about the expected value. The more formal mathematical terms variance and standard deviation measure dispersion of outcomes about the expected value in a precise way and have come to be the accepted measures of risk following the work by Markowitz (Markowitz, 8).

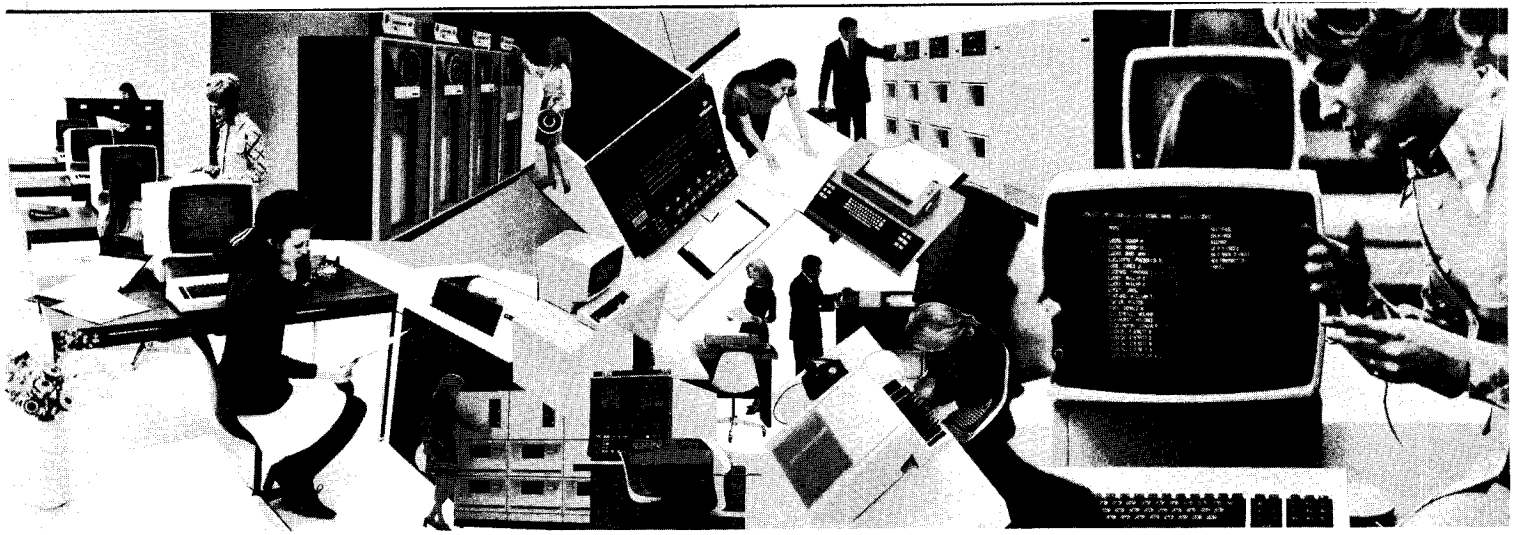
This is not to say there are no other measures of risk (indeed good arguments for other measures such as skewness have been put forward) but variance, being the accepted measure, has been accepted by us, and we have gone on with the construction of our portfolio.

A problem which does concern us is that of covariance when different securities are grouped together in a portfolio. Markowitz himself pointed out that while the returns on individual securities may simply be summed to give the return for a portfolio, the variances cannot simply be summed because of possible covariances. The calculation of portfolio risk can become tedious if the entire population of possible securities has to be re-evaluated each time there is a change. As Markowitz pointed out, "an analysis of 100 securities requires 100 expected returns, 100 variances and almost 5 000 covariances" (Markowitz, 8).

The Sharpe single index model and the use of beta as the risk measure thus represented a very important simplifying step in the process (Sharpe, 9). Sharpe tested the Markowitz full covariance model against his own simplified model on an IBM 7 090 computer and found that he was able to analyse a 100 security portfolio in 30 seconds whereas it took 33 minutes to solve the same problem using the full covariance model. Both models selected the same portfolios. Further evidence of the power of the Sharpe model such as the study by Frankfurter, Seagle and Phillips (Frankfurter et al, 10) has been published and it is now well established in the literature. We have used the Sharpe single index model concept in measuring the risk of our notional portfolios to construct the index fund discussed later in this paper. In each case our chosen portfolio was regressed against a single index in the shape of the JSE actuaries index. The beta so derived was taken as our risk measure in place of a full covariance model.

## STATIONARITY PROBLEMS

The value of beta as a risk measure is reduced if the betas themselves are not stable over time. There is substantial evidence that betas for individual shares are not stable



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and are thus suspect (Brown Bros, 11) but that portfolio betas remain relatively stable and the predictability of the betas improves with the size of the portfolio. (Blume, 12 and Levy, 13). We are on relatively firm ground in that we have only applied betas as a risk measure for portfolios in this study. We have simulated portfolios of various sizes and settled on groups of 30 shares at a time.

The results of studies carried out in European countries are possibly of even more interest to us. These markets are smaller and less liquid than the American markets and may yield results more relevant to South Africa. Fabry (ref. 14) and others have shown that betas for large portfolios are no more volatile in France and Belgium than they are in the United States. If anything they are more stable.

**CONSTRUCTION OF AN INITIAL EXPERIMENTAL NOTIONAL FUND USING THE COMMERCIAL PACKAGES "PROFILE" AND "VISICALC"**

In accordance with the tenets of the CAPM our objective was to construct a notional fund with characteristics representative of the market so that our investor might choose his level of exposure simply by varying the proportion of his investment in our fund and some risk free asset. In order to simulate portfolios we needed to construct a database containing information on the listed shares on the JSE. Our source data for general financial information in the database is the Stock Exchange

Handbook and month-end prices are obtained from the monthly bulletin of the JSE.

At first an experimental database was constructed using the Radio Shack "Profile" package. Experience gained from the use of this database was then incorporated in the development of a more powerful database. The records used in the initial database were left unaltered but different methods of using them were developed as described below. The "Profile" package is similar to the database packages available on most microcomputers. The package allows for the allocation of data into 32 fields each of which may be used as a key for sorting. Key searches are also allowed but they are not multi-level. Direct calculations are not allowed on the fields but it was felt initially that if the key searches and sorts could be used to compile simulated portfolios based on financial selection criteria there would nevertheless be a substantial saving in work. Once the notional portfolios were generated the selected shares were manually typed in from the print-out to the "Visicalc" package. Monthly prices for each share were then typed into "Visicalc" which automatically evaluated the portfolio according to weightings calculated from the output of the "Profile" package. Figure 1 below is a sample of the fielding used in the database records on "Profile" and Appendix I is a sample of the output from the "Visicalc" package showing the final weighting of one of the notional portfolios which were tracked against the JSE all share index to test their performance as index funds.

Figure 1

**Financial data base sample record**

Sector:	Company:	Year ending (February):	
Current assets:		Current liabilities:	
Current ratio: nn.d			
Long and deferred liabilities:		Share capital and reserves:	
Total debt/equity: nn.d		Lt. debt/equity: nn.d	
EPS (after tax - cents):		Dividend (cents per share):	
Dividend cover: nn.d		Number of issued shares (m):	
March (last):	April:	May:	June:
July:	August:	September:	October:
November:	December:	January:	February:
Dividend yield (last payment): nn.d		Earnings yield (last payment): nn.d	
Market capital (last payment):			

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### LIMITATIONS OF ABOVE PACKAGES FOR SIMULATION PURPOSES

The need to manually re-type selected data from the data base printout into the calculation package became a little tedious as the number of simulations grew but was not the major limitation of this approach. In this case we were using "Visicalc" but the point is of more general interest because often data retrieved from some or other public database must be entered into specialised calculation packages (eg advance statistical packages).

The most important limitations turned out to be the slowness of sorting and searching, the restriction to single level enquiry and the restriction to two dimensional links from "Visicalc" to the database.

Another problem has to do with the language in which the package is written. Most database, spreadsheet and word processing packages for microcomputers are written in machine language. This means they overcome the relatively slow operating speeds and space limitations of the microcomputers but flexibility is lost because the user cannot write his own routines in an easy high level language such as Basic for integration with the package.

Consider for example the situation which arose when attempting to construct an index fund according to the criteria of market capitalisation used in the Standard and Poors index and adopted in the JSE actuaries index. In this case constituents are selected according to market capitalisation but in order to gain a spread across all sectors only the company with the highest capitalised value in each sector is included. Thus industries are included which might not have any members with sufficient market capitalisation to be included on a pure capitalised value basis.

Now the lack of multi-level searching discussed above meant that for each simulation it was necessary to sort first by one of the criteria (market capitalisation or sector) and then re-sort or search the sub-list. The problem is compounded by the fact that the sorting and searching are slow. Although useful portfolios were constructed using the above well-known commercial packages it became evident that any improvements in the ease and speed of manipulation of the database would not only assist in the selection of portfolios but could be of general value in the application of microcomputers to business problems.

### IMPROVED INFORMATION HANDLING SYSTEM

One area in which it has proved difficult to separate completely the logical and physical views of data has been the addressing and searching of the database. The pure database view is that there should be a separate data description language, itself a high level language but independent of the other high level programming languages Cobol, Fortran, Basic or whatever. The best known of these data description languages are Codasyl (ref. 15) and IBM's Data language I (ref. 16). Most data description languages are based on a networking model of data structure. However, recently the idea of relational databases following Codd (ref. 17, 18) have become popular and pioneering work for micros has taken place at the University of Toronto with their MRS system (Micro Relational System).

If there was a perfect data management system the designer of a logical database could completely ignore questions of physical storage layout and how the system locates a record or performs a search. However, the current state of the art makes it necessary in many cases

to specify data organisations which speed up addressing or searching. In extreme cases where processing efficiency is the prime goal the database designer has to specify the organisation according to the peculiarities of the programming language, the disk operating system (DOS) or even the hardware in question. While achieving processing efficiency, this approach achieves a very low level of machine independence, a key goal of data description languages.

Our database design is a compromise between the two approaches and seeks to take advantage of certain features of microcomputers, particularly the TRS-80.

First we have made the database accessible from Basic. There are obvious advantages in using Basic as the high level language on a micro since it is available, widely known and easy to use.

The next step was the creation of an indexed sequential access (ISAM) method to replace the ponderous disk sort used by the standard package. The immediate constraint for sorting in memory rather than on the disk is the limitation of RAM in the micro. The creation of index files overcomes this problem as long as the indexes themselves are not too large for the memory. Where necessary this does mean resorting to detached key sorting or sort merging of the index files themselves. Nevertheless it is still much faster than physically moving the records around the disk and has the subsidiary benefit of making multi-level searching feasible. We were also able to take advantage of the more subtle benefits of USR calls in the TRS-80 Basic.

### SELECTION CRITERIA FOR INDEXING THE DATABASE

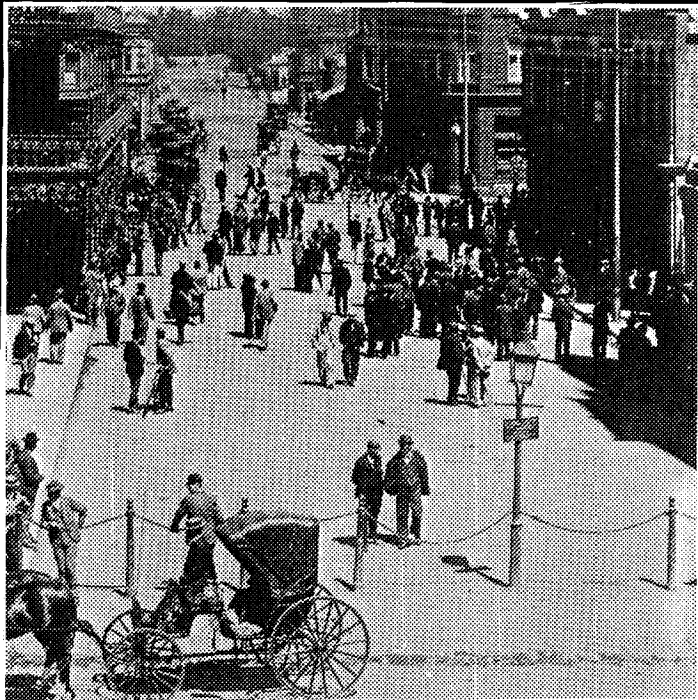
Reference to the sample database record will show that we have assigned 29 fields. However it is immediately apparent that we do not need to assign indexes for sorting or searching on all the fields. Depending on the application, keyfiles can be assigned to chosen fields. Indexes are created and stored only on these chosen fields.

In our application the specific objective was to generate notional funds according to various arbitrary financial criteria. The selected shares and their weightings were then combined into a portfolio and once again the data base accessed for monthly prices to evaluate the risk and return of the simulated portfolio relative to the all share index of the JSE.

Five fields were selected from the 29 available for construction of indexes. The five were market capital, dividend yield, earnings yield, total debt/equity and current ratio. Sets of 30 shares at a time were then extracted from the total database to form each of the notional portfolios. In each case the basis of selection was to include the top share in the sector according to the criterion being applied. The weightings were fixed according to the percentage market capitalisation of the given counter relative to the total market capitalisation of that portfolio.

### SORTING AND SEARCHING METHODS

The selection by criteria explained above requires that a sort is made on each index to select the candidate share. There are roughly 400 shares in the database. The time for each sort on "Profile" can be measured in hours. The time taken even by the slower Basic sorts in memory improves radically from 1 hour 3 minutes 53 seconds on a bubble sort to 2 minutes 11 seconds for the Singleton version of the Quicksort over 500 random elements. The



1897: South African Breweries becomes the first industrial company listed on the Johannesburg Stock Exchange.



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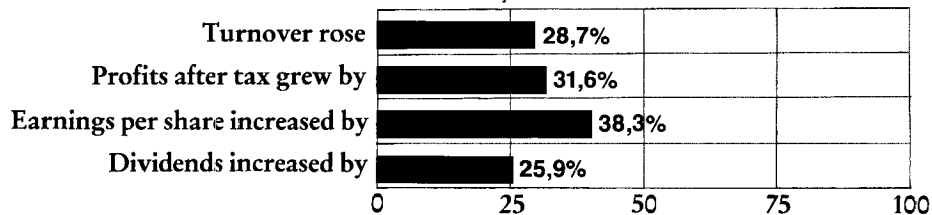
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And they're all successful, making our annual financial statements a pleasure to read.

Results for year ended March 31st, 1982:



**The South African Breweries Ltd.**



times reported for five different sorts in Basic on a model I TRS-80 are given in Table I below. The Bubble sort and Shell sort are well known. The Quicksort, not as well known, is discussed in Grillo (ref. 19). A good general discussion may be found in Knuth (ref. 20).

Some caution is required in evaluating the results as the decision between sorts is not as clear cut as the data would seem to indicate. The data used in the tests consists of random lists. In this case the Bubble sort is hopelessly inefficient. However, there may be cases where data in a database is already well ordered in which case the Bubble sort can be very fast.

**Table 1**

**Sort times for random Lists of 500 elements in Basic on a TRS-80 model I computer**

Name of sort	Hours	Minutes	Seconds (nearest)
Bubble	1	3	52
Shell		5	16
Quicksort		2	55
Singleton		2	11

NB: *There may be small inaccuracies in the timings which are based on the system time function.*

Although our work is now done on the model III which has a faster clock speed than the model I, much earlier work was done on the model I in the department of Business Science so we tested our sort on the model I to provide comparable data. We were able to get the sort time down to 8 seconds for 500 8 byte keys by using the TRS-80 USR call function to exit from Basic to high memory where we had located a Shell sort in machine code. This idea has been used by Johnson (ref. 21) in the Racet sort modules. This concept was then developed a step further. Instead of using a carry variable as Johnson does to carry the record number along while the index is being sorted, our sorting method is to concatenate the record number onto the end of the field.

This is accomplished by using the string convert function and then string concatenation. Each of the index fields is standardised to 5 bytes for the key with 3 bytes for the record number. The resulting 8 byte field can now bypass the string management method of the Basic language itself, thereby yielding savings in both memory space and time. The reason why this bypassing technique works is easily understood if we consider Basic's string array management method. For each element of an array Basic allocates an overhead of 1 byte for the length and 2 bytes for the address of the string. Thus an array of 500 elements will have an overhead of 1 500 bytes. If we standardise the length of the array and then pass it straight from the disk to the protected memory area for sorting we no longer need to keep track of the length or location of the string. Apart from the memory saving there is a speed improvement because Basic no longer manages the array.

The above approach applies equally well to searching. Once arrays are sorted it is possible to use binary search methods such that our 500 element array requires a maximum of 8 comparisons as opposed to an average of 250 for an unsorted array. The binary search is also executed in machine code via a USR call and operates on the index still stored in high memory as explained above to yield significant improvements in speed.

One could continue to seek improvements in this most fascinating and important area. For example an obvious improvement could stem from the recoding of our machine code sort into the Singleton version of the Quicksort and then applying our USR calls. However, it was felt that a balance had to be struck in allocating time to areas of the research and instead attention was turned to generating financial portfolios for the simulation itself.

**SUMMARY AND CONCLUSIONS**

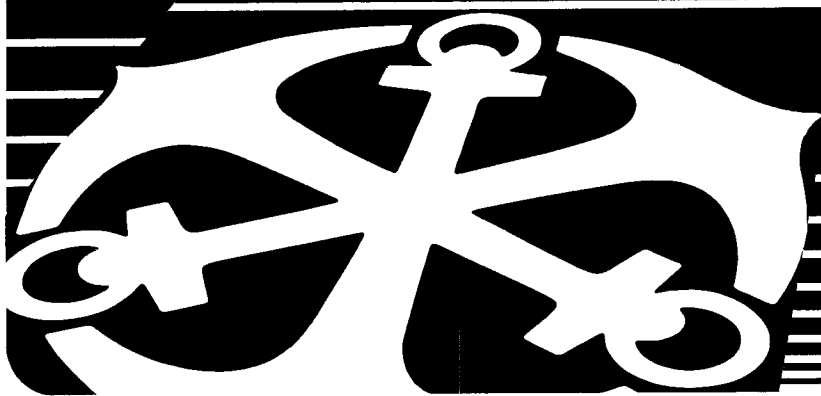
It was found that the database worked well as a source for portfolio generation. There are a number of improvements which could well be introduced. Perhaps the most useful would be to have the database record include a figure for turnover. This would make no difference in the generation of index funds but would add substantially to the value of the database as a source for financial models for fundamental analysis. The problem here is that South African companies are still not forced to publish turnover figures in absolute terms and many therefore do not. It was felt that fields in the database would be better utilised if only consistently available data were included.

The question of what period to select in tracking the market index (in our case the JSE actuaries index) is somewhat arbitrary. Most writers claim that it should be sufficiently long to be meaningful but not so long as to cover a period in which a large number of the companies in the index disappear or radically change their rankings. The various measures seem to range from one year to about five years. Some measures are based on weekly prices and others on monthly prices. We simulated various time periods ranging from 12 months at a time to 30 months at a time. We found that in the case of all the portfolios whether selected on earnings, dividend, liquidity, leverage or capitalisation (by the measure shown in our sample record) the notional portfolio tracked the index better as the measuring period got longer. We also found that the R squared values for the portfolios tended to stay above 75% measured on any criteria but that beta values were lowest for portfolios selected on the basis of market capitalisation and that these portfolios also tended to track the index better. Market capitalisation portfolios selected on the basis of highest capitalisation in a sector tended to track the market better than those selected on the basis of overall capitalisation, but both provided better tracking than portfolios selected by the other four criteria. Portfolios measured 30 months at a time tended to stay within 5% of the index.

Certain practical problems do arise in using these notional funds for practical fund management. One problem is that the fund may have incoming and outgoing moneys which need to be invested. The theoretical funds follow a buy and hold strategy. Obviously therefore, on a given day a real world fund would not hold a perfect theoretical spread between riskless and risky securities or the continual topping up of the fund would give rise to excessive transactions costs. Furthermore in a pure theoretical sense the index itself should be recalculated each day to reflect the new market weightings. In practice the portfolios would only be topped up periodically as is the actuaries index.

The use of the database simplified and speeded up the generation of portfolios and made it practical for us to contemplate many different kinds of simulations for the future. Major improvements in the database are likely to become feasible as a result of advances in the microcomputer industry. Microprocessors capable of addressing enormous amounts of RAM are becoming cheaply

**We Know Where  
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available for microcomputers. This will make it possible to store very large index files in RAM, perhaps the memories may become so large that the records themselves can be held in RAM during processing giving hitherto undreamed of access to information. This will also make possible the downloading of relevant portions of large public databases on main-frames by networking to the micros.

We have found that apart from the research benefit there is a direct teaching benefit in building these databases on microcomputers. The students are able to keep their own records on diskette and have access to them whenever they please. Even where data is available on shared mainframe facilities students are often frustrated in attempts to use it by limitations on machine time imposed by the system authorities. In any shared system this is understandable as there are competing needs from various users and unskilled students can be very wasteful from a system point of view. However, hands-on experience is exactly what the student needs. Apart from actual machine time limitations, students often struggle with administrative features of sharing such as system control on access to various packages, the disk containing their database not being available or very often simple not being up to date. Even if they have the source data they are not usually allowed to interfere with public databases to update them because their brave attempts might be catastrophic to the system. The mini diskette is so cheap that we have allowed students to simply make their own copy of sectors of our database and experiment with it as they will. In our view this acts as a stimulus to learning and creativity.

**University of Cape Town**  
*Department of Business Science*

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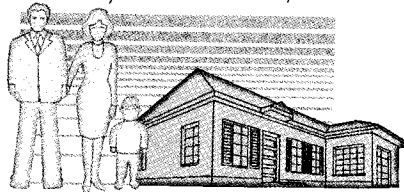
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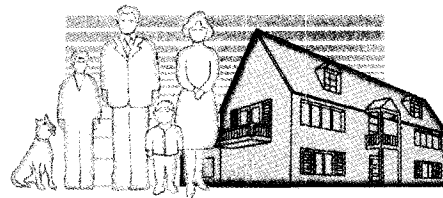


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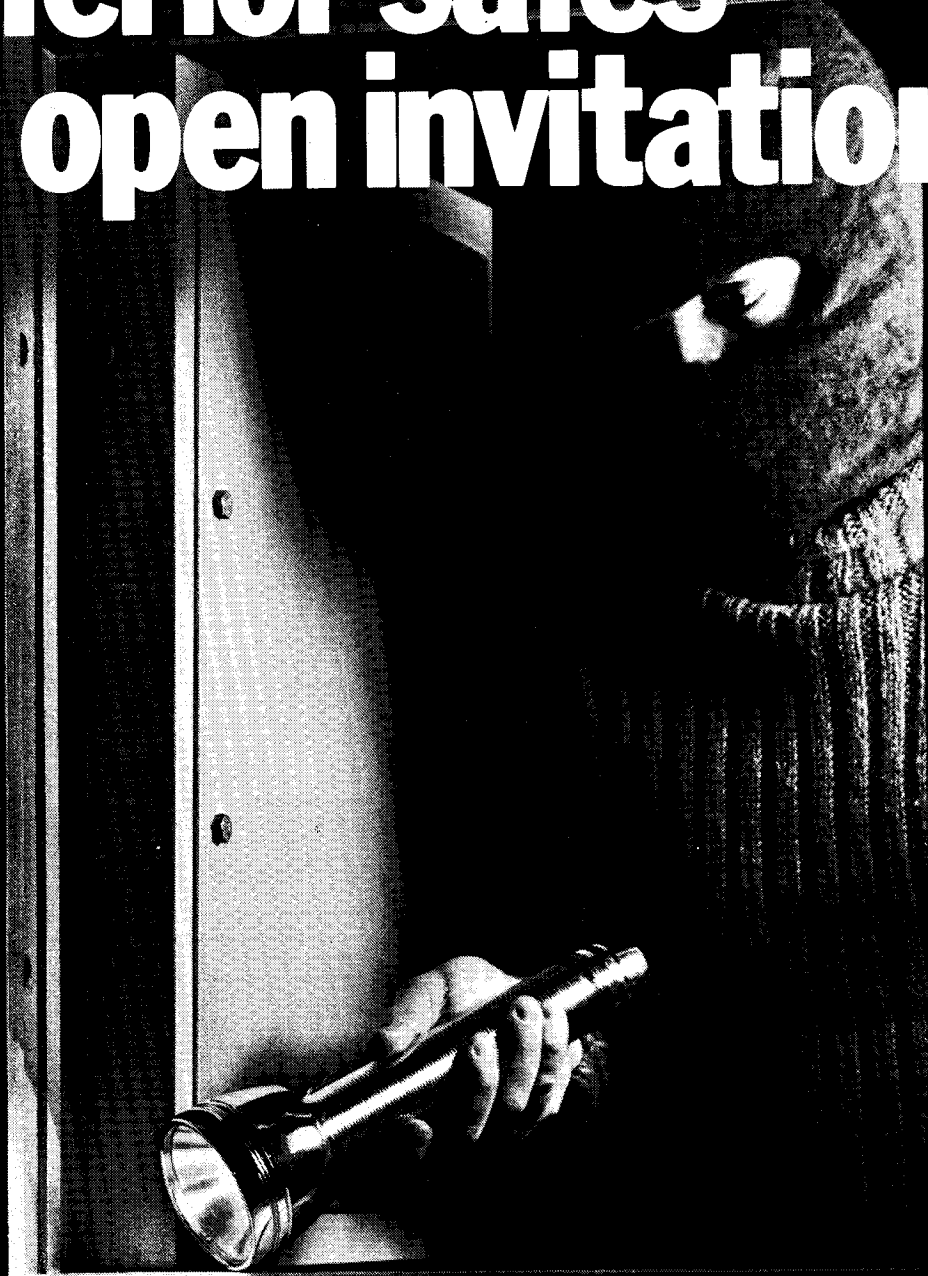
SOUTHERN

**A microcomputer database for a notional index fund**

**Appendix 1**

Notional Fund – University of Cape Town													
Share	%	October 1981		November 1981		December 1981		January 1982		February 1982		March 1982	
AECI	5,34	970	51,80	980	52,33	990	52,87	980	52,33	880	46,99	685	36,58
Afrox	0,74	590	4,37	570	4,22	560	4,14	555	4,11	484	3,58	415	3,07
Amcoal	3,45	3 875	133,69	3 775	130,24	3 900	134,55	3 600	124,20	2 800	96,60	2 700	93,15
Anglo													
American	14,27	1 745	249,01	1 670	238,31	1 630	232,60	1 550	221,19	1 455	207,63	2 200	313,94
Amgold	7,08	11 700	828,36	10 400	736,32	10 200	722,16	9 100	644,28	8 550	605,34	7 400	523,92
Afcol	0,35	640	2,24	610	2,14	600	2,10	585	2,05	575	2,01	470	1,65
Barclays	2,59	915	23,70	890	23,05	865	22,40	850	22,02	850	22,02	800	20,72
Barlows	4,74	1 040	49,30	1 055	50,01	1 050	49,77	1 025	48,59	965	45,74	880	41,71
De Beers	24,08	850	204,68	857	206,37	875	210,70	853	205,40	790	190,23	525	126,42
East Drie- fontein	6,86	2 625	180,08	2 625	180,08	2 625	180,08	2 775	190,37	2 475	169,79	2 550	174,93
Fedfund	0,34	180	0,61	180	0,61	185	0,63	190	0,65	150	0,51	153	0,52
Fugit	0,60	285	1,71	285	1,71	288	1,73	280	1,68	275	1,65	390	2,34
Free State													
Saaiplaas	2,56	5 000	128,00	4 100	104,96	3 900	99,84	4 100	104,96	3 375	86,40	2 950	75,52
Hiveld	1,31	490	6,42	530	6,94	495	6,48	530	6,94	520	6,81	395	5,17
Hulett	0,89	845	7,52	890	7,92	900	8,01	925	8,23	900	8,01	770	6,85
Impala	1,79	970	17,36	920	16,47	820	14,68	765	13,69	665	11,90	500	8,95
Liberty	1,25	450	5,63	425	5,31	455	5,69	500	6,25	495	6,19	4,25	5,31
M & R	0,64	800	5,12	760	4,86	775	4,96	785	5,02	770	4,93	575	3,68
Nampak	1,27	815	10,35	810	10,29	840	10,67	900	11,43	860	10,92	760	9,65
Palabora mining	2,2	1 385	30,47	1 250	27,50	1 275	28,05	1 250	27,50	1 480	32,56	1 000	22,00
Premier Milling	1,15	1 440	16,56	1 470	16,91	1 490	17,14	1 450	16,68	1 440	16,56	1 030	11,85
Randfontein	2,52	7 700	194,04	7 350	185,22	7 400	186,48	6 375	160,65	5 700	143,64	5 350	134,82
Rembrandt	1,58	1 070	16,91	1 060	16,75	1 140	18,01	1 110	17,54	1 055	16,67	950	15,01
Romatex	0,68	790	5,37	710	4,83	740	5,03	750	5,10	750	5,10	650	4,42
SA Breweries	2,87	470	13,49	480	13,78	490	14,06	487	13,98	468	13,43	430	12,34
SA Druggist	0,36	155	0,56	160	0,58	160	0,58	160	0,58	145	0,52	130	0,47
Safmarine	0,47	535	2,51	540	2,54	550	2,59	550	2,59	540	2,54	400	1,88
Vaal Reefs	5,58	8 200	457,56	8 075	450,59	8 350	465,93	8 300	463,14	6 850	382,23	5 800	323,64
Winkelhaak	1,49	3 500	52,15	3 175	47,31	3 400	50,66	3 200	47,68	3 000	44,70	2 850	42,47
Woolworths	0,95	900	8,55	915	8,69	920	8,74	905	8,60	820	7,79	660	6,27
OUR index			270		255		256		243		219		202
ACT index			726		700		692		671		613		529

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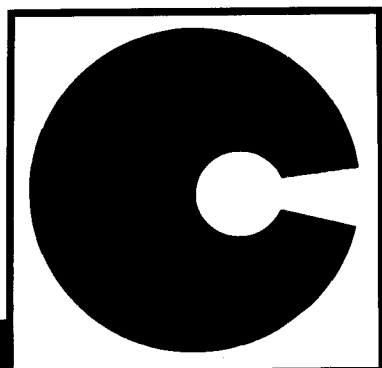
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# The "hidden" costs and benefits associated with different loan repayment frequencies

## INTRODUCTION

Throughout the financial world a variety of interest rates are employed, perhaps the most common rates being flat, nominal and effective. These three rates of interest, and how they are related to one another, have been studied in some detail in (1)–(8). In particular, a nomogram relating these rates of interest appears in (5). From a teaching point of view the nomogram provides a useful facility in converting one interest rate to another. In addition to the variety of interest rates available there are various lending and repayment schedules. In this paper we wish to analyse the costs or benefits, depending on whether one is a borrower or lender, associated with different repayment frequencies. To clarify our ideas we consider the following situation:

Suppose we have two lending companies, A and B. Suppose that company A requires its borrowers to repay their loans by means of equal instalments of \$K every month, whereas company B requires only quarterly repayments of \$3K. If the companies and borrowers each

have the opportunity to invest funds at  $\frac{r}{12}\%$  per

month, then clearly the two repayment schemes have "hidden" advantages and disadvantages, depending upon whether one is the lender or borrower. Clearly, from company A's point of view, monthly repayments are going to be more attractive, because after the first month it can invest \$K at  $\frac{r}{12}\%$  per month, after the

second month it has another \$K to invest, and so on, whereas company B has to wait for three months before it can make a corresponding investment. On the other hand, company B's system of repayment is more attractive to the borrower, because he has use of his money for a longer period.

To be a little more specific, suppose as before, that each company invests its borrowers' repayments at  $\frac{r}{12}\%$  per

month. If we denote by  $R_A$  and  $R_B$  the revenue collected by companies A and B respectively as a result of receiving

and then investing regular repayments at  $\frac{r}{12}\%$  then

we give some examples of the value of  $I = \left(\frac{R_A - R_B}{R_B}\right)$

which represents the fractional profit of one scheme over the other. If company A receives \$K monthly and company B receives \$3K quarterly then I is approximately 1,51% when  $r = 0,18$ . If company A receives \$K monthly and company B receives \$6K every six months, then I is approximately 3,83% for  $r = 0,18$ . In the extreme case in which company A receives \$K daily and company B receives \$365K annually, I reaches about 9,54% when  $r = 0,18$ .

We also determine expressions for the equivalent effective rates of interest earned by the companies on

their investments (loans). If we denote these by  $e_A$  and  $e_B$  for company A and company B, respectively, we give

some examples of the value of  $E = \frac{e_A}{e_B}$  which represents

the ratio of the effective rates of interest of the two schemes.

Let us now briefly examine the situation confronting borrowers. A borrower, contemplating a loan, is faced with numerous possibilities by lending companies offering different rates of interest, and different methods of repayment. Which company does he choose to mini-

mise his cost? The value of the quotient  $\frac{R_A}{R_B}$  or  $I + 1$  in

relation to 1 determines which company to choose. Alternatively, we may use the value of E in relation to 1 to determine the best proposition from the borrower's point of view. Examples will be presented later.

We now address ourselves to determining, in general, the profits accruing to lending companies and the corresponding costs to borrowers when different repayment schemes are adopted, and the equivalent effective rates of interest associated with the investments.

## THE GENERAL CASE

Suppose that company A lends money at a nominal rate of interest  $i_A\%$  per annum and requires annually m equal repayments of \$ $K_A$ . For company B, suppose that it lends at a nominal rate of  $i_B\%$  per annum and requires annually n equal repayments of \$ $K_B$ . In addition, suppose that each company has an equal opportunity to invest the repayments that it receives from its borrowers. More specifically, for company A, suppose that between any two consecutive receipts of \$ $K_A$ , there is an opportunity

to invest this amount for  $\alpha$  periods at  $\frac{r}{\alpha m}\%$  per period.

Similarly, for company B, let  $\beta$  play the same role as  $\alpha$  does for company A, so that company B has the oppor-

tunity to invest \$ $K_B$  for  $\beta$  periods at  $\frac{r}{\beta n}\%$  per period,

where, in general, we will have  $\alpha m = \beta n$ , in which case the period of investment available to each company is the same. For example, suppose  $m = 12$ ,  $n = 4$ . Then  $3\alpha = \beta$ , a solution of which is  $\alpha = 1$  and  $\beta = 3$ , so that each company invests receipts on a per monthly basis.

## THE COMPANY'S GAIN

After the first repayment, company A has accumulated \$ $K_A$ . After the second repayment, the accumulated revenue is

$$K_A + K_A \left(1 + \frac{r}{\alpha m}\right)^\alpha$$

Consequently, at the end of m.y repayments, where y years is the duration of the loan, the accumulated revenue is

\*In the mathematical formulae that follow, all rates of interest will be expressed, for convenience, as decimals, so that  $r = 0,1$  for example, will correspond to 10%.



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$$R_A = K_A \left[ 1 + \left(1 + \frac{r}{\alpha m}\right)^\alpha + \left(1 + \frac{r}{\alpha m}\right)^{2\alpha} + \dots + \left(1 + \frac{r}{\alpha m}\right)^{(\alpha m - 1)\alpha} \right]$$

$$= K_A \frac{\left(1 + \frac{r}{\alpha m}\right)^{\alpha m} - 1}{\left(1 + \frac{r}{\alpha m}\right)^\alpha - 1} \quad (1)$$

Similarly, for company B, the accumulated revenue after  $n \cdot y$  repayments is

$$R_B = K_B \frac{\left(1 + \frac{r}{\beta n}\right)^{\beta n} - 1}{\left(1 + \frac{r}{\beta n}\right)^\beta - 1} \quad (2)$$

Equations (1) and (2) may both be written in terms of the common *effective* rate of interest,  $e\%$  per annum available to the companies for investments. This avoids the necessity to use  $\alpha$  and  $\beta$  and then (1) and (2) become

$$R_A = K_A \left[ \frac{(1 + e)^y - 1}{(1 + e)^{1/m} - 1} \right], \quad (1')$$

$$R_B = K_B \left[ \frac{(1 + e)^y - 1}{(1 + e)^{1/n} - 1} \right], \quad (2')$$

If companies A and B lend  $\$S_A$  and  $\$S_B$  respectively, then we briefly derive formulae for the regular repayments  $K_A$  and  $K_B$ . For convenience of presentation we temporarily omit the subscripts A and B.

Accordingly, let  $S_j$  denote the amount outstanding at the beginning of the  $j$ th period and assume that the nominal interest rate is  $i\%$  per annum, with  $h$  repayments per annum. Then

$$S_j = S_{j-1} \left(1 + \frac{i}{h}\right) - K,$$

which leads to

$$S_j = S \left(1 + \frac{i}{h}\right)^{j-1} - K \sum_{k=0}^{j-2} \left(1 + \frac{i}{h}\right)^k.$$

If the loan is completely repaid at the end of the  $N$ th period, then  $S_{N+1} = 0$ , or

$$S \left(1 + \frac{i}{h}\right)^N = K \sum_{k=0}^{N-1} \left(1 + \frac{i}{h}\right)^k.$$

After summing the geometric progression, the last equation becomes

$$S \left(1 + \frac{i}{h}\right)^N = K \frac{\left(1 + \frac{i}{h}\right)^N - 1}{\frac{i}{h}}$$

from which it follows that

$$K = S \frac{\frac{i}{h} \left(1 + \frac{i}{h}\right)^{hy}}{\left(1 + \frac{i}{h}\right)^{hy} - 1}$$

Consequently, on writing  $h = m$  and then  $h = n$ , we obtain

$$K_A = S_A \frac{\frac{i_A}{m} \left(1 + \frac{i_A}{m}\right)^{my}}{\left(1 + \frac{i_A}{m}\right)^{my} - 1}, \quad (3)$$

and

$$K_B = S_B \frac{\frac{i_B}{n} \left(1 + \frac{i_B}{n}\right)^{ny}}{\left(1 + \frac{i_B}{n}\right)^{ny} - 1}, \quad (4)$$

Substituting (3) and (4) in (1) and (2) respectively, gives formulae for  $R_A$  and  $R_B$  in terms of the amount borrowed, the nominal rate of interest, the loan term, etc. Consequently, the following formulae facilitate calculations in terms of basic loan parameters:

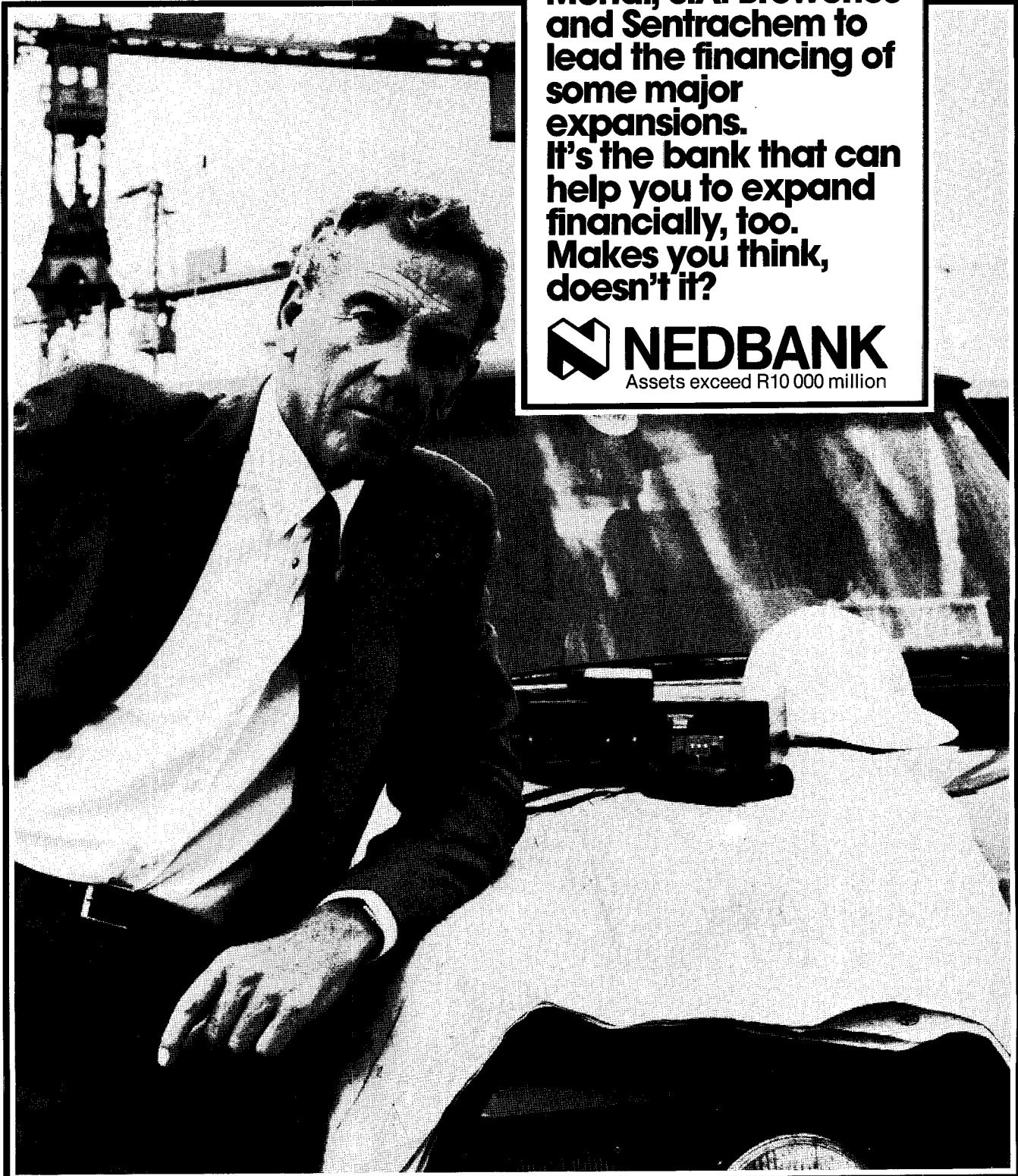
$$R_A = \frac{i_A S_A}{m} \frac{\left[\left(1 + \frac{r}{\alpha m}\right)^{\alpha m} - 1\right]}{\left[\left(1 + \frac{r}{\alpha m}\right)^\alpha - 1\right]} \frac{\left(1 + \frac{i_A}{m}\right)^{my}}{\left[\left(1 + \frac{i_A}{m}\right)^{my} - 1\right]}, \quad (5)$$

and

$$R_B = \frac{i_B S_B}{n} \frac{\left[\left(1 + \frac{r}{\beta n}\right)^{\beta n} - 1\right]}{\left[\left(1 + \frac{r}{\beta n}\right)^\beta - 1\right]} \frac{\left(1 + \frac{i_B}{n}\right)^{ny}}{\left[\left(1 + \frac{i_B}{n}\right)^{ny} - 1\right]}. \quad (6)$$

If  $R_A > R_B$ , the fractional gain in revenue by company A is given by

$$I = \left(\frac{R_A - R_B}{R_B}\right) \% \quad (7)$$



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Of course, whether  $R_A < R_B$ ,  $R_A = R_B$ , or  $R_A > R_B$  is determined by the relative values of the parameters involved in (5) and (6). Illustrations by means of particular situations will be given subsequently, together with specific values for  $l$ .

The equivalent effective rates of interest (per annum),  $e_A$  and  $e_B$ , earned by the companies A and B on their investments, are given by

$$R_A = S_A(1 + e_A)^y, \quad R_B = S_B(1 + e_B)^y \quad (8)$$

respectively. It follows from (8) that

$$e_A = \left(\frac{R_A}{S_A}\right)^{1/y} - 1, \quad e_B = \left(\frac{R_B}{S_B}\right)^{1/y} - 1 \quad (9)$$

and, as a result, that the ratio of the effective rates of interest,  $E$ , is given by

$$E = \frac{e_A}{e_B} = \frac{\left(\frac{R_A}{S_A}\right)^{1/y} - 1}{\left(\frac{R_B}{S_B}\right)^{1/y} - 1} \quad (10)$$

In the subsequent examples  $l$  will be determined for a range of values of  $m$ ,  $n$ ,  $\alpha$  and  $r$  assuming  $mK_A = nK_B$ , that is, when total annual revenues are the same under both schemes. For simplicity we will confine our attention to those cases in which  $S_A = S_B = S$ , say. In order to determine  $e_A$  and  $e_B$  (and also  $E$ ) it is necessary to further specify the (assumed) common duration of the loans and  $i_A$  or  $i_B$  (one is determined from the other if  $mK_A = nK_B$ ). Alternatively, instead of specifying  $i_A$  or  $i_B$  we may specify  $K_A$  or  $K_B$  in terms of  $S$ , that is, one of the repayment instalments as a fraction of the principal. Again, the other repayment instalment, as a fraction of the principal, follows from  $mK_A = nK_B$ .

### THE CUSTOMER'S OPPORTUNITY COST

The analysis of the previous section was, of course, appropriate to assessing a lending company's profit from a particular loan situation. From the borrower's point of view, however, there will be a corresponding analysis determining the cost of a loan. We define the (total) cost of a loan to a borrower as the sum of all the repayments together with the opportunity cost of interest resulting from having to make these repayments. If the loan conditions specified in the previous section apply, and  $C_A$  and  $C_B$  denote the costs of loans through two companies A and B, as defined above, then  $C_A$  and  $C_B$  are exactly the right-hand sides, respectively, of (1) and (2) or (5) and (6). These results could have been predicted from the duality principle "the company's gain is the borrower's loss". However, in practice, the investment opportunities available to borrowers and lenders will not yield the same returns. Only in a perfect market will the values of  $r$  be the same.

### ILLUSTRATIONS AND PARTICULAR CASES

We detail below the (approximate) values of  $l$ ,  $e_A$ ,  $e_B$  and  $E$  corresponding to a variety of values of  $m$ ,  $n$ ,  $\alpha$ ,  $r$ ,  $y$  and  $K_A/S$ .

#### Example 1

If  $m = 12$ ,  $n = 4$ ,  $\alpha = 1$ ,  $r = 0,1$ ,  $y = 25$  and  $K_A/S = 0,01$ , then  $l \approx 0,84\%$ ,  $e_A \approx 10,90\%$ ,  $e_B \approx 10,86\%$ ,  $E \approx 1,003$ .

#### Example 2

If  $m = 12$ ,  $n = 4$ ,  $\alpha = 1$ ,  $r = 0,18$ ,  $y = 25$  and  $K_A/S = 0,01$ , then  $l \approx 1,51\%$ ,  $e_A \approx 17,58\%$ ,  $e_B \approx 17,51\%$ ,  $E \approx 1,004$ .

#### Example 3

If  $m = 12$ ,  $n = 4$ ,  $\alpha = 1$ ,  $r = 0,1$ ,  $y = 5$  and  $K_A/S = 0,025$ , then  $l \approx 1,04\%$ ,  $e_A \approx 14,12\%$ ,  $e_B \approx 13,93\%$ ,  $E \approx 1,014$ .

#### Example 4

If  $m = 365$ ,  $n = 1$ ,  $\alpha = 1$ ,  $r = 0,18$ ,  $y = 1$  and  $K_A/S = 0,003$ , then  $l \approx 9,54\%$ ,  $e_A \approx 19,94\%$ ,  $e_B \approx 9,5\%$ ,  $E \approx 2,099$ .

Let us briefly interpret the results of some of the above examples. In Example 1 and 2 the loans extend over 25 years and the difference between monthly and quarterly repayments is seen to be relatively insignificant, as measured by either  $l$  or  $E$ . Nevertheless, the higher market rate of interest in Example 2 produces a significantly larger value of  $l$  than in Example 1. Example 4 illustrates the extreme case of daily versus annual repayments. In this case ( $y = 1$ ) there is no opportunity for company B to invest repayments in the market. On the other hand, Company A is able to invest its daily repayments in the market and this produces both a significantly higher final revenue and more than twice the effective return on its investment compared with Company B ( $e > 2$ ).

Finally, we give an example from a borrower's point of view. A borrower, being able to invest his money at a nominal rate of 1,25% per month, considers loan conditions from two finance companies. Company A requires six-monthly repayments, while company B requires monthly repayments. If the loan required is \$5 000 for two years, and companies A and B charge interest at the nominal rate of 16% per annum (8% per half year) and 15,6% per annum (1,30% per month) respectively, which company will the borrower choose in order to minimise his cost?

We first calculate the regular repayments  $K_A$  and  $K_B$  of each company by means of (3) and (4). We obtain

$$K_A = 1509,60 \text{ dollars per half year)}$$

and  $K_B = 243,86 \text{ (dollars per month).}$

$$\text{Then } \frac{C_B}{C_A} = \frac{R_B}{R_A} = \frac{K_B}{K_A} \frac{(1 + 0,0125)^6 - 1}{0,0125} = 1,00004, \text{ approximately,}$$

while  $e_A < e_B$  ( $E \approx 0,99988$ ).

Consequently, the loan through Company A is cheaper, even though Company A has a higher nominal rate of interest. If Company B had charged interest at a nominal rate of 15,3% per annum (1,275% per month), the value of  $\frac{R_B}{R_A}$  would have been 0,997, approximately, while  $e_A > e_B$  ( $E \approx 1,0103$ ), in which case company B would have been the borrower's choice.

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## Investment basics – XIII

### An introduction to gold mining tax

#### Part 3

In the first two parts we went through the mechanics of the calculations of lease and taxation payments for gold mines. In this third and final part we will look at some shortcuts which can be used from quick exercises and examine the implications of the formula method of taxation.

Firstly, let us express the taxation formula in a different way which makes it easier to use for quick calculations. If we take the formula:

$$y = 60 - \frac{480}{x} \text{ this is really}$$

$$y = 60 - \frac{480}{\frac{P}{R} \times 100}$$

$$= 60 - \frac{480 R}{100 P}$$

$$\text{But tax} = y \% \text{ of } P$$

$$= \frac{y}{100} P$$

Substituting for y we get

$$\text{Tax} = \frac{P}{100} \left( 60 - \frac{480 R}{100 P} \right)$$

$$= \frac{60 P}{100} - \frac{480 R}{10000}$$

$$= 0,6 P - 0,048 R$$

or 60% of profit – 4,8% of revenue

This conversion can be done for all the different tax formulae. In our first example the taxable profit (P) was R35,173 million and revenue (R) was R100 million. Substituting these values gives:

$$\text{Tax} = 0,60 \times 35,173 - 0,048 \times 100$$

$$= 21,104 - 4,8$$

$$= 16,304$$

which is the same figure as we had previously before the addition of the 15% surcharge. The surcharge can either be added to the calculated tax or to the percentages in the formula to give:

$$\text{Tax} = 0,69 P - 0,0552 R$$

A similar conversion can be made to the lease formula. However, it will not give an exact answer because the above conversion assumes that the P used in calculating x and the P to which y is applied are the same. In the case of the lease calculation this is, of course, not the situation, but provided there are no unredeemed capital allowances brought forward from the previous year the error is relatively small. Let us go back to our first example and see what the overall error is. For lease we

had profit equal to R40 million and revenue of R100 million. Using the converted formula of:

$$\text{lease payment} = 0,15 \text{ profit} - 0,012 \text{ revenue}$$

and adding the 1,25% we get a lease payment of R4,86 million compared to the correct figure of R4,827 million – an error of less than 1%. If we then continue through to the tax calculation our tax payment including surcharge becomes R18,727 million. Reproducing the table in Part 1 gives:

		Rm
Profit		50
Less: Lease	4,86	
Tax	18,727	23,587
Profit after tax		26,413
Less: Capex		10,0
Available for distribution		16,413

In this example the simplified version understates the final figure by less than 0,1% which, for everybody except the Receiver of Revenue, is probably close enough. However, remember the earlier warning that this simplification gives greater errors when there are unredeemed allowances brought forward. To prove this to yourself use it to calculate the lease and tax payments for each year in our second example and check the errors.

Let us now look at some of the implications of the formula method of taxation. If we look at the formula:

$$y = 60 - \frac{480}{x}$$

which, as we have seen above, can be expressed as:

$$\text{Tax} = 0,6 P - 0,048 R$$

it is clear that when the taxation payable becomes zero, then:

$$0,6 P = 0,048 R$$

$$\text{or } P = 0,08 R$$

In other words taxation only becomes payable when the taxable profit reaches 8% of revenue or  $\frac{P}{R} = 8$ .

Similarly with the formula  $y = 60 - \frac{360}{x}$  taxation only becomes payable when the taxable profit reaches 6% of revenue or  $\frac{P}{R} = 6$ , and, in the case of the formula used

for mines qualifying for State assistance the value of x which gives a zero value for y is 8,838, which is the value referred to in Part 2.

Finally, let us look at the marginal rates of tax which apply to changes in revenue or costs. (For the sake of simplicity we will initially ignore the surcharge.) It is easy



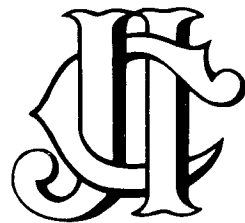
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# Johnnies- Leaders in Mining Finance since 1889

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to show mathematically that, provided the mine is in a tax paying position both before and after the marginal change in revenue or costs, the change in taxation can be calculated by applying the tax formula to the marginal amount.

If we assume that revenue increases by 10 units with no change in costs, then profit will also increase by 10 units. The additional tax payable before any surcharge or loan levy is added can then be calculated as:

$$\begin{aligned} \text{Additional tax} &= 0,6 \times 10 - 0,048 \times 10 \\ &= 5,52 \end{aligned}$$

In other words any additional profit resulting from an increase in revenue is taxed at a marginal rate of 55,2%. Similarly any reduction in profit resulting from a reduction in revenue attracts tax relief at a rate of 55,2%. (Note that in the case of a mine with a formula of

$$y = 60 - \frac{360}{x} \text{ the marginal rate is } 56,4\%.)$$

At this stage we are ignoring the effect of the lease formula, but we will build that in after looking at the marginal tax rate on a change in costs.

If costs decrease by 10 units with no change in revenue, profit increases by 10 units and we get:

$$\begin{aligned} \text{Additional tax} &= 0,6 \times 10 - 0,048 \times 0 \\ &= 6,0 \end{aligned}$$

In this instance the additional profit resulting from a reduction in costs is taxed at a marginal rate of 60%. Similarly a marginal reduction in profit resulting from an increase in costs bears tax relief at a rate of 60%.

In the case of taxation the marginal rate applicable to a change in profit resulting from a change in costs is the same for both standard formulae because the revenue element in the formula does not have any effect. In addition changes in profit resulting from changes in either operating costs and/or capital expenditure have the same effect because there are no capital allowances to be taken into account. When calculating marginal rates for lease payments the current capital allowance on any change in capital expenditure should be taken into account. However, in the type of exercise for which these quick calculations are likely to be used the error created by ignoring the capital allowance will probably be insignificant.

To conclude it is useful to combine the marginal rates of lease and tax resulting from the two formulae used in examples throughout of:

$$\begin{aligned} \text{lease} &= 15\% \text{ of profit} && -1,2\% \text{ of revenue} \\ \text{tax} &= 60\% \text{ of profit} && -4,8\% \text{ of revenue} \end{aligned}$$

### 1 Change in profit resulting from change in revenue

$$\begin{aligned} \text{Marginal rate for} & & & \\ \text{lease payment} &= (15\% - 1,2\%) \times 1,0125 & = & 13,9725\% \end{aligned}$$

$$\begin{aligned} \text{Marginal rate for} & & & \\ \text{tax payment if no lease} &= & & \\ (60\% - 4,8\%) \times 1,15 & & = & 63,4800\% \\ & & & \underline{77,4525\%} \end{aligned}$$

$$\begin{aligned} \text{As lease is a cost for tax must deduct 60\% of} & & & \\ \text{percentage applicable to lease} &= & & \\ (0,6 \times 13,9725) \times 1,15 & & = & 9,6410\% \\ & & & \underline{67,8115\%} \end{aligned}$$

### 2 Change in profit resulting from change in costs (ignoring capital allowance)

$$\begin{aligned} \text{Marginal rate for} & & & \\ \text{lease payment} &= (15\% - 0) \times 1,0125 & = & 15,1875\% \end{aligned}$$

$$\begin{aligned} \text{Marginal rate for} & & & \\ \text{tax payment if no lease} &= & & \\ (60\% - 0) \times 1,15 & & = & 69,0000\% \\ & & & \underline{84,1857\%} \end{aligned}$$

$$\begin{aligned} \text{Deducting lease as a cost for tax} & - & & \\ (0,6 \times 15,1875) \times 1,15 & & = & 10,4794\% \end{aligned}$$

$$\begin{aligned} \text{Marginal rate of lease and tax} & & & \underline{73,7063\%} \end{aligned}$$

These overall marginal rates will vary slightly, depending on the lease and tax formulae applicable to a specific mine.

What is clear is that in the region of 70% of any increased profit resulting from an increase in revenue or a reduction in costs is paid to the State in lease and taxation, which hardly provides an incentive to maximise efforts towards becoming more cost efficient.

## Book review

# Beleggingsbestuur

L. M. Brümmer en W. F. Rademeyer  
J. L. van Schaik, Pretoria 1982

Dit is die eerste boek in die Republiek van Suid-Afrika wat die dissipline van beleggingsbestuur direk toelig binne die Suid-Afrikaanse beleggingsomgewing en beleggingsstruktuur.

Die boek is sterk gebind, die omslag aantreklik en funksioneel terwyl die teks duidelik leesbaar is en met goeie tabelle en grafieke toegelig. Die hoofstukke is goed gebalanseer en in 'n aanvaarbare volgorde.

Die tegniese inhoud vergelyk goed met oorsese literatuur oor dieselfde onderwerp en 'n relatief wye verwydingsbiblioteek word aangebied.

Die grootste deel van die boek behandel beleggingsbeginsels en tegnieke uit die oogpunt van die individuele belegger en die stelling word gemaak dat dieselfde beleggingsbeginsels vir beide die individuele en die institusionele belegger geld. Hierdie stelling kan bevraagteken word vanweë die verskil in, onder andere, die tydspan en risikodoelwitte van die institusie (instelling) soos verteenwoordig deur die professionele belegger en die beleggingsdoelwitte van individuele beleggers. Dit word egter duidelik in die boek gestel dat die primêre doelwit by die bestudering van die beginsels en tegnieke van toepassing by die beleggingsbestuurder slegs die neem van meer wetenskaplike toegeligte en doelmatige beleggingsbesluite is en uit hierdie oogpunt gesien slaag die skrywers daarin om die leser uitstekend toe te rus.

Die boek is die resultaat van 'n uitstaande spanbydrae deur vakkenners by verskeie universiteite en staan onder redaksie van prof. L. M. Brümmer, Nagraadse Bestuurskool, Universiteit van Pretoria en prof. W. F. Rademeyer, Departement Bedryfseconomie, Randse Afrikaanse Universiteit.

'n Brawe poging word aangewend om Afrikaanse benamings te vind vir tradisionele Engelse begrippe (termelys).

Die benadering tot die onderwerp is geredelik sistematies en dek die volgende gebiede:

### DEEL I

#### Inleiding en begripsbepaling

- Hoofstuk 1 Inleiding en terreinverkenning
- Hoofstuk 2 Die kapitaalmark
- Hoofstuk 3 Opbrengskoerse en risiko,

### DEEL II

#### Fundamentele en tegniese ontleding

- Hoofstuk 4 Makro-ekonomiese ontleding
- Hoofstuk 5 Ontleding van die bedryfstak
- Hoofstuk 6 Ontleding van die individuele onderneming en die waardering van gewone aandele
- Hoofstuk 7 Die waardering van vaste rentedraende effekte
- Hoofstuk 8 Omskepbare effekte, opsies en regte-uitgifte
- Hoofstuk 9 Tegniese ontleding

### DEEL III

#### Die beplanning en bestuur van doelmatige portefeuljes

- Hoofstuk 10 Portefeuljeteorie en -bestuur
- Hoofstuk 11 Institusionele beleggers
- Hoofstuk 12 Effektebeurspraktyke en -prosedures

### DEEL IV

#### Die praktiese toepassing van die finansiële ontleding van 'n genoteerde onderneming: tradisionele en moderne perspektiewe

- Hoofstuk 13 'n Toepassing van die finansiële ontleding van 'n genoteerde onderneming

Vaste eiendom as 'n beleggingsgebied word kortliks in drie bladsye bespreek aangesien die boek slegs op die belegging in finansiële bates soos aandele en effekte toegespits is.

Die bespreking van enkele basiese beginsels by die waardering van goudaandele word as uitsonderlik beskou – geen ander teksboek bied hierdie fasiliteit nie, terwyl dit 'n wesenlike deel vorm van die Suid-Afrikaanse beleggingsomgewing.

Elke hoofstuk deel met 'n beleggingsvorm wat 'n vakgebied op sy eie is en aldus verskeie teksboeke sou moes beslaan om in besonderhede bespreek te word.

Die boek kan as 'n algemene inleiding tot die beleggingsomgewing beskou word. Verdere studie in die verskillende gebiede sal dus nodig wees vir die persoon wat meer spesialiteitsdiepte wil opbou.

Die boek kan met vrug op 'n voorgraadse vlak by Afrikaanse universiteite gebruik word asook deur persone wat in die besigheidswêreld optree en spesifiek ook gemoeid is met beleggings.