The Investment Analysts Journal

Number 36 – Summer 1992/1993

Die Beleggings-ontleders Tydskrif

Nommer 36 – Somer 1992/1993

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Inhoud

This issue in brief

SA Foreign Exchange Risk under Managed Floating: Distributional Aspects
The authors examine exchange rate risk over the decade of managed floating. Distributional tests lead to the rejection of the normal distribution often used to evaluate and control exchange rate risk. Estimation shows that the leptokurtic character of empirical exchange rate distributions are better characterised by the class of non-normal stable Paretian distributions. The major economic implication is the higher probability of the irregular occurrence of larger price changes than is usually allowed for. Improved knowledge of the underlying distribution will allow for more efficient hedging.

Are our portfolio managers ready to invest overseas when exchange control goes?
The results of a questionnaire survey revealed that the majority of portfolio managers in South Africa are aware of the overall investment benefits accruing from investing in foreign securities. However, these same portfolio managers showed a distinct reluctance towards investing in foreign securities. It would seem that portfolio managers in South Africa are functionally fixated with investing on the JSE, and that they are thus inefficient in their role as allocators of investments funds. As a result of this functional fixation, portfolio managers are unlikely to optimise their portfolio returns by pursuing international portfolio diversification when exchange control regulations are partially relaxed or completely abolished.

Equivalent dividends: an extension
The equivalent dividend is a mechanism which can be used to incorporate capital structure changes in the calculation of share returns in computerbased systems without having to change the time-series of price data. This note highlights a number of problems in the calculation of the equivalent dividends for simultaneous or near simultaneous changes in the capital structures, and suggests the correct approach to the calculation. The problems are illustrated with examples of capital structure changes of companies listed on the JSE.

Stock Market Over-reaction: The South African Evidence
It has been suggested that stock markets over-react and that investors pay too much attention to recent "dramatic" news. If over-reaction does occur and prices overshoot then there should be a subsequent revision in the opposite direction. This paper outlines empirical research into the over-reaction hypothesis on the Johannesburg Stock Exchange using data over the period July 1974 to June 1989 for two hundred and four well traded securities.

The findings provide clear evidence of long run weak-form inefficiencies in the South African stock market over the period investigated. Additionally, while less pronounced than for the American market, there is evidence of both a January effect and an asymmetric excess returns effect for the South African market.

Investment Basics – XXVI Trading Systems
All technical indicators suffer from limitations which makes it impractical to use the buy and sell signals they generate blindly for trading. On the other hand, a knowledge of limitations could enable the analyst to distinguish when the signals produced by some indicator are more likely to be correct.

Further, not all indicators suffer from the same limitations. While one indicator is generating incorrect or ambiguous signals, another indicator may well be more reliable, just because it is not subject to the problems and limitations of the first.

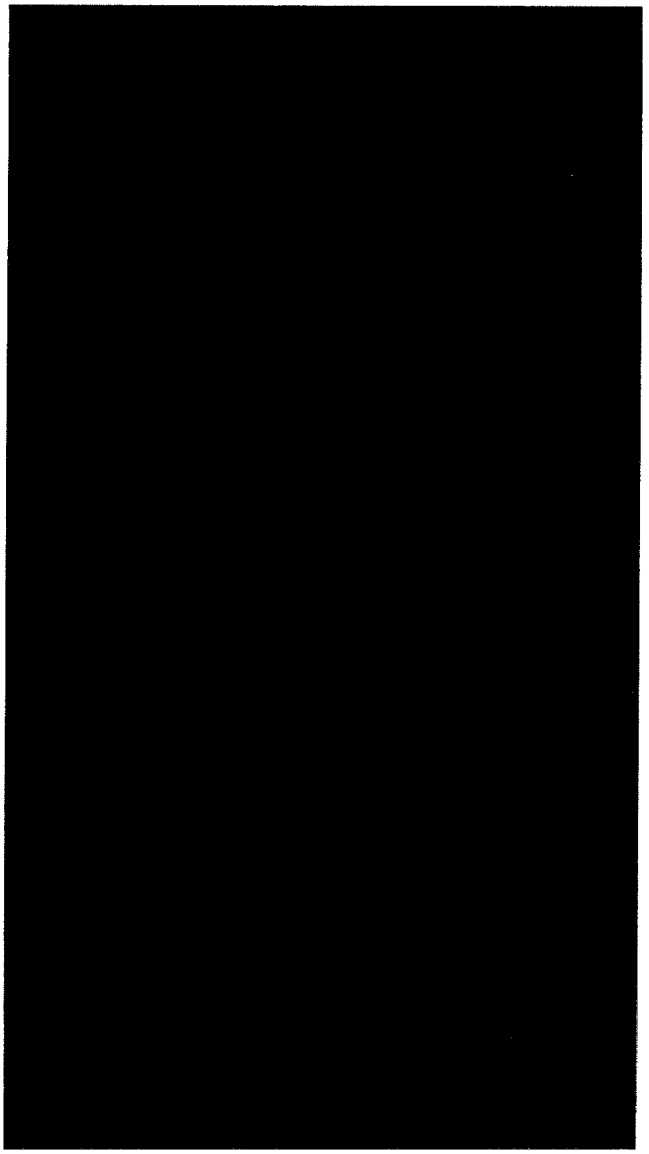
This means that the judicious use of different indicators in combination, should result in improved trading performance.

The procedures which govern the selection and interpretation of indicators, and also the way signals are translated into buy or sell orders, constitute a trading system. A trading system has the advantage of improving discipline, the most important single ingredient of successful trading.

Complex trading systems extend well beyond mere technical analysis, and could well include economic analysis and portfolio theory.

The following firms have, in addition to our advertisers, assisted in the financing of this issue of the journal and thanks are due to them for their kindness.

Bo en behalwe ons adverteerders, het die onderstaande maatskappye hulp verleen met die finansiering van hierdie uitgifte van die tydskrif en hulle word bedank vir hulle vriendelikheid.



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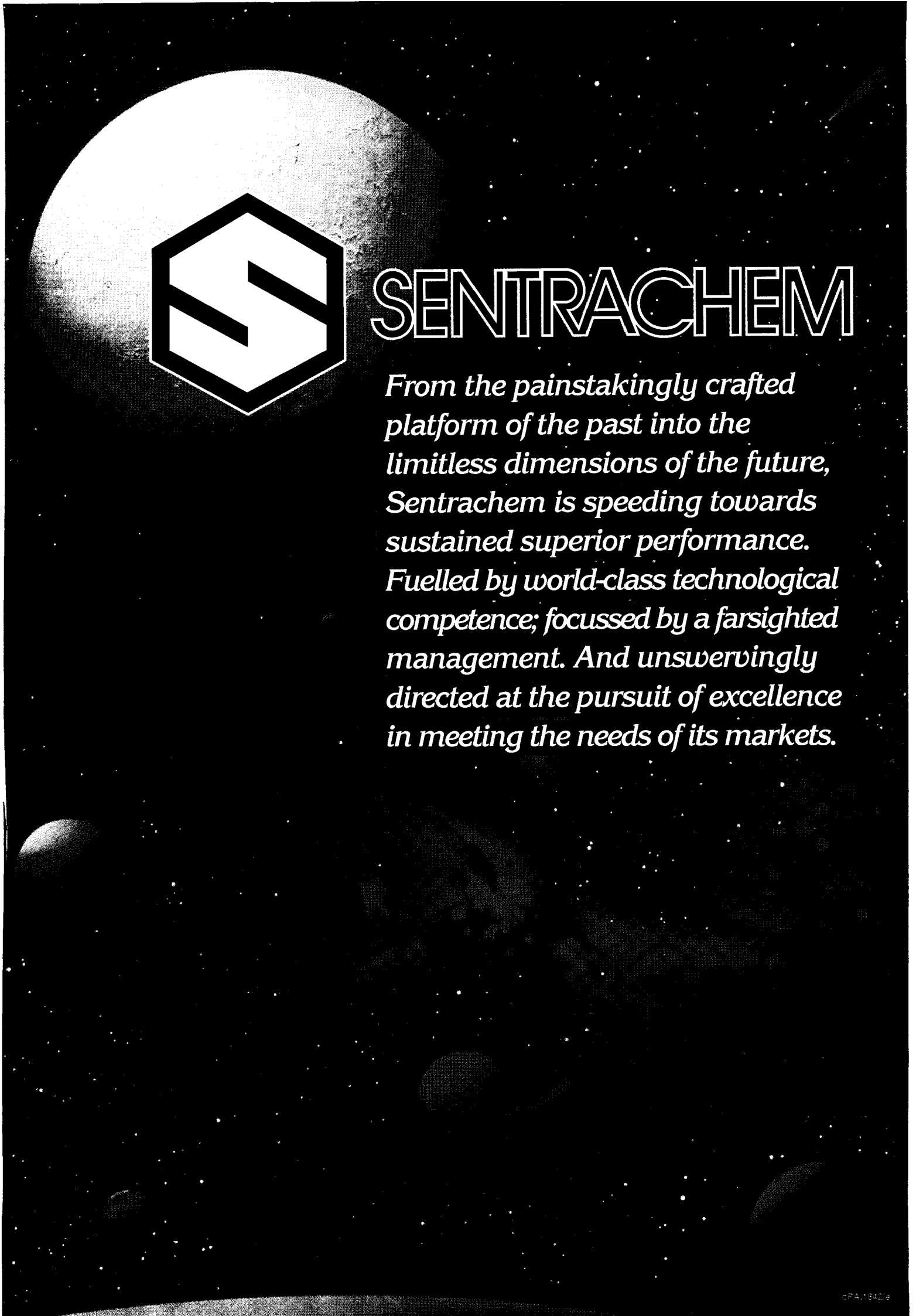
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The Investment Analysts Journal

Thirty-sixth issue – Summer 1992/1993

It would be a nice world if it were possible to abolish all national currencies and for them to be replaced by a common exchange medium that would be used by all people everywhere. Imagine being able to get onto an aeroplane and flying off to Tokyo, Texas or Timbuktu and not having to worry about travellers cheques or making mental calculations of comparative prices when touring abroad. In the common currency, one would know, instantly, what was cheap and what was expensive. Gone too would be all the foreign exchange speculation that has become the bane of the lives not only of central banks but also of ordinary people. How much more efficient the world economy would be and how much economic growth itself would be encouraged. Without exchange risk, trade between countries would expand, and investment flows would increase as well, to the benefit of everybody.

But if this is what would really happen, why is it taking so long for national governments to agree on a new monetary order? Three reasons suggest themselves. First, while there would be advantages to such a world system, there could also be disadvantages. These would be born by weaker nations rather than by stronger ones. In brief, an open world system would pose the threat of a loss of funds by those most desperately in need, and as long as this was the perception, it would be resisted by the governments concerned. South Africa declines to abandon exchange controls, let alone adopt, say, the dollar as its currency, precisely for this reason.

Second, the adoption of a common currency by any group of countries would necessitate a loss of both economic and political sovereignty for the affected individual governments. Gone would be the possibility of exercising any separate monetary policy (raising or lowering interest rates, revaluing or devaluing the currency) for the purpose of protecting a domestic economy or trying to win for a particular country an advantage relative to others in the shared area. Clearly, this second reason is not far removed from the first (mentioned above) although the first would most often apply to underdeveloped or developing countries, while the second would apply most often to more advanced countries.

Third, in order to bring a situation of monetary union about would require a high degree of economic convergence between participating countries at the time the union was instituted. If the needed convergence did not exist, stronger countries would benefit at the expense of weaker ones and all the reasons just mentioned above as problems would come into force. Britain's withdrawal from the European Community's ERM is a demonstration of this. If fixing the pound to the Deutschmark was too much for the country to bear, how much worse would it have been had monetary union in the EC already been instituted? High German interest rates, made necessary because of a merging of the West German and East German economies, would have applied with equal force in Britain itself, driving its economy deeper into recession.

The Maastricht commitment to monetary union by the end of the present decade needs to be re-examined in the light of the tough experience of recent months. Is it reasonable to expect that such an objective can be achieved when the world economy has been subjected to such major structural change (the US's emergence as a net debtor, the collapse of Soviet socialism, the end of the arms race) and the economies of member EC countries are still so far apart? The common sense

Die Beleggingsontleders Tydskrif

Ses-en-dertigste uitgawe – Somer 1992/1993

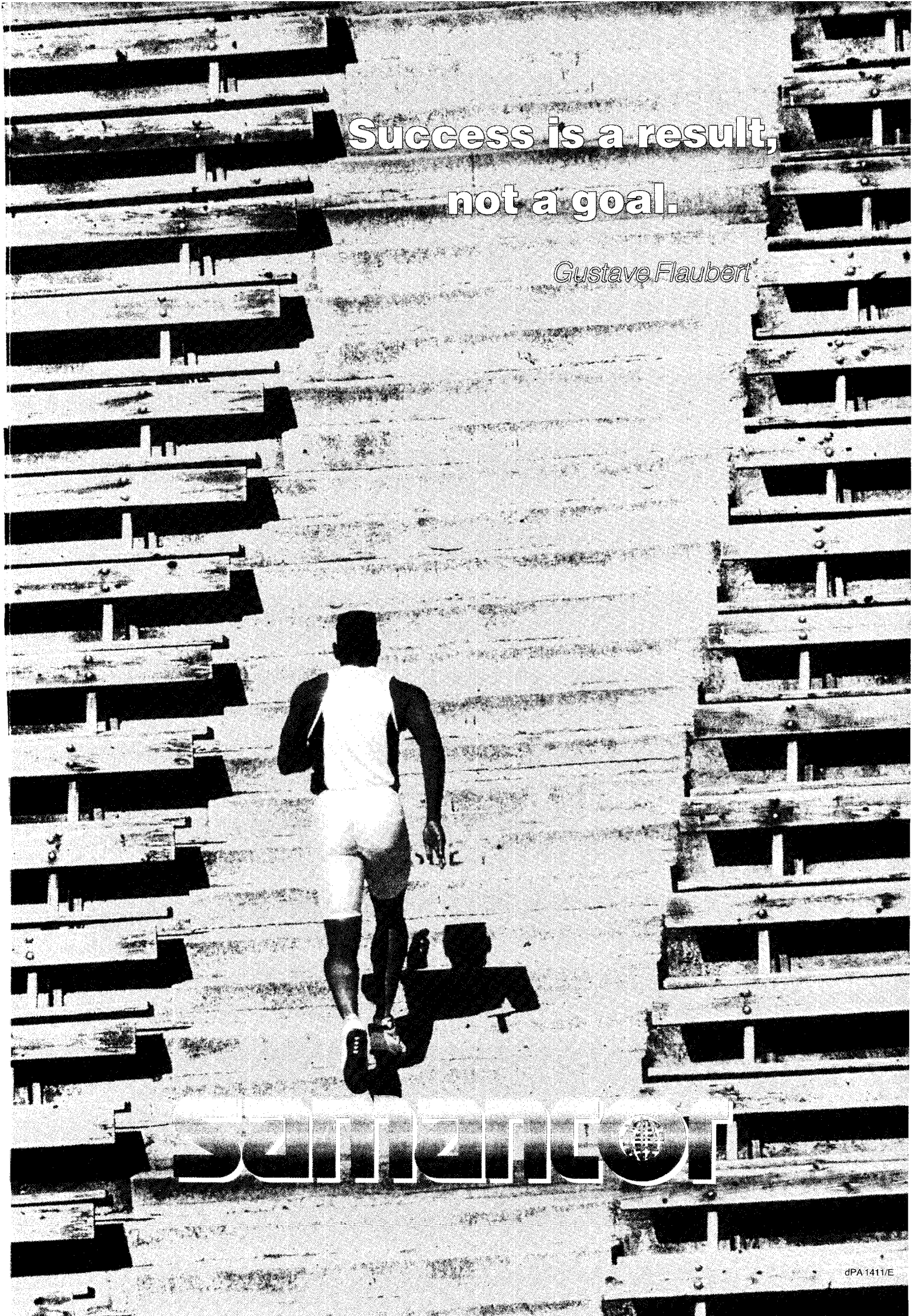
Dit sou 'n wonderlike wêreld wees indien alle nasionale geldeenhede kon verdwyn en vervang word met 'n gemeenskaplike geldeenheid wat oral deur alle mense gebruik word. Dink daaraan om op 'n vliegtuig na Tokio, Texas of Timbuktu te klim en jou nie hoef te bekommer oor reisigerstjeks nie, of om oorsee te reis sonder die hoofrekenkunde van prysvergelykings. In 'n gemeenskaplike geldeenheid sou jy onmiddellik kon bepaal wat goedkoop en wat duur is. Wisselkoersspekulasie, wat nie net die straf van sentrale banke, maar ook van gewone mense geword het, sou verdwyn. Hoeveel meer effektief sou die wêreldekonomie nie wees en hoeveel sou ekonomiese groei nie aangemoedig word nie. Sonder wisselkoersrisiko's sou die handel tussen lande uitbrei en beleggings toeneem, tot voordeel van iedereen.

Maar as dit regtig sou gebeur, waarom neem dit so lank vir regerings om 'n ooreenkoms te bereik aangaande 'n nuwe monetêre orde? Drie redes lê voor die hand. Eerstens, terwyl daar voordele in 'n sodanige wêreldstelsel is, bevat dit ook nadele. Laasgenoemde sou die swakker lande, eerder dan die sterkeres, toeval. Kortliks, 'n wêreldstelsel sou die bedreiging inhou dat hulle wat fondse die meeste benodig, die beste kans staan om dit te verloor, en terwyl hierdie persepsie geld, sal dit deur die betrokke regerings teengestaan word. Suid-Afrika wys die afskaffing van wisselkoersbeheer, en die aanvaarding van die dollar as nasionale geldeenheid, af juis om hierdie rede.

Tweedens, die aanvaarding van 'n gemeenskaplike geldeenheid deur enige groep lande, sal 'n verlies aan beide ekonomiese en politieke soewereiniteit beteken vir die individuele regerings. Daar sou weggedoen word met die moontlikheid om onafhanklik monetêre beleid te bepaal (die verhoging of verlaging in rentekoerse, die revaluasie of devaluasie van die geldeenheid) ten einde die nasionale ekonomie te beskerm, of 'n relatiewe voordeel bo 'n ander in 'n area van gedeelde belang te bekom. Hierdie tweede rede is duidelik nie ver verwyder van die eerste (hierbo genoem) nie, maar sal eerder van toepassing wees op ontwikkelde lande, terwyl die eerste meer dikwels van toepassing sal wees op onderontwikkelde of ontwikkelende lande.

Derdens, die skepping van monetêre eenheid sal 'n hoë mate van ekonomiese konvergensie tussen deelnemende lande vereis op dié stadium dat die eenheid daargestel word. Indien sodanige konvergensie nie, bestaan nie sal sterker lande bevoordeel word ten koste van swakkeres en al die voorgaande argumente sal geld. Brittanje se onttrekking uit die EEG se eenheidswisselkoersmeganisme is 'n voorbeeld hiervan. Indien die vaspenning van die pond tot die Deutschmark meer was as waarvoor die land kans gesien het, hoeveel slegter af sou dit gewees het indien monetêre eenheid in die EEG alreeds bestaan het? Hoë Duitse rentekoerse, genoodsaak deur die samesmelting van die Wes-Duitse en Oos-Duitse ekonomieë, sou net so in Brittanje gegeld het, wat die ekonomie dieper in 'n resessie sou dryf.

Die Maastricht verbintenis tot monetêre eenheid teen die einde van die huidige dekade behoort hersien te word in die lig van die moeilike ondervinding van onlangse maande. Is dit redelik om te verwag dat so 'n doelstelling verwesenlik kan word wanneer die wêreldekonomie onderwerp is aan aansienlike strukturele veranderings (die VSA se opkoms as 'n netto skuldenaar, die ineenstorting van Sovjet sosialisme, die einde van


Success is a result,
not a goal.
Gustave Flaubert
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answer to this question would seem to be 'No!' At best what looks feasible is a union comprising the currencies of those countries most clearly linked to Germany, but even in their case there are problems as long as the union between West Germany and East Germany remains incomplete. However, the EC governments in their wisdom, or lack thereof, appear still to be committed to a single speed advance towards a common European currency rejecting a multi-speed approach where weaker countries can join as and when they are able. This single speed approach is the solution of the lowest common denominator, or put another way, the forging of a chain the strength of which depends on its weakest link. We would venture to guess that if Mr Delors and his friends remain fixed on the idea of a common moment of union for all, monetary union in the EC will never happen. It would be better then to abandon the idea now. That would be less potentially damaging both to the European and the world economies than continuing to maintain a goal all analysis and good sense suggest is an illusion.

Lest this be taken to be a rejection of the idea of EC monetary union, let us hasten to add that it is not. The long run desirability of such union has been spelled out in the opening paragraph of this editorial. That desirability remains. But union will not be achieved at the wave of a wand from a political or bureaucratic ivory tower. To happen, and to endure, it must make sense on the ground. Governments can help by doing sensible things consistent with market forces, and consistent with the development of a Community central bank that will inspire the required degree of international confidence. The ERM broke precisely because it ignored market forces and what was happening on the ground. It provides a lesson from which there is much still to learn.

THE EDITOR

die wapenresies) en die ekonomieë van ledelande in die Europese gemeenskap nog so ver uiteen is? 'n Redelike antwoord op hierdie vraag skyn te wees "Nee!" Ten beste is daar 'n moontlikheid van 'n gemeenskap wat die geldeenhede omsluit van daardie lande wat Duitsland se belange deel, maar selfs in hierdie geval bestaan daar nog probleme terwyl die vereniging tussen Wes-Duitsland en Oos-Duitsland onafgehandel bly. Regerings in die EEG in hulle wysheid, of gebrek daaraan, steeds skyn verbind te wees tot eenfasige vordering in die rigting van 'n gemeenskaplike Europese geldeenheid, wat 'n meerfasige benadering waardeur swakker lande kan aansluit indien en wanneer hulle kan, uitsluit. Hierdie eenfasige benadering is die oplossing van die kleinste gemene veelvoud, of anders gestel, die smee van 'n ketting waaraan die krag van die swakste skakel afhang. Ons raai dat indien mnr Delors en sy vriende bly vas staan op die idee van een gemeenskaplike unie vir almal, op een enkele tydstip, monetêre eenheid in die EEG nooit bereik sal word nie. Dit sou beter wees om die idee nou te laat vaar. Dit sou minder potensiële skade inhou vir beide die Europese en die wêreldekonomieë as om 'n doel na te streef wat deur analise en goeie oordeel as 'n illusie uitgewys word.

Indien dit gelees sou word om te beteken dat ons die idee van 'n Europese monetêre eenheid verwerp, laat ons haas om te sê dat dit nie so is nie. Die langtermyn wenslikheid van 'n sodanige eenheid is uitgespel in die openingsparagraaf van hierdie redaksionele kommentaar. Daardie wenslikheid bly behoue. Maar eenheid sal nie behaal word deur die swaai van 'n towerstaf òf uit 'n politiese óf burokratiese ivoortoring nie. Om tot uitvoering te kom en te oorleef, moet dit op die grondvlak sinvol wees. Regerings kan bydra deur op te tree in ooreenstemming met markkragte en in ooreenstemming met die ontwikkeling van 'n Gemeenskaplike Sentrale Bank wat die nodige mate van internasionale vertroue sal inspireer. Die eenheidswisselkoersmeganisme het misluk omdat dit markkragte en dit wat op grondvlak gebeur, verontagsaam het. Dit bied 'n les waaruit nog heelwat geleer kan word.

DIE REDAKTEUR

E. van der Merwe Smit, T.W. Pahn

South African Foreign Exchange Risk under Managed Floating: Distributional Aspects

ABSTRACT

The paper examines exchange rate risk, defined as the variability in weekly log-ratios of the Rand-Dollar exchange rate during the decade of managed floating. Distributional tests lead to the rejection of the Gaussian model often used to evaluate exchange rate risk. Estimation shows that the leptokurtic character of the empirical distributions is better characterised by the class of non-normal stable Paretian distributions.

1. INTRODUCTION

This paper examines exchange rate risk, defined as the variability in the log-ratios of the Rand-Dollar exchange rate, during the regime of managed floating. The scope of the empirical research is limited to the nominal commercial Rand vs. the U.S. Dollar spot exchange rate, as well as to the corresponding one, three, six and twelve month forward rates. As for the spot rate, the period under consideration starts with the introduction of the managed floading regime in January 1979, whereas the examination of the forward rates begins in September 1983, marking the point when the South African Reserve Bank terminated the system of administered forward contracts in favour of a swap system. Both sample periods end in March 1990.

The purpose of this study is to investigate whether the risk as measured by the variability of the Rand-Dollar exchange rate was subject to notable changes given the external pressures and changes in domestic monetary policy during this period. The sample data are thus divided into various sub-periods, coinciding with major events during the past decade. Special consideration is given to the unrest period between August 1984 and October 1986.

Although it is commonly assumed in foreign exchange research that the Gaussian or normal model accounts for successive differences in exchange rates, the distributional tests of this study lead to the rejection of the normal model in the case of the Rand due to the highly leptokurtic character of the empirical distributions. Alternative statistical distributions have to be employed to provide more adequate models of the behaviour of exchange rate changes. The assumption of a real world situation similar to changes of stock-market prices (Mandelbrot, 1963), leads to the alternative hypothesis of an underlying form of non-normal stable Paretian distributions. Unlike the normal model which is completely described by its moments, the non-normal stable Paretian distributions are described by their characteristic exponents and their scale and location parameters. The former is related to the tail area probability of the density function. An important characteristic of the stable Paretian family of distributions is the infinite variance. Thus the variance is an inadequate measure of variability, both theoretically and empirically. Consequently the sample standard deviation also becomes a misleading and erratic measure of variability.

Estimation of the parameters shows that the empirical distributions conform better to the non-normal stable Paretian class of distributions. These distributions are characterised by a greater probability of observations in the tail areas. This finding corresponds with the findings of Fama (1965), Westerfield (1977), Rana (1980) a.o. A further alternative measure of the distributional characteristics, Gini's mean difference, is also estimated and discussed.

2. FOREIGN EXCHANGE MARKETS IN BRIEF: 1979 – 1990

The shift from a relatively fixed peg against the Dollar with protective exchange control, to a managed float in January 1979 characterised a new era of South African exchange rate policy. The changes to the system went hand in hand with further developments of the spot and forward markets as well as with a slight relaxation of exchange controls. The final acceptance of the floating regime meant the retention of capital rationing and the option of Reserve Bank intervention, the idea being that the exchange rate should in the long run be subject to market forces, whereas the Reserve Bank could manipulate the exchange rate in the short-term. In order to explain cut-off points for the sub-division of the sample data, a short chronological review of the last decade is given.

Following the recommendations of the De Kock Commission, the Reserve Bank since January 1979 allowed the exchange rates to vary more frequently, but continued to quote predetermined buying and selling rates for the Dollar. The former Securities Rand was renamed as Financial Rand and the possibilities of its use were widened. The official exchange rate was called Commercial Rand. Discounts or premiums on forward Dollars were quoted in order to manipulate flows of foreign capital. In May 1979 the Reserve Bank shifted from a variable Dollar peg towards a real managed float by responding more freely to market forces, nevertheless exercising a large measure of control over the exchange rate. In April 1980 the Reserve Bank started quoting three forward rates for sub-periods, ranging from one day to a year. In general the forward market became more flexible.

In February 1983 a merger between Financial and Commercial Rand took place, thereby creating a homogeneous currency. Yet concessions in terms of exchange control were limited to non-residents and only made at a later stage. In order to allow the exchange rate to be determined by market forces, the Reserve Bank in September 1983 decided to participate as buyer and seller and ceased quoting the spot rate. The forward market was also revised, i.e. the Reserve Bank extended the system of forward contracts by means of quotas in terms of swap agreements. Thus the spot rate experienced a more realistic weight of transactions, since the expectations as indicated in the forward market had a stronger impact on the spot market. Notably the Reserve Bank began to pay the gold mines in Dollar and in October 1983 the gold mines were allowed to sell forward a percentage of their anticipated Dollar earnings.

Started off by student riots, the Soweto incidents in August 1984 marked the outbreak of a period of continued township unrest, which in turn led to intensified sanctions and disinvestment. Uncertainty with regard to the internal stability of South Africa started to determine the attitude of foreign investors. This point marks the beginning of the second sub-period of the analysis. In order to limit the government's risk in the provision of forward cover, forward exchange exposure was reduced by thirty percent in September 1984.

To counteract speculation against the Rand penal rates for ex-

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cessive use of accommodation by the banking sector were introduced in January 1985. To reduce the pressure on the spot rate the Reserve Bank allowed authorised dealers to buy forward Dollars on an outright base. Dollar payments to the gold mines were reduced by fifty percent. Acting on the unrest situation the government declared a state of emergency in July 1985. French sanctions and the withdrawal of loans by the Chase Manhattan Bank added to the abnormal pressure on the Rand. One month later the Rubicon speech did not meet the expectations of foreign observers. As a result the JSE had to be closed for a week and trading on the foreign exchange market was also temporarily suspended. Negotiations were conducted with foreign creditors which led to the declaration of a standstill in the repayment of foreign debt, followed by the re-introduction of the Financial Rand and the re-imposition of exchange control on non-residents. Spot and forward rates were again quoted by the Reserve Bank. The USA imposed stricter sanctions, which were followed in October by Commonwealth action. This caused exchange control measures to be tightened again in December in order to prevent speculative capital outflow. From then on gold mines were paid fully in Rand, and Dollar payments ceased. The debt standstill period was unilaterally extended until March 1986.

In March 1985 a final agreement was reached between South Africa and the majority of foreign bank creditors regarding the repayment of debt and the terms of interest payments. The successful negotiations caused the average value of the Rand to appreciate by 30% from December 1985 to March 1986, yet socio-political disturbances and the threat of extended sanctions led to a sharp decline of the exchange rate to a new record low in June 1986. October 1986 signifies the third sub-period under analysis when a sharp increase in the Dollar price of gold caused the effective exchange rate to rise abruptly, followed by a modest appreciation of the Rand up to the end of the year. The easing of pressure on the Rand was accompanied by a change in foreign perceptions about the socio-political situation in South Africa.

In July 1987 3,9 billion Dollar of South African's foreign debt was converted into 9½-year loans which implied a significant shift in the maturity structure of the foreign debt (Second Interim Arrangement). The gold holdings of the South African Reserve Bank increased substantially. In August 1987 overseas observers' more favourable views of the South African situation, together with an increase in the Dollar price of gold, led to the sharp appreciation of the Financial Rand against the Dollar by nearly 50%. South Africa's gold reserves increased to a peak of R8,7 billion by the end of the month. This situation was reversed in June 1988 when the United States proposals for intensified sanctions against South Africa and large sales of South African securities by U.S. citizens and insurance companies caused a sharp fall of the Financial Rand. A successive strengthening of the Dollar contributed to the decline in the Dollar price of gold, which reinforced the negative effect on the South African balance of payments.

A further weakening of the Financial Rand which occurred in October 1988 could be attributed to disinvestment actions by foreign companies. The trade weighted value of the Rand in the international exchange markets decreased by 16,6% to the end of the month. A strengthening of the Dollar as well as the fall in the Dollar price of gold added to the downward pressure on the Rand. May 1989 saw a renewed and unexpected strengthening of the Dollar and a successive decline of the Dollar price of gold which again brought the Rand under extreme pressure. Throughout the remainder of the sample period the Rand-Dollar exchange rate continued to decline, although less steeply due to the announced socio-political reforms. Foreign investors remained in the position of cautious observers. In February 1990 the strengthening of the Dollar led to a sudden decline of the Dollar price of gold while the Commercial and Financial Rand continued to weaken.

Against this historical background, data was collected and sub-periods were selected for analysis.

3. THE DATA

Five time series were used in the analyses, namely the Rand/Dollar spot exchange rate and the cost of one month, three month, six month and twelve month cover against the Dollar[1]. All the series are published on a daily basis; but the analysis is confined to weekly changes.

The forward exchange rates had to be converted from point quotes into real forward rates by adding the points to the corresponding spot rate. All data represent opening offer quotes. Because of differences in currency trading patterns directly before and after weekends, Thursday was taken as the basis for weekly data. If Thursday data was not available, owing to a public holiday, data for the next day was used. In the case of the spot rate the sample encompasses the entire period of managed floating, beginning on 4 January 1979 until 5 April 1990. However, forward rate data was obtainable only for the period 1 September 1983 until 29 March 1990. As noted above, this period coincides with the introduction of a more flexible and market-related forward rate system.

The cut-off points for the sub-division of the time series correspond to major environmental incidents as described in the previous section. Whereas file RNDD03 represents the sample of the spot rate for the entire period of managed float, the files RNDDPI and RNDDPII (period I and II) divide spot rate data into a "Pre-Rubicon" and a "Post-Rubicon" era. The file SADREAL includes the Rand-Dollar spot rate as well as the one, three, six and twelve month forward rates for the period of September 1983 until March 1990. Here the division into a "Pre-Rubicon" and a "Post-Rubicon" era is also applied, as reflected in the files REALPI and REALPII. The beginning of township unrest in August 1984 marks the first cut-off point of a further subdivision of this period into the sample periods BEGIN, UNREST and END. The second cut-off point, which marks the end of the sample period UNREST in October 1986 coincides with an up-swing in the Dollar price of gold and a gradual return of confidence of foreign observers in the economic stability of South Africa. This last cut-off point is somewhat arbitrary since leads and lags in foreign perceptions are difficult to assess.

4. MEASURES OF EXCHANGE RATE VOLATILITY

The most common measures of data variability in current use are the *variance* and the *standard deviation.* Several studies describe exchange rate variability using the concept of variance around the mean (Jurgensen Report, 1983: 36-55, Lessard, 1979: 196-199 a.o.). The variance is a suitable measure if the probability model describing the exchange rate changes is normal, since the Gaussian distribution provides a model for which the second moment is finite (Mandelbrot, 1963: 396). The assumption of normality has the advantage of providing conceptional simplicity. The same, of course, is true of the concept of standard deviation.

In accordance with IMF statistics, the *average absolute percentage change* is also employed by the South African Reserve Bank to assess exchange rate volatility. The average absolute percentage change in the nominal effective exchange rate between September 1983 and August 1984 e.g. was about three times larger than during the period of January 1979 until August 1983 (South African Reserve Bank, respective Annual

Economic Reports). The changes in exchange rate volatility as measured by the average absolute percentage changes tend to support the cut-off points of the sub-samples identified.

As a measure to assess exchange rate changes in the empirical analysis of this study, *log-price, ratios,* i.e. the natural logarithm of the exchange rate at the end of a week divided by the exchange rate at the beginning of a week, were used. Notationally, this measure is equal to $\log_e (S_{t+1}/S_t)$ or $\log_e (F_{t+1}/F_t)$, t = 1,2,...,N, where S represents the Rand-Dollar spot rate, F the respective forward exchange rates and t a time index.

The most compelling reason for this procedure is that log-price ratios eliminate the problem of the units of measurement. If one currency is stated in terms of another, the reversal of this quote will have a mirror-effect on the shape of the density function, whereas the use of log-ratios implies that the exchange rate distributions will have the same shape even if stated in terms of another currency. This implies that when a random variable is normally distributed with mean and standard deviation, the inverse function (in this case the reversed quote of the exchange rate) is not normally distributed with the same properties, but when the same random variable is log-normally distributed the character of the function remains unchanged. Subsequently, the shape of the distribution of the inverse function will not alter and the mirror effect is thus eliminated. Another important reason for the use of the natural logarithm is the fact that an exchange rate cannot be quoted negatively. Hence, if log-normality is assumed, the log-ratios should be normally distributed (Kroll and Levy, 1980: 170-175). Furthermore, if absolute price changes are relatively small, the change in the log price almost equals the percentage price change.

5. DESCRIPTIVE MEASURES OF THE EMPIRICAL EXCHANGE RATE DISTRIBUTIONS

The computation of some descriptive measures provides a first description of the properties of the distribution of weekly exchange rate changes. Estimates of the mean, variance and coefficients of skewness and kurtosis are presented in Table 1. An examination of these measures allows a preliminary identification of the probability models from which the samples could have derived.

TABLE 1
DESCRIPTIVE MEASURES

Period SADREAL	Mean	Variance	Skewness	Kurtosis
1/9/83 – 29/3/90 N=344				
Spot	0,0025035	0,00076021	-0,328	8,874
One month	0,0025109	0,00075494	-0,339	8,873
Three month	0,0025346	0,00074616	-0,340	8,791
Six month	0,0025700	0,00073729	-0,349	8,717
Twelve month	0,0026341	0,00073304	-0,334	8,303
Preriod RNDD03	**Mean**	**Variance**	**Skewness**	**Kurtosis**
4/1/79 – 5/4/90 N=588				
Spot	0,0018917	0,00047160	-0,293	14,945
Sub-Periods				
Period RNDDPI	**Mean**	**Variance**	**Skewness**	**Kurtosis**
4/1/79 – 4/7/85 N=340				
Spot	0,0023359	0,00032421	-1,246	24,285
Period RNDDPII	**Mean**	**Variance**	**Skewness**	**Kurtosis**
11/7/85 – 5/4/90 N=248				
Spot	0,0012828	0,00067516	0,199	9,437
Period REALPI	**Mean**	**Variance**	**Skewness**	**Kurtosis**
1/9/83 – 25/7/85 N=100				
Spot	0,0067382	0,00115974	-0,227	8,298
One month	0,0067128	0,00114554	-0,233	8,334
Three month	0,0066782	0,00112098	-0,202	8,341
Six month	0,0066275	0,00109531	-0,185	8,295
Twelve month	0,0065901	0,00106606	-0,139	8,081
Period REALPII	**Mean**	**Variance**	**Skewness**	**Kurtosis**
1/8/85 – 29/3/90 N=244				
Spot	0,0007679	0,00059017	-0,634	7,559
One month	0,0007888	0,00058867	-0,646	7,594
Three month	0,0008364	0,00058656	-0,667	7,526
Six month	0,0009071	0,00058490	-0,689	7,570
Twelve month	0,0010127	0,00059130	-0,678	7,200
Period START	**Mean**	**Variance**	**Skewness**	**Kurtosis**
4/1/79 – 2/8/84 N=292				
Spot	0,0020564	0,00012368	1,800	7,868
Period BEGIN	**Mean**	**Variance**	**Skewness**	**Kurtosis**
1/9/83 – 26/7/84 N=48				
Spot	0,0079655	0,00035734	1,201	1,529
One month	0,0079406	0,00035235	1,206	1,548
Three month	0,0078976	0,00034344	1,222	1,568
Six month	0,0078401	0,00033831	1,234	1,560
Twelve month	0,0078358	0,00033548	1,259	1,640
Period UNREST	**Mean**	**Variance**	**Skewness**	**Kurtosis**
2/8/84 – 16/10/86 N=116				
Spot	0,0026947	0,00183276	-0,320	3,085
One month	0,0026717	0,00182019	-0,326	3,084
Three month	0,0026392	0,00179612	-0,324	3,059
Six month	0,0026008	0,00176998	-0,330	3,047
Twelve month	0,0025514	0,00173818	-0,327	2,950
Period END	**Mean**	**Variance**	**Skewness**	**Kurtosis**
23/10/86 – 29/3/90 N=180				
Spot	0,0009237	0,00017489	-0,312	1,181
One month	0,0009594	0,00017436	-0,317	1,155
Three month	0,0010371	0,00017570	-0,275	1,124
Six month	0,0011449	0,00017733	-0,220	1,219
Twelve month	0,0013002	0,00019080	0,007	1,669

The small values of the sample means are the result of working with weekly proportional changes which already represent small values. The variance is substantially higher over the period August 1984 until October 1986 (on average about five times higher than the previous period).

The examination of the sample coefficients of skewness, which in nearly eighty percent of the sample distributions are not much different from zero, suggests that the distributions are approximately symmetric. This findings corresponds to the results of similar studies on exchange rate change distributions by Westerfield (1977) and Rana (1980).

In terms of the hypothesis of an underlying distribution other than the normal model, the values of the sample coefficients of kurtosis offer the most interesting finding of this preliminary examination. Kurtosis is defined as the fourth moment about the mean divided by the square of the second moment about the mean. It measures the degree of peakedness of a distribution. Thus, the kurtosis also measures the fatness of the tails of the distribution. Viewing the coefficient of kurtosis of the empirical distributions, it seems that the length of the

period under consideration affects the value of the kurtosis. The larger sample periods (SADREAL, RNDD03, RNDDPI, RNDDPII, REALPI, REALPII and START) display higher values of kurtosis than smaller sample periods (BEGIN, UNREST and END). The highly leptokurtic character of the larger sample periods is in accordance with the findings of Westerfield (1977) and Rana (1980), whereas the most striking observation is that the coefficient of kurtosis for the unrest period of August 1984 until October 1986 does not differ much from 3, the coefficient of kurtosis of the normal distribution. One should, however, bear in mind that the variance is used in the computation of the kurtosis. As already stated, the variance in the underlying case may be an unreliable measure, since it may be infinite. This fact turns the coefficient of kurtosis into an unreliable measure as well. This period displays kurtosis values which are on the average twice as large as those of the previous period or the period thereafter. Given an underlying normal population, the variance of the coefficient of kurtosis is 24/N, where N resembles the sample size (Westerfield, 1977:185). Computing the variance of the kurtosis for all sample distributions shows that only 56% of the sample distributions are larger than or equal to 3,90 (two standard deviations), thus indicating non-normality. In comparison to the research of Westerfield (1977: 185) and Rana (1980:5), where non-normality was found in almost all sample populations, this may seem strange, but could possibly be explained by the comparatively small sample sizes given in the files BEGIN, UNREST and END. As a moment of higher order the sample coefficient of kurtosis is in its nature a positive function of the estimate of the mean which tends to be biased by extreme observations in smaller samples and can thus be misleading.

However, the examination of the larger samples indicates a pronounced "fat-tailed" property of the underlying distributions when compared to the normal model.

6. DISTRIBUTIONAL ASPECTS

6.1 General

The characteristics of the non-normal stable Paretian class of distributions are first described as an alternative hypothesis to the normal distribution for modelling the volatility of exchang rate change. The examination of the kurtosis coefficients in the previous section has already suggested the unsatisfactory degree of approximation to the real world situation that is reached by using the normal hypothesis. One explanation for this phenomenon is that the sample data have been drawn from a mixture of distributions. Given the attractiveness of the well-known properties of the normal distribution, a mixture of normal distributions would by its conceptional simplicity provide an appealing alternative explanation (Teichmoeller, 1971: 282). Mixed distributions are also characterised by leptokurtosis. Thus, it is not surprising that economists often describe empirical distributions with high tail area probabilities by means of a mixed model. As a first step in order to assess whether the sample distributions are drawn from a member of the non-normal stable Paretian family of distributions, the Chi-square goodness-of-fit statistic is computed. This calculation is based on findings of Fama and Roll (1968, 1971), who did extensive research on symmetric stable distributions. Next the parameters of the stable Paretian model are estimated. The evidence obtained by the parameter estimation are then compared with the results of the Chi-square goodness-of-fit statistics.

In order to finally distinguish the observed exchange rate change distributions from the possible mixed distribution, the sample distributions are tested for stability. This test, also developed by Fama and Roll (1971: 337), makes use of the property of stable Paretian distributions to display invariance under addition. This is in contrast to the behaviour of mixed distributions. All tests tend to support the hypothesis that the empirical samples are not drawn from a mixture of normal distributions, but from a member of the stable Pareto class of probability distributions. The section concludes with an examination of three alternative measures of exchange rate variability, namely the scale parameter, Gini's mean difference and the standard deviation.

6.2 The stable Paretian class of distributions

In his discussion of the variation of certain speculative prices, Mandelbrot (1963: 395-420) presented the stable Paretian distributions as possible alternatives to the Gaussian model. Since the assumption of normality confines the examination of the samples to finite moments, he considered the normal distribution to be "in a somewhat complex way . . . a limiting case of this new family (of distributions) . . ." (1963: 395), In contrast, the assumption of an underlying form of stable Paretian distribution, allows an empirical examination that is not biased by a formal model. The normal distribution represents the only member of the class of symmetric stable distributions for which moments of higher orders exist. Mandelbrot's pioneering work was continued by Fama (1965) in research on the behaviour of stock market price changes and by Westerfield (1977) and Rana (1980) on exchange rate changes. Symmetric stable distributions were employed as models of price changes since they potentially account for the higher probability of observations occurring in the tails of the density function that characterised the empirical distributions.

The family of stable Paretian distributions is defined by the log of the characteristic function:

$$\log_e \varphi(t) = \log_e[\, e^{itx}\, dF(x)]$$
$$= i\delta t - \gamma \mid t \mid^{\alpha},$$

where x is the random variable, t is any real number and i is $\sqrt{-1}$. Symmetric stable distributions are charaterised by three parameters: δ, a location parameter, γ, a dispersion parameter; and α, the characteristic exponent. The characteristic exponent is related to the probability of observations occurring in the tail area of the density function ($0 < \alpha \leq 2$). The smaller the value of α the higher the probability to observe large positive or negative values. The normal model forms part of the symmetric stable class of distributions with a characteristic exponent equal to 2. The normal model is the only member of the class of stable distributions for which the variance and other higher moments exist. In particular, only moments of the order r, $r < \alpha$, exist, i.e. are finite (Fama and Roll, 1968:817). The scale parameter $c = \gamma^{\frac{1}{\alpha}}$ is equal to the standard deviation dividend by 2 in the normal distribution and the mean exists only when $\alpha > 1$, i.e. in this case the location parameter resembles the mean (Fama and Roll, 1968:826.). The Cauchy distribution with $\alpha = 1$, is another member of the class of symmetric stable distributions.

If the characteristic exponent approaches a value smaller than 2, the variance and other higher moments cease to exist. The far reaching implications of this characteristic are explicitly explained by Fama (1965b:94-95): "The statistical implications of the Mandelbrot hypothesis follow mostly from the absence of variance for the stable Paretian distributions with a characteristic exponent less than 2. In practical terms "*infinite*" means that the sample variance and standard deviation of a stable Paretian process with $\alpha < 2$ will show extremely erratic behaviour even for large samples. That is, for larger and larger sample sizes the variability of the sample variance and standard deviation will not tend to dampen nearly as much as would be expected with a Guassian process. Because of their extremely erratic behaviour, the sample variance and standard deviation are not meaningful measures of the variability inherent in a stable Paretian process with $\alpha < 2$."

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6.3 Goodness-of-fit tests

The Chi-square statistic of goodness-of-fit provides a means to assess whether the sample distributions are likely to be drawn from the population of symmetric stable distributions with a given characteristic exponent. Here the Chi-square statistic is used to examine which value ($1 < \alpha \leq 2$) best describes the empirical distributions. Thus the statistic is computed for all spot and forward rate distributions for characteristic exponent values from 1,1 to 2,0. The results of the tests are presented in Table 2. The test is based on findings of Fama and Roll (1968:817-836) who published fractiles of standardised symmetric stable distributions, generated by means of a Monte-Carlo study.

TABLE 2
CHI-SQUARE TESTS

SADREAL	Spot	F1	F3	F6	F12
1/9/83 – 29/3/90					
N=344					
alpha = 1,1	12,715	13,355	15,215	14,808	18,326
alpha = 1,2	6,058*	5,099*	8,762	7,279*	11,610
alpha = 1,3	6,436	6,233	7,715*	9,779	9,663*
alpha = 1,4	9,459	10,390	12,599	12,192	13,645
alpha = 1,5	22,628	23,326	25,826	30,099	27,860
alpha = 1,6	36,901	41,349	41,029	49,488	44,547
alpha = 1,7	50,738	52,657	48,849	50,855	52,424
alpha = 1,8	56,174	58,674	57,483	63,413	65,244
alpha = 1,9	64,895	64,169	65,797	68,994	71,116
alpha = 2,0	73,645	72,657	73,703	78,180	72,744
Estimate	1,23	1,23	1,41	1,22	1,24

	RNDD03	RNDDPI	RNDDPII
	4/1/79 – 5/4/90	4/1/79 – 4/7/85	11/7/85 – 5/4/90
only Spot	N=588	N=340	N=248
alpha = 1,1	10,878	16,882*	10,831
alpha = 1,2	9,092*	17,559	5,669*
alpha = 1,3	11,150	22,735	6,153
alpha = 1,4	14,874	27,853	9,782
alpha = 1,5	28,684	35,412	18,331
alpha = 1,6	34,891	47,324	27,565
alpha = 1,7	53,803	52,588	34,782
alpha = 1,8	62,374	59,471	36,637
alpha = 1,9	83,786	69,853	39,702
alpha = 2,0	111,983	77,853	46,476
Estimate	1,19	1,17	1,24

REALPI	Spot	F1	F3	F6	F12
1/9/83 – 25/7/85					
N=100					
alpha = 1,1	175,600	170,200	178,000	181,600	178,500
alpha = 1,2	163,300	163,300*	181,500	180,200	174,600
alpha = 1,3	172,000	183,000	171,900*	173,700	173,200
alpha = 1,4	159,200*	166,400	172,400	164,100*	170,800*
alpha = 1,5	163,100	166,300	177,300	172,600	171,700
alpha = 1,6	179,900	176,900	188,200	178,900	181,300
alpha = 1,7	189,100	186,700	203,800	193,700	186,300
alpha = 1,8	212,700	210,700	232,100	226,100	210,700
alpha = 1,9	241,900	237,500	279,800	270,100	241,100
alpha = 2,0	268,300	266,400	286,600	279,300	261,000
Estimate	1,29	1,30	1,28	1,69	1,30

REALPII	Spot	F1	F3	F6	F12
1/8/85 – 29/3/90					
N=244					
alpha = 1,1	9,975	11,533	14,852	15,467	16,369
alpha = 1,2	6,000*	5,877*	8,213*	10,057*	8,459
alpha = 1,3	6,943	5,918	8,254	10,754	7,639*
alpha = 1,4	9,730	7,844	12,025	10,959	12,148
alpha = 1,5	16,820	17,148	19,648	22,311	23,582
alpha = 1,6	25,057	24,525	24,811	26,738	25,467
alpha = 1,7	32,107	31,246	30,139	32,270	33,664
alpha = 1,8	33,828	36,164	35,221	38,336	35,590
alpha = 1,9	36,820	34,443	40,918	39,689	40,508
alpha = 2,0	46,451	43,582	45,959	42,967	45,918
Estimate	1,28	1,28	1,28	1,25	1,24

START		BEGIN			
4/1/79 – 2/8/84		1/9/83 – 26/7/84			N=48
	N=292	F1	F3	F6	F12
alpha = 1,1	25,877	12,000	10,333*	8,250*	12,417*
alpha = 1,2	25,329	12,417	10,333*	9,500	14,083
alpha = 1,3	21,904	13,667	13,250	11,583	14,500
alpha = 1,4	19,438*	14,083	15,750	15,333	15,750
alpha = 1,5	22,418	10,333	12,000	15,333	13,667
alpha = 1,6	27,966	10,333	12,000	10,750	13,667
alpha = 1,7	35,808	4,083*	13,667	10,750	13,667
alpha = 1,8	41,596	4,917	13,667	10,750	15,750
alpha = 1,9	48,993	4,917	13,667	10,750	18,667
alpha = 2,0	57,897	4,917	13,667	10,750	18,667
Estimate	1,36	1,44	1,50	1,51	1,47

UNREST	Spot	F1	F3	F6	F12
2/8/84 – 16/10/86					
N=116					
alpha = 1,1	15,552	17,621	15,724	14,603	20,552
alpha = 1,2	12,793*	12,190*	15,293*	14,086*	19,000*
alpha = 1,3	14,172	18,828	16,759	15,207	22,448
alpha = 1,4	18,828*	19,086	18,052	19,948	20,638
alpha = 1,5	20,724	20,724	22,017	21,328	24,690
alpha = 1,6	22,448	22,017	23,397	25,207	31,414
alpha = 1,7	28,310	27,276	28,483	26,586	43,828
alpha = 1,8	27,276	27,276	30,466	35,121	59,000
alpha = 1,9	36,931	41,500	42,793	47,448	65,293
alpha = 2,0	48,310	48,310	54,431	52,966	78,741
Estimate	1,27	1,26	1,25	1,24	1,18

END	Spot	F1	F3	F6	F12
23/10/86 – 29/3/90					
N=180					
alpha = 1,1	27,111	28,944	26,889	28,278	33,056
alpha = 1,2	19,611	21,944	19,222	17,944	25,667
alpha = 1,3	15,278	16,833	12,833	14,000	19,056
alpha = 1,4	10,333	9,833	6,778	7,278	16,500
alpha = 1,5	7,278	7,278	5,667	6,611	14,500
alpha = 1,6	6,056	4,889	4,389	6,222	9,444
alpha = 1,7	4,556	5,389	3,667*	5,667	9,889
alpha = 1,8	4,111*	4,556*	4,000	6,333	9,278*
alpha = 1,9	5,000	5,667	4,722	6,333	10,333
alpha = 2,0	5,000	5,667	6,056	5,500*	10,556
Estimate	1,78	1,82	1,73	1,71	1,77

* smallest Chi-square value

The sample values are first transformed into standardised t-values. The random sample, i.e. the log-ratios, x_i, i = 1, N, where i equals the weekly observation for each spot and forward rate, were standardised by subtracting an estimate of the mean $\bar{x}$ and dividing by the estimate of the scale parameter c (also dispersion parameter) to obtain the statistic $(x_i - \bar{x})/c$. Fama and Roll (1968:832) found that in cases where α is unknown, 0,50 truncated means generally perform as "best estimators" over the entire range of $1 < \alpha < 2$. As in the procedure used by Westerfield (1977:186 footnote 7), the standardised empirical samples were then ranked in ascending order and divided into deciles. To examine the extreme tail areas more closely, the last decile in both tails was again divided in half (only exception: file BEGIN – the small number of observations made a division into only ten class intervals possible). The number of observations in each of the twelve (ten) cells were counted and the Chi-square computed for nine

degrees of freedom (the location and scale parameters had to be estimated in order to transform the log-ratios into standardised t-values, thus two degrees of freedom were lost). The period of unrest displays observations that are more than five standard deviations from the mean. Under the Guassian hypothesis such observations should only occur once every 7000 years (Fama, 1965b:50). The number of observations in the tails are much larger than expected under the normal model; thus the probability of larger price changes is much higher. In accordance with the findings of Westerfield (1977:189) the sample distributions are more peaked in the centre, whereas the remaining areas between the centre and the tails display fewer observations than expected.

The examination of the results in Table 2 shows that the normal model provides an inadequate description of the empirical distributions when compared to other symmetric stable distributions. The Chi-square value when $\alpha = 2$ is the largest in the majority of cases and decreases gradually as the value of the characteristic exponent is reduced to an average level of 1.3 (which is exactly the same behaviour as observed by Westerfield, 1077:189). The Chi-square value increases again as the characteristic exponent further approaches the Cauchy distribution.

Testing the null hypothesis that the empirical distributions *are* drawn from the population of symmetric stable distributions with a given characteristic exponent $1 < \alpha \leq 2$, when the value of the Chi-square statistic is at a minimum, leads to acceptance at a 0,025 level of significance in 26 out of 33 or seventy-eight percent of the cases. It is interesting to note that the null-hypothesis had to be rejected exclusively for the Pre-Rubicon samples. Nevertheless, the null hypothesis is accepted in more than seventy percent of the cases, as in Westerfield's study (1977:189), which suggests a high degree of approximation. In Rana's examination of the behaviour of the exchange rate of eight Asian countries (1980:7) the null hypothesis was accepted in all but one of the cases.

The Chi-square statistic of goodness-of-fit allows the conclusion that the empirical samples are better described by members of the class of symmetric non-normal stable distributions with $1 < \alpha < 2$ than by the normal model. This implies that the variance and the sample standard deviation or coefficient of variation, the commonly used measures of variability, are not likely to be very accurate measures of exchange rate risk.

6.4 Parameter estimation for the non-normal stable distributions

To gain further insight into the characteristics of the empirical distributions, the sample parameters are estimated. Fama and Roll (1968, 1971) have provided methods to estimate the location and scale parameters as well as the characteristic exponent for samples drawn from a symmetric stable Paretian distribution with a characteristic exponent larger than one and smaller or equal to two. Their Monte-Carlo studies (1968:832) indicate that, if the characteristic exponent is unknown, the best estimate of the location parameter δ is a $x_{0,5}$ truncated mean. The truncated mean is recommended because it displays a lower sampling variance over different sample sizes than the arithmetic mean. For the Cauchy distribution, a 0,25 truncated mean is recommended, while naturally the arithmetic mean performs as best estimator for the Gaussian distribution. Given the Chi-square values which indicate an average value of 1,3 (for the characteristic exponent), the sample arithmetic mean with the extreme 25% of each tail truncated performs as best estimator. The Monte-Carlo study of Fama and Roll shows that truncated means of samples drawn from symmetric stable distributions are themselves distributed closely to normal, which is in accordance with the Central Limit Theorem. This holds even for small samples (the smallest n was 15 in Fama and Roll's Monte-Carlo study).

The estimate of the scale parameter c can be obtained from sample fractiles. Fama and Roll (1971) found that a constant times 44% of the interfractile range provides a sensible estimator for the scale measure as compared to the standard deviation. According to their findings the scale parameter $c = \delta$, for symmetric stable distributions with a characteristic exponent $1 < \alpha < 2$, should be estimated by:

$$\hat{c} = (\hat{x}_{0,72} - \hat{x}_{0,28})/2(0,827).$$

They found the estimator to be asymptotically normally distributed and less than 0,4 percent asymptotically biased. However, it must be borne in mind that this measure might ignore some extreme observations.

To obtain a *sensitive* estimate for the characteristic exponent, Fama and Roll (1971) recommend:

$$\hat{z}_{0,95} = (\hat{x}_{0,95} - \hat{x}_{0,05})/2\hat{c} = 0,827\,(\hat{x}_{0,95} - \hat{x}_{0,05})/(\hat{x}_{0,72} - \hat{x}_{0,28})$$

TABLE 3
PARAMETER ESTIMATES OF SYMMETRIC STABLE DISTRIBUTIONS

Period SADREAL	Location	Scale	Characteristic exponent
1/9/83 – 29/3/90 N=344			
Spot	0,00206958	0,0097715	1,23
One month	0,00208625	0,0096853	1,23
Three month	0,00209150	0,0096479	1,41
Six month	0,00212374	0,0093719	1,22
Twelve month	0,00213272	0,0097067	1,24
Period RNDD03	**Location**	**Scale**	**Characteristic exponent**
4/1/79 – 5/4/90 N=588			
Spot	0,00117837	0,0068151	1,19
Sub-Periods			
Period RNDDPI	**Location**	**Scale**	**Characteristic exponent**
4/1/79 – 4/7/85 N=340			
Spot	0,00076482	0,0050813	1,17
Period RNDDPII	**Location**	**Scale**	**Characteristic exponent**
11/7/85 – 5/4/90 N=248			
Spot	0,00159925	0,0093807	1,24
Period REALPI	**Location**	**Scale**	**Characteristic exponent**
1/9/83 – 25/7/85 N=100			
Spot	0,02715606	0,0126042	1,29
One month	0,02700139	0,0125592	1,30
Three month	0,02671397	0,0120255	1,28
Six month	0,02640550	0,0120450	1,69
Twelve month	0,02609752	0,0120864	1,30
Period REALPII	**Location**	**Scale**	**Characteristic exponent**
1/8/85 – 29/3/90 N=244			
Spot	0,00157623	0,0093288	1,28
One month	0,00160070	0,0094021	1,28
Three month	0,00162691	0,0092938	1,28
Six month	0,00168567	0,0090360	1,25
Twelve month	0,00170961	0,0091092	1,24

Period START	Location	Scale	Characteristic exponent
4/1/79 – 2/8/84 N=292			
Spot	0,00059883	0,0045919	1,36
Period BEGIN	**Location**	**Scale**	**Characteristic exponent**
1/9/83 – 26/7/84 N=48			
Spot	0,00458840	0,0097139	1,40
One month	0,00461638	0,0100668	1,44
Three month	0,00455485	0,0105906	1,50
Six month	0,00444836	0,0108344	1,51
Twelve month	0,00446314	0,0102754	1,47
Period UNREST	**Location**	**Scale**	**Characteristic exponent**
2/8/84 - 16/10/86 N=116			
Spot	0,00243339	0,0173778	1,27
One month	0,00244865	0,0171731	1,26
Three month	0,00239597	0,0168569	1,25
Six month	0,00244258	0,0163233	1,24
Twelve month	0,00245249	0,0149469	1,18
Period END	**Location**	**Scale**	**Characteristic exponent**
23/10/86 - 29/3/90 N=180			
Spot	0,00122154	0,0082781	1,78
One month	0,00123051	0,0083720	1,82
Three month	0,00127335	0,0083118	1,73
Six month	0,00134513	0,0082734	1,71
Twelve month	0,00132974	0,0088151	1,77

Fama and Roll (1971:335) found in their Monte Carlo study a minimum dispersion and bias in using the fractile of 0,95 because values of $0,95 < f < 0,97$, as "interfractile estimator has sampling properties that are "robust" against variation in the true value of α". The fact that the tail areas of the distribution are most sensitive to changes in the characteristic exponent is taken into account, i.e. the inverse relation between the value of α and the heights of the tail areas of the density function. The value obtained by calculating z is then referred to a table of fractiles of standardised symmetric stable distributions provided by Fama and Roll (1968:822) to derive the value of the characteristic exponent whose 0,95 fractile provides the best fit to z. However, an *optimal* value of f cannot be determined analytically. The method to obtain a sensitive estimate for the characteristic exponent makes use of Fama and Roll's finding (1971:335), that Monte-Carlo results indicated for the interfractile estimator ($0,95 < f < 0,97$) a minimum sensitivity for changes in the real value of the characteristic exponent, which suggests a high degree of approximation. The values for the characteristic exponent given in Table 3 represent interfractile estimators that are obtained by extrapolation of the Monte-Carlo fractiles provided by Fama and Roll (1968:822). Table 3 reveals that in all cases the values for the location parameter are very close to zero as expected, indicating little change when compared to the parameter values given in Table 1. It is, however, interesting to note that the location parameter for the Pre-Rubicon period of September 1983 until July 1985 (file: REALPI) is more than ten times larger than the average of the other periods. The same phenomenon was found by Westerfield (1977) with regard to Canada's floating period in the nineteen-seventies when compared to other currencies. As expected, the scale parameter measures a substantial increase in the variability of the exchange rate for the unrest period between August 1984 and October 1986. The scale value over the entire period when compared to the scale values for the Pre- and Post-Rubicon periods with (files: RNDDPI and RNDDPII with RNDD03) resembles almost the exact average between the two sub-periods. This averaging tendency is also reflected in the scale measures for the forward rates. Another interesting finding is that the scale measure suggests a decrease in variability risk for the period after the disturbances when compared to the period prior to the beginning of township unrest and increased trade restrictions. The value for the characteristic exponent for the more recent period is also closer to the expected value of α for the normal distribution than that of any other period. An intraperiod comparison of the scale measure for the spot rate with the respective forward rates does not reveal the same upward movement as maturity lengthens, as found by Westerfield (1977) in samples of currencies of major industrialised nations. It is generally found that the scale measure displays a slight decrease for the forward rates of shorter maturity and then increases in the case of the twelve month forward rate. Given the higher degree of uncertainty as the periods lengthen, it could be expected that the scale parameter would indicate a gradual increase.

6.5 The stability test

To finally assess whether the empirical samples are drawn from the population of symmetric *stable* distributions, the samples are tested for stability. This test allows us to distinguish between a possible mixture of normal distributions and an underlying non-normal stable model. Fama and Roll (1971:337) suggested a test, based on the definition of the stable class of distributions. The test utilises the fact that a linear combination of independent identically distributed stable variables with a given characteristic exponent is also symmetric stable with the same value of α (Fama, 1965b:43). Hence, the property of invariance under addition serves as an indicator of stability.

According to Fama and Roll (1971), one can expect that for the case of a Gaussian mixture, the estimate of the characteristic exponent gradually approaches two as the sum size increases. Correspondingly, the estimates of the characteristic exponent will approach a limiting value smaller than two if the samples resemble mixtures of non-normal stable Paretian distributions. The property of stability is upheld if the estimate of the characteristic exponent appears to be independent of sum size (Teichmoeller, 1971:283). To obtain evidence about the empirical distributions, the sample for the period September 1983 until March 1990 (file: SADREAL, N = 344) was first transformed into a sample of 172 non-overlapping sums of two, then into 68 non-overlapping sums of five observations, and finally into 34 sums of ten observations. Hence, the characteristic exponent was estimated for each of these independent new samples. It was decided to use the sample period September 1983 until March 1990, since the number of observations roughly coincide with the number of observations of the samples used by Westerfield (1977:192). This allows a direct comparison with the currencies of five major industrialized countries. Given the fact that the chosen sample period resembles the largest obtainable sample for the South African spot and forward rates, it can be regarded as representative for the other sample periods.

Table 4 resembles a combination of a table provided by Westerfield (1977:192) and the empirical results for the South African exchange rates. While comparing the estimates for the characteristic exponent, it must be borne in mind that Westerfield (1977) gives the results primarily for periods of a fixed-rate regime. The evidence shows that neither the standard deviation nor the average estimate of the characteristic exponent are significantly influenced by the addition of the South African estimates. The variation of the average estimates for the characteristic exponent is small and does not indicate the increase displayed by Gaussian mixtures found in the Monte-

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Carlo studies of Fama and Roll (1971:336). Considering the downward bias for α in smaller sample sizes $N \leq 99$ found by Fama and Roll (1971:336), additive corrections of 0,01, 0,04 and 0,07 respectively are made to the means of the estimates for sums of 2, 5 and 10, respectively. The same method was used by Teichmoeller (1971:283) in a stability test for price changes in common stock. He observed a slight upward movement of the means corrected for bias, which is also observed by Westerfield (1977). In both studies there was not sufficient evidence to reject the conclusion that samples were drawn from non-normal stable distributions. If the estimates for the South African sample are examined individually, it is found that α first increases with the sum size and then decreases with sums of ten. This behaviour suggests that the distribution of log-ratios for the Rand-Dollar exchange rate is also consistent with stability which implies that the South African samples does not resemble a "thick-tailed" Gaussian mixture.

TABLE 4
TESTS OF STABILITY

	Estimates of characteristic exponents for sums of:			
	1	2	5	10
Netherlands				
1/4/62 – 4/29/71				
Spot	1,51	1,43	1,52	1,69
One month	1,28	1,52	1,22	1,49
Three month	1,37	1,49	1,41	1,55
Switzerland				
1/4/62 – 4/29/71				
Spot	1,19	1,26	1,29	1,56
One month	1,21	1,41	1,47	1,28
Three month	1,23	1,45	1,48	1,34
United Kingdom				
1/4/62 – 8/12/71				
Spot	1,33	1,23	1,42	1,61
One month	1,16	1,15	1,06	1,39
Three month	1	1,02	1,03	1,41
Germany				
1/4/62 – 4/29/71				
Spot	1,15	1,12	1,15	1,39
One month	1,1	1,2	1	1,27
Three month	1,25	1,24	1,03	1,2
Canada				
5/3/62 – 5/28/70				
Spot	1,41	1,82	1,13	1,49
One month	1,57	1,52	1,26	1,43
Three month	1,45	1,39	1,3	1,47
South Africa				
9/1/83 – 3/29/90				
Spot	1,23	1,25	1,49	1,46
One month	1,23	1,25	1,52	1,46
Three month	1,41	1,24	1,51	1,44
Mean:	1,28	1,33	1,29	1,44
Standard deviation	0,14	0,18	0,19	0,12
Mean: (corrected for bias)	1,28	1,34	1,33	1,51

6.6 Alternative measures of variability

Besides the scale parameter and the characteristic exponent, theory offers other measures of variability which can be employed to gain more insight into the characteristics of dispersion in exchange rates. A nonparametric statistic that can be used is Gini's mean difference, the average of the difference in all possible pairs of values of the random variables, which measures the absolute dispersion. Statistically Gini's mean difference resembles the expected value of the difference between any two observations. Thus it is not dependent on a central value or a finite moment of order $r < \alpha$ (Westerfield, 1977:195). Mathematically, it has the advantage that its defining integral converges whenever the mean exists, regardless of whether the variance converges. Practically it is computed by summing the absolute differences between the two observations of every possible pair of observations and dividing by the number of possible pairs. The results of the computation of Gini's mean difference are displayed in Table 5.

TABLE 5
MEASURES OF VARIABILITY

Period SADREAL	Gini's mean difference	Standard deviation	Scale
1/9/83 – 29/3/90			
N=344			
Spot	0,0265205	0,0275720	0,0097715
One month	0,0264255	0,0274762	0,0096853
Three month	0,0262918	0,0273159	0,0096479
Six month	0,0261447	0,0271530	0,0093719
Twelve month	0,0261904	0,0270746	0,0097067
Period RNDD03	**Gini's mean difference**	**Standard deviation**	**Scale**
4/1/79 – 5/4/90			
N=588			
Spot	0,0195315	0,0217163	0,0068151
	Sub-Periods		
Period RNDDPI	**Gini's mean difference**	**Standard deviation**	**Scale**
4/1/79 – 4/7/85			
N=340			
Spot	0,0155633	0,0180057	0,0050813
Period RNDDPII	**Gini's mean difference**	**Standard deviation**	**Scale**
11/7/85 – 5/4/90			
N=248			
Spot	0,0246090	0,0259837	0,0093807
Period REALPI	**Gini's mean difference**	**Standard deviation**	**Scale**
1/9/83 – 25/7/85			
N=100			
Spot	0,0332132	0,0340550	0,0126042
One month	0,0329946	0,0338459	0,0125592
Three month	0,0326114	0,0334811	0,0120255
Six month	0,0322552	0,0330955	0,0120450
Twelve month	0,0318754	0,0326505	0,0120864
Period REALPII	**Gini's mean difference**	**Standard deviation**	**Scale**
1/8/85 – 29/3/90			
N=244			
Spot	0,0236006	0,0242934	0,0093288
One month	0,0235643	0,0242625	0,0094021
Three month	0,0235505	0,0242190	0,0092938
Six month	0,0235015	0,0241848	0,0090360
Twelve month	0,0237442	0,0243166	0,0091092
Period START	**Gini's mean difference**	**Standard deviation**	**Scale**
4/1/79 – 2/8/84			
N=292			
Spot	0,0108802	0,0111211	0,0045919

Period BEGIN	Gini's mean difference	Standard deviation	Scale
1/9/83 – 26/7/84			
N=48			
Spot	0,0204052	0,0189034	0,0097139
One month	0,0202481	0,0187711	0,0100668
Three month	0,0199674	0,0185323	0,0105906
Six month	0,0198033	0,0183932	0,0108344
Twelve month	0,0196693	0,0183160	0,0102754
Period UNREST	Gini's mean difference	Standard deviation	Scale
2/8/84 – 16/10/86			
N=116			
Spot	0,0449406	0,0428108	0,0173778
One month	0,0447748	0,0426637	0,0171731
Three month	0,0444684	0,0423806	0,0168569
Six month	0,0441323	0,0420711	0,0163233
Twelve month	0,0438035	0,0416915	0,0149469
Period END	Gini's mean difference	Standard deviation	Scale
23/10/86 – 29/3/90			
N=180			
Spot	0,0145027	0,0132245	0,0082781
One month	0,0144909	0,0132046	0,0083720
Three month	0,0145500	0,0132553	0,0083118
Six month	0,0145721	0,0133165	0,0082734
Twelve month	0,0149805	0,0138130	0,0088151

Unlike the scale parameter (which is estimated by using a truncated mean), it gives more weight to the tails of the observed distribution. This is evident from Table 5. It is interesting to note that Gini's mean difference indicates a decrease in variability for all exchange rates in the Post-Rubicon period as compared to the Pre-Rubicon period except for the spot rate. A dramatic increase is shown for the period between August 1984 and October 1986. In all cases Gini's mean difference displays a value more than twice as high as in the period prior to the disturbances as well as in the period thereafter. The significance of this increase can be determined in a comparison with the value for the entire period, which is also considerably lower. Compared to the other two measures of dispersion, Gini's mean difference indicates the same changes in variability and thus underlines the previous findings.

7. SUMMARY

The analysis of economic problems in international finance often assumes certain probability distributions for the purpose of building theoretical and empirical models. It has been argued that the commonly used variability measures of the standard deviation and the variance often provide unsatisfactory results. This study examines the non-normal stable Paretian distribution as an alternative model to the normal distribution for modelling exchange rate risk. Unlike the normal distribution, the symmetric stable Paretian distribution is characterised by infinite variance, thus the standard deviation and the variance do not exist. Stable Paretian distributions display a pronounced "fat-tailed" property which is also found in mixtures of normal distributions.

The Chi-square goodness-of-fit statistic provides a preliminary measure of assessing whether the empirical data are likely to be drawn from the population of stable Paretian distributions with a given characteristic exponent as opposed to the Gaussian model. The empirical finding is that the majority of sample distributions display a characteristic exponent smaller than 2, the value which could be expected from the normal distribution (the six month forward rate of the period October 1986 until March 1990 being the only exception).

To gain more insight in the characteristics of the empirical distributions, the parameters of the assumed Pareto distribution are estimated for the samples. This computation is based on the result of Fama and Roll (1971:331-338). The evidence obtained by the parameter estimation largely confirms the findings of the Chi-square goodness-of-fit statistic with regard to the characteristic exponent which is related to the tail area probability.

In order to establish a distinction between two possible explanations of the empirical distributions – a Gaussian mixture vs. a member of the non-normal stable class of distributions- stability tests are performed. The evidence suggests that the estimates for the characteristic exponent are consistent with stability. The parameter estimation and the test together suggest that the data are better described by the non-normal members of the symmetric stable class of distributions, which is in accordance to the findings of Westerfield (1977) and Rana (1980).

A further examination of the exchange rate risk of the Rand by comparing three measures of variability (Gini's mean difference, standard deviation and scale parameter) reveals that the variability increased, as expected, in the unrest period between August 1984 and October 1986. The scale parameter is nearly twice as large as in the previous period and the period thereafter. Another interesting finding is that the scale measure indicates a decrease in variability risk for the period after the disturbances as compared to the period prior to the beginning of township unrest and increased trade restrictions. The value for the characteristic exponent for the more recent period is also closer to the expected value of α for the normal distribution than that of any other period. A comparison of the scale measure for the spot rate with the respective forward rates does not reveal the same upward movement as maturity lengthens, as found by Westerfield (1977) in samples of the currencies of major industrialised nations. The scale parameter displays a slight decrease for the forward rates of shorter maturity and then increases in the case of the twelve month forward rate, which can be interpreted as an indication of government intervention in the forward market. In interperiod comparisons Gini's mean difference and the standard deviation in general indicate the same pattern of variability, whereas both measures suggest a decrease in variability in the comparison of the spot rate with the corresponding forward rates as maturity lengthens. This is in contrast to the behaviour of the scale parameter and is difficult to explain.

In essence, the major economic implication of a symmetric non-normal stable model is the higher probability of the irregular occurrence of large price changes. This probability is reflected in the characteristic exponent of the distribution. Since the probability of larger oscillations in the exchange rate is allowed for by hedging improved knowledge of the shape of the underlying distribution would allow more efficient hedging or even facilitate market arbitrage.

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N Bhana, L Konar

Are our portfolio managers ready to invest overseas when exchange control goes?

INTRODUCTION

Following the pioneering study by Grubel (1968), much attention has been devoted to the benefits to be derived from international portfolio diversification. Because of the existing exchange control regulations, very little attention has been devoted by South African investors to the possibility of investing in foreign securities. The purpose of this investigation is twofold: firstly, to study the attitudes of portfolio managers to the possibilities offered by international portfolio diversification, and secondly, to determine whether portfolio managers in South Africa would be efficient in their decisions to allocate funds between domestics and foreign securities.

EXCHANGE CONTROL AND FOREIGN INVESTMENT BY SOUTH AFRICAN RESIDENTS

The rationale for international portfolio diversification is that foreign securities should be expected to have low covariances with a portfolio of domestic securities (Solnik and Noetzlin, 1982). The market portfolio used in the Capital Asset Pricing Model (CAPM) is theoretically assumed to contain all risky assets available to the investor. Almost all empirical studies of the CAPM have used some market index (Standard and Poor's 500 Composite Index, JSE Overall Actuaries Index, etc.) as a surrogate for the market portfolio. This is a gross understatement of the market portfolio because the composite market index only includes securities that are listed on a given stock exchange. The true market portfolio should ideally comprise all risky assets as well as equities listed on all Stock Exchanges.

In recent years, researchers (Van den Honert and Affleck-Graves (1985) and Bhana (1986)) have submitted that South African investors would have derived substantially greater benefits by including foreign securities in their portfolios. These researchers have shown that the inclusion of foreign securities would result in superior portfolio returns being generated when compared with returns derived from investments exclusively in South African securities. Furthermore, the South African investor is able to accomplish significant risk reduction when overseas securities are added to their portfolios. Barr (1986, p. 41) has demonstrated that South Africa can be expected to experience volatile exchange rate movements in the future, and therefore it is appropriate that institutional investors should engage in international portfolio diversification. Foreign securities would serve as excellent rand hedges for South African investors.

The Exchange Control Regulations of 1961, as amended, preclude South African residents from acquiring foreign securities from income derived in South Africa. As a rule, exchange control permission is only granted to resident South African companies when making 'direct' investment where some form of control is obtained over the foreign company concerned. In recent years, the Reserve Bank has been more favourably disposed towards foreign investments by South African companies which are of strategic importance to the country (i.e. where it promotes exports or where it strengthened South Africa's international business status).

The De Kock Commission (1985, p. 134) recommended a progressive relaxation of exchange control over foreign portfolio investments. The Commission recommended that, initially, registered Insurers, Pension Funds, and Mutual Funds be allowed to invest 10% of their annual cash inflows in securities approved by the Registrar of Financial Institutions. The De Kock Commission (1985) also recommended that in due course such provisions should be extended to other financial institutions and corporate bodies such as Mining Houses. The Commission also recommended that eventually the restriction on foreign portfolio investments should be extended to individuals and non-corporate bodies.

Bhana (1985) has demonstrated that the various recommendations of the De Kock Commission relating to portfolio investments, when implemented by the authorities, are likely to create an efficient financial market in South Africa. Depending on the state of the economy and prospects for listed companies, investment funds are likely to move between the JSE and various foreign equity markets. Therefore South African investors are placed in a position to reap the benefits of international portfolio diversification.

The South African authorities have, in principle, accepted the basic recommendations of the De Kock Commission related to exchange control regulations. However, the current sociopolitical uncertainty in South Africa has delayed the actual relaxation of exchange control regulations. It is submitted that the authorities are likely to implement the De Kock Commission's recommendation of abolishing exchange control with the strengthening of the domestic economy and favourable political developments.

THE ROLE OF FUNCTIONAL FIXATION IN DECISION MAKING

Kahneman and Tversky (1973) have shown that there is a strong tendency for investors to be functionally fixated in their decision making process. Functional fixation can be defined as a tendency for a decision maker to rely on a given information process despite changes in the underlying structures of the information process. For example, if an investor is fixated or conditioned to evaluate a company's prospects according to the return on investment ("ROI") technique, he would assign the same importance to the "ROI" figure irrespective of the change in the manner in which its variable is measured.

Functionally fixated behaviour is likely to lead to incorrect decisions, because changes in information variable are not recognised, and the information is interpreted in the same way as before the change was effected. Functionally fixated decision makers may well adapt to change over time. However, in the interim, decisions may be taken which are inconsistent with the optimal response to the revised signal.

Several researchers have attempted to study investors' behaviour in order to acquire a better understanding of human information processing in situations requiring recognition of a change in the variable affecting investment decisions. The original fixation study by Ijiri, Jaedicke & Knight (1966) observed the behaviour of subjects trying to discover new responses to changed accounting variables after undergoing specific training relating to the changed circumstances. Ijiri et al. (1966, p. 3) developed the following hypothesis: "people who do not understand accounting well tend to neglect the fact that alter-

native methods may be used to prepare outputs". The results of the study showed clearly that users of accounting information made inadequate responses to the new variables influencing investment decisions. On the basis of their findings Ijiri et al. (1966) concluded that functional fixation does exist, and further suggested that as a result of this, changes in accounting may not achieve their intended purposes. This emphasized the need for professional bodies and research institutions to highlight the importance of major developments in accounting and investment research for the users of such information.

Knight and Affleck-Graves (1983) studied the efficiency of the JSE by monitoring the price movements of 21 listed companies that announced a change from a FIFO to a LIFO basis of inventory valuation. It was observed that a switch to LIFO valuation had an overall negative impact on share prices. Furthermore, this negative impact was not instantaneous but was incorporated in the share prices over several weeks after the announcement. Knight and Affleck-Graves (1983, p. 31) concluded that this suggests inefficiency on the JSE for two reasons: the market was incorrect in evaluating the true economic significance of a change to LIFO valuation and it took too long to reach equilibrium following an announcement. These findings suggest that investors are functionally fixated with regard to the economic interpretation of a switch in inventory valuation.

A SURVEY TO DETERMINE THE EFFICIENCY OF ALLOCATING INVESTMENT FUNDS IN SOUTH AFRICA.

This investigation is concerned with the study of investor's behaviour when there is a potential change in investment opportunity which should significantly affect the decision making process of portfolio managers. Portfolio managers are assumed to be given the opportunity of investing in foreign securities in addition to domestic investments. This study differs from the traditional EMH research which is mainly concerned with the relationship between the release of information in a specific domestic market and its impact on security prices.

In order to determine the efficiency of the allocation process and to gain some insight into the probable reaction of portfolio managers if exchange control regulations were abolished, the following hypotheses were tested:

1. Institutional Investors and portfolio managers of the JSE Stock Broking firms generally have superior access to investment information, and are able to process this information more efficiently than most investors. Accordingly, these groups of investors would perceive that they can outperform the market as a whole. Therefore, the majority of these investors would not regard the JSE as an efficient capital market.
2. Those institutional investors/JSE portfolio managers that do not believe in the efficiency of the JSE would be predisposed towards investing on the JSE despite the appreciation of potential benefits that would arise from international portfolio diversification.
3. As a result of a lack of familiarity with foreign securities and security markets, portfolio managers are unlikely to commit a significant portion of their funds to international portfolios. Owing to the existence of exchange control, portfolio managers are currently restricted to security investments, on the JSE. Therefore, these investors have become conditioned and fixated towards investing on the JSE.

This postal questionnaire survey was conducted during April/June 1986, some nine months after the release of the final report of the De Kock Commission of Inquiry (which recommended a gradual process of dismantling exchange control in South Africa). During this nine month period there was considerable informed commentary in the investment literature regarding the benefits accruing to South African investors from international portfolio diversification (Bhana (1986), Barr (1986)). The respondents were institutional investors (insurance companies, unit trusts, and investment trusts listed on the JSE) as well as the portfolio managers of the JSE Stock Broking firms (who manage equity investments on behalf of clients). A copy of the questionnaire with a summary of the responses received is shown in Appendix 1.

A random sample representative of institutional investors and portfolio managers of stock broking firms was chosen for this investigation. A total of 79 questionnaires was sent to the different categories of respondents. Responses suitable for analysis were received from 41 respondents. This represents a very satisfactory response rate of 51,9 percent. It was ascertained that the respondents were sufficiently representative of the different categories of investors whose views on foreign security investments were investigated.

Question 1 was divided into four parts and was designed to test hypothesis 1 and also to elicit the views of the respondents concerning the efficiencies of the NYSE and the LSE. Of the total response of 41, the majority of the respondents, namely 34 (82,9%) believed in the efficiency of capital markets in general, but only 12 respondents (29,3%) regarded the JSE to be an efficient capital market, consistent with hypothesis 1. Part 3 of question 1 required the respondents to comment on the empirical evidence which suggests only the NYSE and the LSE to conform to the definition of efficient capital markets. A total of 28 respondents (68,3%) agreed with this observation imputing efficiency to the NYSE and the LSE and characteristics of inefficiency to all others. The 28 respondents who believed in the efficiency of the world's leading stock exchanges were asked if they believed that South African investors could improve their portfolio performance by investing in stock exchanges they considered to be inefficient. These results are consistent with the respondents' perception of market efficiency because 25 respondents (89,3%) believed that South African investors could improve their portfolio performance by investing in the relatively inefficient smaller overseas stock exchanges.

Questions 2 and 5 were designed to determine if portfolio managers are efficient in their decisions to allocate investment funds and also to test hypotheses 2 and 3. The first part of question 2 sought the respondents views regarding the De Kock Commission's recommendation that exchange control over foreign equity investments by South African residents should be gradually dismantled. A total of 38 respondents (92,7%) believed that the removal of exchange control was in the best interests of South African investors. These results are hardly surprising as the dismantling of exchange control would lead to an improvement in portfolio performance. Ryan (1985) reported that several large institutional investors have expressed enthusiasm for foreign security investments when the Commission's final report was released. In reply to part 2 of question 2, a total of 37 respondents (90,2%) indicated that they would seriously consider investments in foreign securities when the existing exchange control regulations are relaxed or abolished. This confirms that Portfolio Managers are aware of the possibilities of improving the risk-return characteristics of their portfolios by including foreign securities to their existing portfolios.

In part 3 of question 2, the 37 respondents favourably disposed toward foreign security investments were asked the period of time over which they would consider the inclusion of foreign securities in their portfolios. Only 14 (38%) of the respondents indicated their willingness to acquire foreign securities in the short-term (a period of up to 2 years). The other 23 respondents (62%) expressed a preference to make a long-term commitment (over a period of 5 years and more) to foreign security investments. Part 4 of question 2 required the respondents

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*p.p. – per plan

Unit Trusts(s) Applicable

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Account Details:

Account holder's name _____ Bank/Building society _____

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I warrant that I have full power and authority and am legally competent to enter into and conclude this transaction with the necessary assistance where such assistance is legally required.

Signature _____ Date _____ Assisted by (if necessary) _____

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to indicate what percentage of their total portfolio value they were prepared to invest in foreign securities. An arbitrary figure of 25 percent was chosen as being representative of a meaningful investment in foreign securities. In view of the high fixed cost of investing in foreign securities (research, administration, etc.) and the possibility of significantly reducing the risk of domestic portfolios, a sufficiently large investment in foreign securities is essential. A total of 28 respondents (75,6%) failed to meet the 25 percent cut-off point for meaningful investment in foreign securities. Furthermore, 20 of the respondents (54,0%) were only prepared to invest up to 10 percent of their total funds in foreign securities. These results further confirm the hesitancy of portfolio managers to invest in foreign securities despite clearly recognizing their investment merits.

As only 4 respondents (9,8%) had indicated that they would not consider investing in foreign securities, an analysis of their reasons for taking this decision cannot be very reliable. Nevertheless, the perceived reasons for not investing are important in the evaluation of investment allocation decisions. The two most important reasons established by ranking on a 5 point scale (5 points for first ranking and 1 point for fifth ranking) were: "liabilities to clients denominated in South African currency" (30,2%), and "the average returns on the JSE are likely to be superior in the long-term" (27,9%). The other reasons reported were "the risk associated with exchange rate fluctuations" (18,6%), "lack of detailed knowledge of foreign securities" (14,0%) and "the lack of liquidity and investment flexibility" (9,3%). These arguments against foreign security investments have no validity. Khoury (1983) reports that the investment literature has addressed each of these perceived "problems" and has demonstrated that the benefits far outweigh the obstacles.

Of particular interest is the high ranking (30,2%) given to "liabilities to clients denominated in South African currency". As taking cover against foreign exchange risks associated with foreign currency dealings is an established practice, it can be expected that portfolio managers would make suitable provisions to protect their investment in foreign securities. There is also no justification for assuming that the JSE would provide superior returns (on a risk-adjusted basis) in the long-term. These results suggest that these four respondents representing unit trust, pension fund, insurance company, and JSE portfolio managers are taking a very narrow view on foreign portfolio investments.

Question 5 was designed to measure the commitment of institutional investors and portfolio managers to foreign security investments. The respondents were asked if they were engaged in any specific research into foreign securities (so that they would be able to benefit immediately when exchange controls are relaxed or abolished). Only 13 respondents (31,7%) indicated that they were engaged in any research related to foreign securities. Several of the respondents who were engaged in researching foreign securities indicated that the nature of their investigations was exploratory and was aimed at familiarization with foreign securities rather than seeking specific securities as potential investment opportunities. The remaining 28 respondents (68,3%) indicated that they were not engaged in any research on foreign securities. The fact that the majority of portfolio managers are not pursuing any specific research into foreign securities has potentially serious consequences. These portfolio managers will not be able to benefit immediately by optimising portfolio returns when exchange controls relating to overseas securities are partially relaxed or eventually abolished.

As the majority of respondents are not researching foreign securities, the specific reasons for not pursuing research would be instructive. On a percentage first ranking basis, 60,1% of the respondents indicated that there was "little likelihood of exchange control being relaxed in the foreseeable future"; 15,4% of the respondents indicated that "the purchase of overseas expertise is a more efficient method of acquiring information on foreign securities", 12,6% of the respondents indicated that "research expenditure is not warranted in view of their intended limited exposure to foreign securities", a further 8% preferred to "appoint foreign managers" and the remaining 3,9% indicated that "expertise to conduct research was lacking in South Africa". The same trend is obtained if the reasons are ranked on a point scale with 5 points for the first ranking and 1 point for the fifth ranking.

Question 3 required the respondents to rank the specific investment benefits they considered important when considering foreign security investments. On a percentage first ranking basis, 40,8% ranked "reduction in portfolio risk" first, "portfolio protected against economico-political risk in South Africa" (22,2%) was ranked second, "improvement in portfolio return" (11,1%) was ranked third, and "benefits from currency appreciation" (7,4%) was ranked fourth. The high ranking given to the improvement in risk-return characteristics of internationally diversified portfolios (81,5%) indicates that portfolio managers are indeed aware of the overall investment benefits accruing from foreign securities. The remaining reasons: "improved investment services to individual investors", "making local markets more efficient", and "access to foreign products and markets" make up the remaining 18,5% of the response to question 3 and can be considered as subsidiary benefits.

Question 4 further analyzes the benefits from international portfolio diversification by asking the respondents to identify indirect benefits (spin-offs) from such investments. On a percentage first ranking basis, only three reasons were chosen: "ease the burden of continually seeking additional investments in a market (JSE) with limited opportunities" (72,8%); "the creation of more efficient capital and equity markets in South Africa" (22,7%); and "skills acquired in foreign investments can be transferred to investments on the JSE" (4,5%). When ranking is performed on a point scale the respective scores are: 25,9%, 22,3% and 17,2% respectively. Furthermore, reasons such as "the creation of a more efficient market for foreign exchange in South Africa" (15,7%); "the facilitation of overseas acquisitions and mergers" (13,5%) and "other reasons" (5,4%) also received responses when the point scale ranking was used.

An analysis of the ranking given to specific benefits outlined in questions 3 and 4 suggests that portfolio managers in South Africa are fully cognizant of the benefits of investing in foreign securities. However, an analysis of their intentions to make foreign security investments when exchange control restrictions are removed (questions 2 and 5) reveals an inconsistency. While these portfolio managers are fully aware of the benefits arising from investing in foreign securities, there is a distinct reluctance to make such investments (only 38% of the respondents are willing to make investments within a period of 2 years). There also appears to be a very cautious approach to the size of the foreign portfolio holdings (only 24,4% of the respondents were willing to invest 25 percent or more of their portfolio value in foreign securities). Furthermore, there also appears to be a reluctance to pursue specific research into foreign securities (68,3% of the respondents are not researching foreign securities) despite the favourable prospects for the relaxation of exchange control regulations at the time of sending the questionnaires to the respondents.

Several possible explanations could be offered to account for the disparity between the proper understanding of the benefits from foreign security investments and the reluctance to make significant investments in these securities. First, it can be suggested that portfolio managers in South Africa are functional-

ly fixated with investing on the JSE as suggested by hypothesis 3. Second, a lack of familiarity with foreign securities and security markets may have resulted in raising the level of caution. Third, South Africa is confronted with a significant outflow of funds as revealed by the Leutwiler proposals (an agreement between South Africa and its major creditors which provided a programme of debt repayments which were subject to a moratorium), and in these circumstances local portfolio managers may consider it inappropriate to make significant foreign investments and thereby contribute towards the further outflow of capital from this country. Fourth, the majority of the respondents have rated the JSE as an inefficient market, and may erroneously believe that the various problems involved in foreign security investments are costs that exceed any improvement in portfolio performance.

CONCLUSION

The results of this exploratory investigation reveal some interesting observations on the investment behaviour of portfolio managers in South Africa. It is difficult to draw broad generalizations from this study as the sample investigated was not large. In this research situation it appears that portfolio managers have sufficient information related to maximization of portfolio returns (they are fully informed of the benefits emanating from foreign security investments). A lack of commitment to foreign security investments suggests that portfolio managers show a tendency to be inefficient in their role as allocators of investment funds. The evidence also seems to suggest that some informed professional investment managers are functionally fixated towards investing on the JSE – unable to adapt readily to new information and developments relating to portfolio investment. As a result of this functional fixation, some portfolio managers are unlikely to optimise their portfolio returns by pursuing international portfolio diversification when exchange control regulations are eventually lifted. We would like to suggest that further empirical work be undertaken to establish the nature and reasons for the reluctance by portfolio managers to invest internationally and to search for and identify further opportunities and limitations.

If portfolio managers avoid opportunities to invest in foreign securities because of a lack of familiarity with foreign securities and international security markets, then such action will have major consequences for individual investors whose funds are administered by institutions (unit trusts, pension funds, insurance companies, investment trusts etc.). To the extent that there is a misallocation of funds (not deriving the full benefits of international portfolio diversification), the wealth of these investors will not be maximized. Furthermore, in view of the major role played by the institutional investors in the allocation of investment funds in the South African economy, it can be said that the welfare of all South African citizens will be eroded by inefficient investment decisions i.e. investment funds continued to be invested in South Africa despite greater rewards offered by foreign investments.

The reluctance of institutional investors to invest overseas may also be due to their observance in recent years of the volatility of international security markets. In particular, adverse market sentiments on the New York and Tokyo stock exchanges have produced corresponding ripple effects on other stock exchanges, including the JSE. For instance, the massive share price declines on the New York Stock Exchange on 19 October 1987 resulted in corresponding share price declines in other stock exchanges. Local portfolio managers can be expected to be very hesitant in making foreign security investments in highly volatile international security markets. As a result, local portfolio managers can be expected to be even more circumspect in making foreign security investments when exchange control regulations are abolished or partially relaxed.

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APPENDIX

A questionnaire to determine the views of institutional investors on the recommendation of the De Kock commission of inquiry relating to the abolition of exchange control relating to overseas portfolio investments.

QUESTIONNAIRE NUMBER: _____

Question 1

The concept of "efficient capital markets" implies that at a given point in time the prices of securities fully reflect all publicly available information concerning the securities.

1.1 Do you consider that stock exchanges in general can be regarded as efficient in terms of the above definition of efficient capital markets?
(Please mark with "X" in the appropriate square)

Yes	No
34 (82,9%)	7 (17,1%)

1.2 Do you consider the Johannesburg Stock Exchange to be efficient in terms of the above definition of efficient capital markets?

Yes	No
12 (29,3%)	29 (70,7%)

1.3 Empirical evidence suggests that other than the two largest stock exchanges, namely, the New York Stock Exchange and the London Stock Exchange all other stock exchanges show characteristics of market inefficiency. Do you agree with this observation?

Yes	No
28 (68,3%)	13 (31,7%)

1.4 If your answer to the above question (1.3) is yes then do you believe that investing in inefficient foreign stock exchanges is likely to improve the portfolio performance of South African investors?

Yes	No
25 (89,3%)	3 (10,7%)

Question 2

2.1 The De Kock Commission of Inquiry into Monetary System and Monetary Policy in South Africa recommended a gradual process of dismantling exchange control over foreign equity investments by South African residents. Do you consider this to be in the best interests of South African investors?

Yes	No
38 (92,7%)	3 (7,3%)

2.2 Assume that exchange control over foreign equity investments is abolished by the authorities. With regard to the portfolio you are associated with, would you consider making investments in foreign securities?

Yes	No
37 (90,2%)	4 (9,8%)

2.3.1 If your answer to question 2.2 is yes, then over what period would you implement the acquisition of foreign securities?

Immediately	Over a period of 2 years	Over a period of 5 years	Over a period greater than 5 years
6 (16,2%)	8 (21,6%)	11 (29,8%)	12 (32,4%)

2.3.2 When you decide to make foreign equity investments what percentage of your total portfolio value would you be prepared to invest in foreign securities (assuming that there are no limitations to funds invested abroad)?

1-10%	11-24%	25-40%	41-50%	More than 50%
20 (54,0%)	8 (21,6%)	4 (10,8%)	3 (8,2%)	2 (5,4%)

2.3.3 If your answer to question 2.2 is no (i.e. you are not prepared to make foreign equity investments) then indicate one or more of the following reasons why you have decided against foreign equity investments. Please rank the relative importance of the various factors for not investing in foreign securities i.e.
1 = most important
2 = second most important

Reason	Ranking	First Ranking	Point Scale
Foreign securities are riskier because detailed knowledge of securities (published financial reports, prices, P/E ratios, media coverage etc.) is not readily obtained in South Africa	4	0	14,0%
Foreign securities are riskier because of exchange rate fluctuations of the currencies in which these investments are denominated.	3	25,0%	18,6%
The average returns on the Johannesburg Stock Exchange are likely to be superior to the average returns provided by foreign securities.	2	25,0%	27,9%
The greater distance and slower communication between South Africa and foreign stock exchanges increase the time required to deal in foreign securities. This relative lack of liquidity and investment flexibility increases the risk of investing in foreign securities.	5	0	9,3%
Our liabilities to clients (unit trust investors, pension fund holders, prospective insurance claimants etc.) are denominated in South Africa rands. Therefore, it is not appropriate to make investments in securities denominated in foreign currencies.	1	50,0%	30,2%
Other (please specify)			
(i)			
(ii)			

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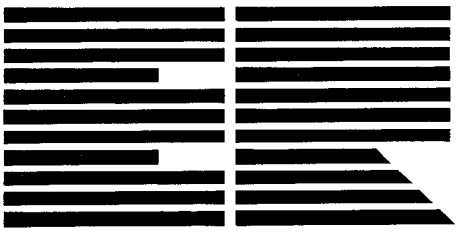

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Tel. (022) 467969
Fax. (022) 476395

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Diagonal Street
Johannesburg 2001
P O Box 61320
Marshalltown, 2107
Tel (011) 833-5530
Fax. (011) 838-7653
Telex 4-87202

Question 3

Assuming that exchange control over foreign equity investments is completely or partially abolished by the authorities in South Africa. What are the specific investment benefits (if any) that are likely to be derived from foreign equity investments?

Please rank the relative importance of the various benefits in order of importance i.e.
1 = most important
2 = second most important

Reason	Ranking	First Ranking	Point Scale
Portfolio returns are likely to be improved (higher yields) as a result of international portfolio diversification.	3	11,1%	18,3%
The portfolio risk is likely to be reduced because of the counter cyclical movements in the equity prices on the different stock exchanges.	1	40,8%	24,6%
An international exposure will make institutional portfolios more attractive to individual investors who generally do not have the expertise to invest in foreign securities. Therefore, the demand for the investment services provided by institutional investors can be expected to increase.	6	3,7%	11,0%
In the event of a major economico-political change in South Africa our portfolios are likely to be protected by not having all funds invested in South Africa.	2	22,2%	19,8%
Astute investors are likely to obtain significant foreign exchange gains by tilting their portfolios towards securities of those countries whose currency is likely to appreciate against the South African rand.	4	7,4%	13,8%
Other (please specify)			
(i) Broader knowledge of foreign markets will make local markets more efficient.	5	14,8%	12,5%
(ii) Gain access to products/markets and growth opportunities in foreign countries.			

Question 4

What other benefits not directly related to portfolio performance (spin-offs) are likely to arise from investing in foreign equities?

Please rank the relative importance of the various benefits in order of importance i.e.
1 = most important
2 = second most important

Reason	Ranking	First Ranking	Point Scale
By acquiring strategic holdings in certain foreign equities acquisitions and mergers of overseas companies can be facilitated.	5	0	13,5%
An exposure to the more sophisticated investment environment in countries such as the United States and the United Kingdom may enable skills so acquired to be transferred to investments on the Johannesburg Stock Exchange.	3	4,5%	17,2%
Depending on the state of the economies in the different countries investment funds can be expected to move freely between the JSE and various foreign equity markets. This can be expected to create a more efficient market for foreign exchange in South Africa.	2	22,7%	22,3%
The greater volume of foreign exchange required to service security transactions can be expected to result in a more efficient market for foreign exchange in South Africa.	4	0	15,7%
There is a limited range of investment opportunities in South Africa, and institutional investors are constantly confronted with the task of investing vast sums of investment funds in a narrow range of investment mediums. Being able to invest in foreign securities will ease the burden of continually seeking additional investments in a market with limited opportunities.	1	72,8%	25,9%
Other (please specify)	6	0	5,4%
(i)			
(ii)			

If there are more than two other reasons please specify on separate page.

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Question 5

The De Kock Commission has recommended that at some stage in the future institutional investors should be allowed to invest in foreign securities. Is the portfolio with which you are associated pursuing any spesific research into foreign securities so that you would be able to benefit immediately when exchange controls relating to overseas portfolio investments are abolished or partially relaxed?

Yes	No
13 (31,7%)	28 (68,3%)

If your answer to the above question is no could you provide specific reason for not pursuing research into foreign securities.

Please rank the relative importance of the various reasons in order of importance i.e.

1 = most important

2 = second most important etc.

Reason	Ranking	First Ranking	Point Scale
(i) No serious likelihood of this recommendation being implemented in the foreseeable future.	1	60,1%	46,7%
(ii) The purchase of overseas expertise is a more efficient method of acquiring information on foreign securities.	2	15,4%	21,3%
(iii) Expense not warranted in view of a limited exposure to foreign securities is expected.	3	12,6%	20,1%
(iv) Prefer the appointment of foreign managers as they would have greater expertise relating to foreign securities.	4	8,0%	7,3%
(v) Limited number of local researchers who have expertise to conduct research into foreign securities.	5	3,9%	4,6%

W R Gevers

Equivalent dividends: an extension

1. INTRODUCTION

In a recent paper De Villiers (1988: 26-28) suggested the use of what he called equivalent dividends to provide for changes in the capital structure of companies when calculating stock returns in computerbased systems.

His suggestions were implemented in a computer system that is used to determine the risk of shares traded on the Johannesburg Stock Exchange. In using the system a number of anomalies in share returns were noted. These could be traced to the use of equivalent dividends. It was found that the formule suggested did not cope with situations of simultaneous or near-simultaneous announcements of capital structure changes and an improvement is suggested in this note. A comment regarding the reduction of capital by a company is also included. Computational problems which occur when the dates of capital structure changes are incorrect, are also discussed briefly.

2. SIMULTANEOUS CAPITAL STRUCTURE CHANGES

2.1 Occurrence of simultaneous capital structure change

Capital structure changes usually occur in isolation. If more than one capital structure change however occurs within a return period (a week or a month), the calculation for the equivalent dividend may be in error if De Villiers's formulae are used. In analysing capital structure changes on the Johannesburg Stock Exchange it was found that in some instances companies declared a stock dividend and subsequently consolidated or split their shares. Another occurrence of a simultaneous capital structure change was the announcement of a simultaneous share split and consolidation of shares. This usually occurred when a single announcement would have led to a fractional ratio in the split or consolidation announcement. No other combinations of simultaneous announcements were found.

In developing his formulae for equivalent dividends, De Villiers based his derivation on a single capital structure change. This assumes that each capital structure change has an associated share price behaviour before another capital structure change will take effect. If the market does not react separately to the individual components of a combination of capital structure changes, one would expect that De Villiers's formulae will yield incorrect results.

2.2 Simultaneous split and consolidation of shares

For a share split De Villiers found that the equivalent dividend may be determined by using equation (1), while the formula for the equivalent dividend for a consolidation of shares is represented by equation (2).

Share split:

$$ED_{j,t} = P_{j,t}(r_s - 1) \quad (1)$$

Consolidation of shares:

$$ED_{j,t} = P_{j,t}\left(\frac{1}{r_c} - 1\right) \quad (2)$$

$ED_{j,t}$ = equivalent dividend per share resulting from a capital structure change during period t for share j

$P_{j,t}$ = price of share j at the end of period t

r_s = number of shares into which a single share has been split during period t

r_c = number of shares consolidated into a single share during period t

If a company were to announce a simultaneous share split of r_s for one share and a consolidation of shares of one share for r_c shares, it is clear that for each share that the shareholder held prior to the announcement, it would end holding r_s/r_c after both announcements. Thus it is established that

$$V_{j,t-1} = P_{j,t-1} \quad (3)$$

and

$$V_{j,t} = \frac{r_s}{r_c} \cdot P_{j,t} \quad (4)$$

where

$V_{j,t-1}$ = value in the possession of a shareholder that owns one share j at the beginning of period t. This includes the price of one share j plus any amount that the shareholder will invest in period t as a result of owning the share j.

$V_{j,t}$ = value in the possession of the shareholder (who owned one share at the beginning of period t) at the end of the period t. This includes the value of all the shares he now owns plus the value of any other investment he has obtained plus any dividend received.

De Villiers's generalised equation for equivalent dividends is given below as equation (5).

$$ED_{j,t} = \frac{P_{j,t-1} \cdot V_{j,t}}{V_{j,t-1}} - P_{j,t} \quad (5)$$

Substituting equations (3) and (4) into this equation and simplifying yields:

$$ED_{j,t} = P_{j,t} \cdot \left(\frac{r_s}{r_c} - 1\right) \quad (6)$$

where the symbols are as defined before. Equation (6) is in a generalised form and provides for both share splits (r_c = 1) and consolidation of shares (r_s = 1) or a combination of the two.

The effect of applying equation (6) to a simultaneous announcement rather than De Villiers's formulae in succession is illustrated in example 1.

Example 1

Delta Electrical Industries announced a share split of 7 for 1 on 9 May 1988. On the same day it also announced a consolidation of shares of 1 for 2 (JSE, 1990: 60). On 5 May 1988 the share traded at 825c. The next trade took place on 17 May 1988 when a closing price of 275c was recorded.

If equations (1) and (2) are applied in succession using the share price for the first trade after the announcement, as would have occurred in a computerised system based on De Villiers's formule, the following equivalent dividends and trade-to-trade share return are generated.

Share split:	ED=275 . (7 − 1)=1650
Consolidation:	ED=275 . (½ − 1)=−137,5
Share return:	(275 − 825 + 1650 − 137,5)/825 = 117%
Equation (6) yields:	ED = 275 . (7/2 − 1) = 687,5
Correct share return:	(275 − 825 + 687,5)/825 = 17%

If the simultaneous split and consolidation was seen by the market as merely a technical procedure, and no other information that could have had an influence on Delta's share price had been announced, one would have expected to see Delta's share price drop to 2/7 of its price before the announcement (i.e. 236c). The higher closing price on 17 May 1988 indicates a positive return of 17% [(275 – 236)/236] for the period 5 May to 17 May 1988. Serious errors in share returns could thus be generated in a computerised system which treats a simultaneous share split and consolidation as separate capital structure changes.

2.3 Simultaneous stock dividends and consolidation of shares

If a stock dividend of r_d shares per share held, is issued, De Villiers found that the equivalent dividend to represent this capital structure change is given by equation (7).

$$ED_{j,t} = r_d \cdot P_{j,t} \quad (7)$$

where

r_d = number of shares issued as a stock dividend during period t per share held at the beginning of the period and all other symbols as defined before.

If such a stock dividend is followed by a consolidation of shares at 1 share for every r_c shares held (after the stock dividend), the value in possession of the shareholder per share is as follows:

$$V_{j,t-1} = P_{j,t-1} \quad (8)$$

and

$$V_{j,t} = \frac{1 + r_d}{r_c} \cdot P_{j,t} \quad (9)$$

Substituting into De Villiers's generalised equation for equivalent dividends and simplifying yields:

$$ED_{j,t} = \left(\frac{1 + r_d}{r_c} - 1\right) \cdot P_{j,t} \quad (10)$$

where all symbols are as defined before.

If such a stock dividend is followed by a share split of r_s shares for every 1 share held (after the stock dividend), the value in possession of the shareholder per share at time t is as follows:

$$V_{j,t} = r_s \cdot (1 + r_d) \cdot P_{j,t} \quad (11)$$

Substituting into De Villiers's generalised equation for equivalent dividends and simplifying yields:

$$ED_{j,t} = (r_s \cdot (1 + r_d) - 1) \cdot P_{j,t} \quad (12)$$

where all symbols are as defined before.

If it is desirable to keep the equivalent dividend due to the stock dividend separate from the equivalent dividend due to the consolidation of shares, this can only be achieved by expressing the one change in capital structure in terms of the share price prior to the change, and the other in terms of the share price after the change. This in turn requires the simplifying assumption that the value in possession of the shareholder immediately prior to the change is equal to the value in possession of the shareholder immediately after the change. It is then possible to express the share price after the change in terms of the share price before the change, as follows:

$$V_{j,t-1} = V_{j,t} \quad (13)$$

Hence:

$$1 \times P_{j,t-1} = (1 + r_d) \times P_{j,t} \quad (14)$$

and the equivalent dividend due to the stock dividend reduces to:

$$ED_{j,t} = \frac{r_d}{1 + r_d} \cdot P_{j,t-1} \quad (15)$$

It must be emphasised that the simplifying assumption assumes a zero return for the stock dividend which is not necessarily correct.

The effect of the simultaneous declaration of a stock dividend and a consolidation or split of shares on the determination of the equivalent dividend and the share return are illustrated in examples 2 and 3 respectively.

Example 2

Crusader Life Assurance Group declared a stock dividend of 150 shares for every 100 held with the last day to register for the stock dividend being 4 December 1987. It also announced a consolidation of shares from 15 to 6 on 7 December 1987 (JSE, 1990: 58). On 4 December Crulife traded at 155c. The closing price on the next day that it traded, namely 9 December 1987, was 145c.

If in a computerised system equations (7) and (2) were applied in succession, (both referring to the share price on 9 December 1987), the equivalent dividends and associated share return would be:
Stock dividend: ED = 150/100 . 145 = 217,5
Consolidation of shares: ED = (6/15 – 1) . 145 = –87
Share return (trade-to-trade) = (145 – 155 + 217,5 – 87)/155 = 77,7%
Equation (10) yields: ED = ((1 + 150/100)/(15/6) – 1) . 145 = 0
Correct share return = (145 – 155 + 0)/155 = –6,5%

If equation (15) had been used to determine the equivalent dividend for the stock dividend, the following is obtained:
Stock dividend: ED = (1,5)/(1 + 1,5) . 155 = 93
Approximate share return = (145 – 155 + 93 – 87)/155 = –2,6%

Example 3

Pick 'n Pay Stores declared a stock dividend of 40 shares for every 100 held with the last day to register for the stock dividend being 13 November 1981. It also announced a share split of 5 shares for every share held on 16 November 1981 (JSE, 1990: 97). On 11 November 1981 Pick 'n Pay's closing share price was 6900c. It next traded on 17 November 1981 when the share price closed at 1000c.

If in a computerised system equations (7) and (1) were applied in succession (both referring to the closing price on 17 November 1981), the equivalent dividends and associated share return would be:
Stock dividend: ED = 0,4 . 1000 = 400
Share split : ED = (5 – 1) . 1000 = 4000
Share return (trade to trade): (1000 – 6900 + 400 + 4000)/6900 = –21,7%
Equation (12) yields: ED = (5(1 + 0,4) – 1) . 1000 = 6000
Correct share return = (1000 – 6900 + 6000)/69000 = 1,4%

If equation (15) was used to determine the equivalent dividend for the stock dividend, the following is obtained:
Stock dividend: ED = (0,4/(1 + 0,4)) . 6900 = 1971
Approximate share return = (1000 – 6900 + 1971 + 4000)/6900 = 1,0%

The approximate approach using equation (15) thus yields a return of the same order of magnitude as the correct share return in both examples 2 and 3. As such it is a vast improvement over the successive application of De Villiers's formulae.

3. REDUCTION OF CAPITAL

From time to time companies may announce a reduction in capital. In some instances this reduction in capital is merely an accounting entry, reducing the share capital account and increasing the capital reserve account by a similar amount. Under these circumstances the value in the possession of the shareholder does not change and an equivalent dividend should not be calculated.

Sometimes, however, a company actually repays some of its capital when the reduction in capital is announced. Under those circumstances an equivalent dividend must be determined. Using the value in the possession of the shareholder approach, it is established that

$$V_{j,t-1} = P_{j,t-1} \tag{16}$$

and

$$V_{j,t} = P_{j,t} + CR \tag{17}$$

which yields:

$$ED_{j,t} = CR \tag{18}$$

where CR = amount of capital repaid per share.
Since the situation is similar to the payment of a dividend, the formula for the equivalent dividend with the repayment of capital is identical to the formula for paying a dividend.

4. COMPUTATIONAL ISSUE

The date on which the change in capital structure of a company occurs has an important influence on the determination of the equivalent dividend. The formulae for equivalent dividends developed by De Villiers and extended in this note, usually refer to a share price, $P_{j,t}$, at the end of period t. To determine the correct value for the equivalent dividend, it is important that this share price is that price quoted immediately *after* the change in capital structure has come into effect. When a company declares a dividend or a stock dividend, or shareholders receive the right to purchase additional shares, a last-day-to-register date is also announced. Share price reaction is then expected on the trading day following the last-day-to-register. When a share split or a consolidation of shares is announced, the stock market reacts on the day that the change in capital structure takes effect. Thus the dates for the different announcements have to be treated differently depending on the type of capital structure change.

This problem is particularly severe when daily returns are calculated and these returns are accumulated using the additive return model for longer periods e.g. a week or a month. The logarithmic return model is not sensitive to a date error if the returns are accumulated. If daily returns are used to determine the risk of a company, errors in pinpointing the correct dates of the changes in capital structure will cause high positive and negative return values which could seriously affect the statistical significance of the risk parameters being estimated.

5. CONCLUSION

The method of equivalent dividends to incorporate capital structure changes in share return calculations as suggested by De Villiers (1988) was implemented. It was found that his method does not cope correctly with simultaneous capital structure changes. Improvements to his method are suggested to cater for simultaneous capital structure changes as well as for the reduction of capital. Finally a comment is made about the necessity of using the correct dates and the share prices quoted on those dates to ensure that the equivalent dividend formulae yield the correct results, leading to correct return values.

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M.J. Page & C.V. Way

Stock Market Over-reaction: The South African Evidence

ABSTRACT

It has been suggested that stock markets over-react and that investors pay too much attention to recent "dramatic" news. If over-reaction does occur and prices overshoot then there should be a subsequent revision in the opposite direction. This paper outlines empirical research into the over-reaction hypothesis on the Johannesburg Stock Exchange using data over the period July 1974 to June 1989 for two hundred and four relatively well traded securities.

The results are consistent with the over-reaction hypothesis and indicate substantial weak form inefficiencies in the South African stock market in the long-term. The performance of portfolios of shares formed on the basis of prior return data can be predicted and, on average, portfolios of prior 'losers' outperformed prior 'winners' by about twenty percent over the three years after portfolio formation. Finally, comparison between the empirical results and a similar study for the New York Stock Exchange calls into some question the hypothesis that exceptionally large returns in January in the USA are due to investor tax loss selling. There is evidence of both a January effect and an asymmetric excess returns effect for the South African market but it is less pronounced than for the American market.

1. INTRODUCTION

A vast amount of research has been directed at the field of market efficiency both internationally and locally, and models have been proposed to describe stock market behaviour based on the assumption that the implications of information available to the market are immediately incorporated into stock prices. When observed behaviour deviates from the predicted by the model, two hypotheses are suggested; either the model has been mis-specified or the market is inefficient.

Contrary to the notion of efficient markets, research into the psychology of individual decision making suggests that people over-react to unexpected and dramatic news events (De Bondt and Thaler, 1985: 793). Within the investment realm, this suggests that investors overweight recent news and drive the price of the affected stock(s) too far. This action will result in extreme movements in stock prices followed by corrections in the opposite direction. The existence of any stock market over-reaction will therefore provide an arbitrage opportunity since, based on previous return data, investors can construct portfolios that will achieve abnormal risk adjusted returns.

Drawing extensively on the approach used by De Bondt and Thaler (1985, 1987) for the New York Stock Exchange, this study investigates the over-reaction hypothesis using Johannesburg Stock Exchange data. The findings show clear evidence of investor over-reaction. This has potentially profound implications in the understanding of the efficient market hypothesis in the short- and long-term, is of material significance to investors, and adds to the understanding of the securities markets generally. Additionally, although the South African stock market data is not as extensive as that used in American studies, differences between market mechanics such as financial year ends and capital gains tax policy yield valuable comparisons.

2. THEORETICAL OVERVIEW

Over-reaction studies of the nature carried out in this paper fall into the broad category of tests of the efficient market hypothesis which states that "prices fully reflect all relevant information" (Copeland and Weston, 1988:332). If a securities market is efficient all securities will be priced to earn an appropriate risk adjusted return. The over-reaction hypothesis suggests however that investors drive security prices to unsustainably high (or low) levels based only on recent returns performance. These levels then correct in the opposite direction. Since weak form efficiency implies abnormal (residual) returns cannot be consistently earned on the basis of historical price information, evidence of market over-reaction is contrary to efficient market theory in its weakest form.

The Reverend Thomas Bayes proposed a rule through which decision makers incorporate new information into the decision making process (Groebner and Shannon, 1981: 898). In making non-repetitive decisions in a changing environment people make a tentative decision, gather new information and use this new information to update the decision until the time comes to act. At this time they follow the cource of action dictated by their decision criteria.

It is now widely accepted that people are generally poor Bayesin decision makers (De Bondt and Thaler, 1985: 793). In revising their beliefs people tend to overweight recent information and underweight historical information. Given the degree of uncertainty prevalent in the securities market, this is not necessarily an irrational action. Risk averse investors faced with the uncertainty of forecasting future dividend streams attempt to achieve returns from shorter term price changes. This results in investors forecasting tomorrow's stock prices rather than the present value of future dividend streams. In forecasting stock prices investors extrapolate recent earnings trends into the future, ignoring the fact that many earnings patterns follow a random walk and inevitably revert to the mean (Bernstein, 1985: 806).

After forecasting earnings trends investors purchase recent good performers and divest of poor short term performers. This drives stock prices to unsustainable levels in both directions and is the basis of the over-reaction hypothesis. Recent good performers or 'winners', become overpriced relative to the market and poor performers or 'losers', underpriced. In subsequent periods when the optimistic (pessimistic) forecasts are not realised, investors divest (purchase) the affected securities, forcing a revision of prices downwards (upwards).

3. PRIOR EMPIRICAL RESEARCH

Evidence consistent with the over-reaction hypothesis was first observed for the New York Stock Exchange by De Bondt and Thaler (1985). Using monthly return data, portfolios were formed of the fifty most extreme winners and fifty most extreme losers as measured by cumulative abnormal returns over thirty six months prior to portfolio formation. Their results, graphed in figure 1, show that over the last fifty years loser porfolios outperformed the market by an average of about twenty percent over the thirty six months after portfolio formation. On the other hand, winner portfolios earned approximately five percent less than the market over the same period. Their findings are also notable for three other features; firstly, abnormal returns in absolute terms were considerably higher for losers than winners; secondly, a major proportion of the abnormal return occurs in January, and thirdly; the abnormal returns continue for more than three years after portfolio for-

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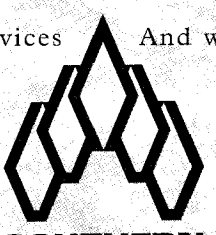

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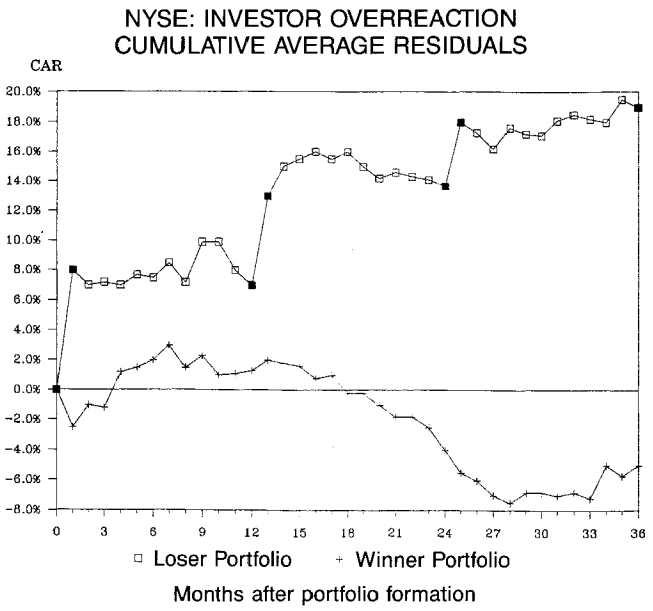
mation. In repeat studies both the portfolio formation period and the portfolio formation month were varied with no effect on the results.



SOURCE: THE JOURNAL OF FINANCE, VOL. XI, NO. 3, JULY 1985

Figure 1: De Bondt and Thaler results for the New York Stock Exchange Three year formation and test periods – 01/1933 to 12/1980

One of the most striking features in De Bondt and Thalers' results is that a large proportion of the abnormal returns are realised in January. Chan (1986: 1115) suggested that this January seasonal effect may be due to tax-loss selling. Investors wish to realise losses before the end of the tax year and this exerts a downward pressure on stock prices during December, followed by a rebound in January. Although his results confirm that the January seasonal is associated with decreases in stock prices, the association does not necessarily support the existence of year-end price pressure due to tax-loss selling. Schultz (1985) found no evidence of the January effect in returns before personal income tax was introduced in the USA. Reinganum (1983: 104) found that the January effect is still evident after "purging the data of potential tax loss selling effects."

Both De Bondt and Thaler, and Reinganum showed that changing the portfolio formation month does not remove the January effect which suggests that, for the United States data, the large abnormal returns are associated with the month of January itself and not related to the month following the portfolio formation. This is further confirmed by the absence of similar sharp "jumps" in figure 1 for the prior winners which supports the tax-loss selling hypothesis since there would be no motivation to sell shares that had made substantial gains. The fact that large increases continue to occur in successive January returns has so far not been satisfactorily explained.

Keim (1983), Basu (1983), Reinganum (1981) and others relate the January effect to firm size. There is a negative correlation of abnormal returns with firm size and almost fifty percent of the average risk adjusted premium of small firms over large firms occurs in January (Keim., 1983: 31). The implications of these studies is that the large increases in January are due mainly to large abnormal returns for small firms rather than over-reaction. Blume and Stambaugh however, found that the size effect had been over-estimated due to statistical biases. They state that the use of closing prices contains a bias due to the "bid-ask" effect and "non synchronous trading" (1983: 389-391).

Basu (1977, 1983) and Reinganum (1981) considered the interaction between earnings yield and firm size and their effects on anomalous returns. Firms with high earnings yields earn higher returns than those with low earnings yield. Reinganum found that "the firm size effect largely subsumes the E/P" (1981: 19). Basu states that the opposite is true and the Reinganum's findings were due to him not controlling for either systematic or total risk (1983: 131). Basu's "price ratio hypothesis" suggests that firms with very high earnings yields are thought to be temporarily undervalued because investors become excessively pessimistic after a series of poor earnings. Once future earnings turn out to be better than the gloomy forecasts the price adjusts. While the reasons for the existence of abnormal returns in these studies cannot be proved conclusively, the evidence is broadly consistent with the over-reaction hypothesis.

Attempts have also been made to explain the existence of persistent abnormal returns as a statistical anomaly. These attempts rely mainly on mis-estimation of risk. Roll (1983) found that infrequent trading imparts a downward bias to a stock's beta. Blume and Stambaugh (1983: 395) found biases in returns calculated using closing prices for both small and large firms. The "risk change hypothesis" suggests that a decline (increase) in stock prices leads to an increase (decline) in debt/equity ratios and risk as measured by CAPM betas. A stock's beta therefore varies with time and abnormal returns may be the result of these changes (Chan, 1986).

In his review of prior empirical work, Schwert (1983) concluded that adjusting for risk could not be completely explain the observed abnormal returns. Additionally he suggested that "the statistical association between risk and average return is often only marginally significant . . . and the association between firm size and average return is about as strong." (1983: 4).

In a second paper De Bondt and Thaler (1987) expanded on their previous research. Given Reinganum's contention that excess returns in the long term are indicative of model misspecification rather than market inefficiency, their focus in explaining their previous paper was on the long term results with a portfolio formation period of five years. They concluded that; (a) for winners, excess returns in January are negatively related to the excess returns for the prior December, possibly reflecting a capital gains tax "lock-in" effect; (b) the "risk change hypothesis" cannot adequately explain the abnormal returns; (c) the firm size effect contributes to but cannot explain the winner-loser effect; and, (d) that while other theories do contribute to their findings, they "are not mutually exclusive with over-reaction bias".

4. RESEARCH METHOD

The method followed in this study is similar to that used by De Bondt and Thaler (1985). Data for two hundred and four Johannesburg Stock Exchange trade shares were obtained from the U.C.T. Graduate School of Business database. The selection procedure involved firstly, extracting all companies for which share price information was available for the full fifteen year period July 1974 to July 1989, and secondly, selecting from these only those companies for which trading activity occured in at least thirty weeks per year. Appendix A lists all the companies used in the study. A survival bias is introduced into the procedure because the database used only contains share prices for companies still listed on the Johannesburg Stock Exchange at July 1989. For the purposes of this study however, the impact of the bias which results in the selection of larger well established companies is if anything against the over-reaction hypothesis since abnormal returns for these firms will be smaller. The selection of only the more frequently traded shares was made to ensure better abnormal returns

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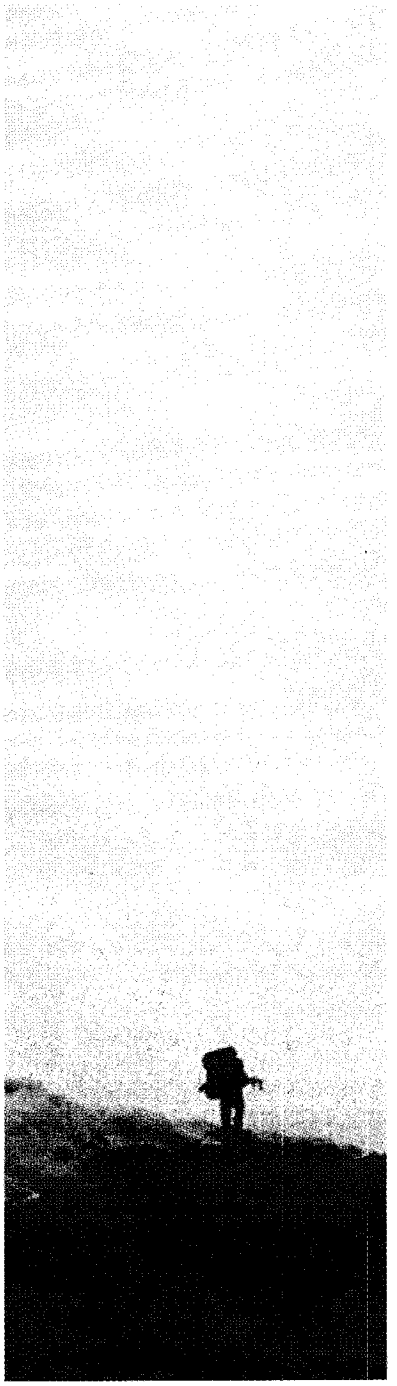

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measures could be obtained (Ross, 1983). Additionally, any conclusions as to market inefficiency can only be made if arbitrage opportunities based on traded prices are shown to exist.

The market index used in the study was constructed as an equally weighted arithmetic average rate of return of the selected shares. The use of equally weighted indices has been shown to be preferable to value weighted indices in the estimation of risk and abnormal returns (Banz, 1981: 6). Additionally, Brown and Warner suggest that a value weighted index "imparts a positive pressure on return" and therefore rejects the null too often (1980:239). There are three basic types of abnormal return used in market efficiency studies; mean adjusted returns, market adjusted returns, and market and risk adjusted returns. Brown and Warner conclude that "beyond a simple', one factor market model, there is no evidence that more complicated methodologies convey any benefit" (1980: 249). De Bondt and Thaler based their analysis on market adjusted returns, market model residuals and abnormal returns relative to the Sharpe-Lintner CAPM. They found that whichever type of residual was used, the results were similar and that the choice did not affect their main conclusions. Because of the comparatively short time period of fifteen years, this study is limited to the use of market adjusted returns. This is not considered a limitation since the method has the advantage of again possibly biasing the research against the over-reaction hypothesis (De Bondt and Thaler, 1985: 797). Finally, Brown and Warner recommend the use of monthly data to avoid statistical biases due to non synchronous and infrequent trading, the "bid-ask" effect and because daily and weekly returns depart more from normality.

4.1 Research Procedure

For each share in the database monthly abnormal returns were first calculated over the fifteen year period by deducting the corresponding market return. These abnormal returns formed the basic input for all the subsequent analysis. The fifteen year period was divided into a series of overlapping five and six year sub-periods with the starting dates of each sub-period being the 1st of July and January in each year. The choice of five and six year sub-periods was made to allow for two and three year portfolio formation periods together with a three year test period in each case. Similarly, the choice of two starting dates results in actual portfolio formation dates (based on the previous two or three years of data) of either 31st of December or 30th June. Table 1 presents the details of the sub-periods used in the analysis. Sub-period sets A, B, C and D contain overlapping formation periods with consequent implications for dependency amongst the test period portfolio abnormal returns. Sub-periods set E, F, G and H contain reduced numbers of sub-periods so that the formation periods do not overlap.

FORMATION DATES FOR SETS OF SUB-PERIODS USED IN THE ANALYSIS	
PANEL A	**Overlapping formation periods at single year intervals**
Five year sub-periods	Two year formation period up to formation date Three year test period post formation date
Set A formation dates	30/6/76; 30/6/77; 30/6/78; 30/6/79; 30/6/80; 30/6/81; 30/6/82; 30/6/83; 30/6/84; 30/6/85; 30/6/86
Set B formation dates	31/12/76; 31/12/77; 31/12/78; 31/12/79; 31/12/80; 31/12/81; 31/12/82; 31/12/83; 31/12/84; 31/12/85
Six year sub-periods	Three year formation period up to formation date Three year test period post formation date
Set C formation dates	30/6/77; 30/6/78; 30/6/79; 30/6/80; 30/6/81; 30/6/82; 30/6/83; 30/6/84; 30/6/85; 30/6/86
Set D formation dates	31/12/77; 31/12/78; 31/12/79; 31/12/80; 31/12/81; 31/12/82; 31/12/83; 31/12/84; 31/12/85
PANEL A	**Independent replications with non-overlapping formation periods**
Five year sub-periods	Two year formation period up to formation date Three year test period post formation date
Set E formation dates	30/6/76; 30/6/78; 30/6/80; 30/6/82; 30/6/84; 30/6/86
Set F formation dates	31/12/76; 31/12/78; 31/12/80; 31/12/82; 31/12/84
Six year sub-periods	Three year formation period up to formation date Three year test period post formation date
Set G formation dates	30/6/77; 30/6/80; 30/6/83; 30/6/86
Set H formation dates	31/12/77; 31/12/80; 31/12/83

Table 1: Formation dates for sets of sub-periods used in the analysis

For each of the sets of sub-periods, the following detailed procedure was adopted. The procedure is presented below for the two year formation period (five year long sub-period) condition. The three year formation period condition is identical except that the subscript "-23" in equation (1) must be replaced with "-35".

1. For each of the sub-periods in the set, the formation period cumulative abnormal return was computed for each of the two hundred and four shares as;

$$CR_j = \sum_{t=-23}^{0} u_{jt} \qquad (1)$$

where u_{jt} is the abnormal return for share j in month t. The subscript t refers to the month relative to the formation date where month t = 0 represents the month ending on the formation date, and month t = 1 is the first month of the test period.

2. The shares in the sub-period were then ranked by cumulative abnormal return. The fifty highest, consisting of those shares that had most outperformed the market over the formation period, were selected for inclusion in the winner portfolio and the fifty lowest, consisting of those shares that had most underperformed the market over the formation period, were selected for inclusion in the loser portfolio. For each of the one hundred selected shares the test period

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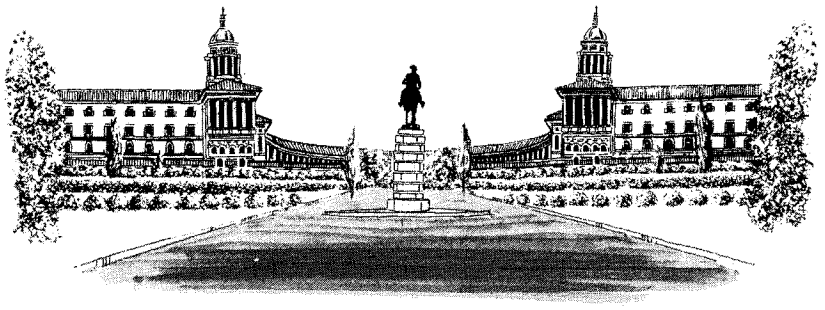

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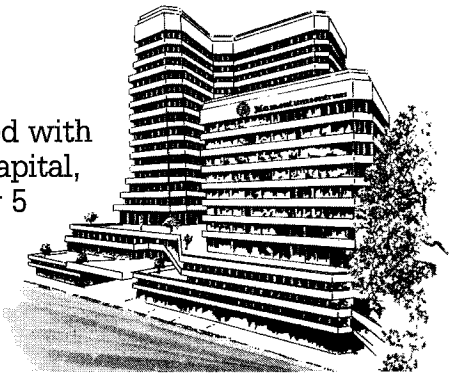

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cumulative abnormal returns (CR_{jT}) were calculated as well as the average cumulative abnormal returns (ACR_{XT}) for the winner and loser portfolio respectively. The formulae used were;

$$CR_{jT} = \sum_{t=1}^{T} u_{jt} \text{ ; where } T = \{1, 2, 3, \ldots, 36\} \quad (2)$$

$$ACR_{XT} = \frac{1}{50} \sum_{j=1}^{50} CR_{jT} \text{; where } X = \begin{cases} W \text{ for the winner portfolio} \\ L \text{ for the loser portfolio} \end{cases} \quad (2)$$

Using equations (2) and (3) seperate CR_{jT}s, ACR_{WT}s, and ACR_{LT}s were therefore calculated for every time period T, in order to give the cumulative abnormal returns up to each of the post formation dates extending out to three years.

3. For the full set of sub-periods the overall averages and variances of the winner and loser portfolios were calculated, for every post portfolio formation date, using the CR_{jT} and ACR_{XT}. For set A, consisting of eleven two year formation periods commencing in July of each year, the formulae used were;

$$AACR_{XT} = \sum_{N=1}^{11} ACR_{XT}^{N} \quad (4)$$

$$s_{XT}^2 = \sum_{N=1}^{11} \sum_{n=1}^{50} (CR_{nT}^{N} - AACR_{XT})/(50 \times 11 - 1) \quad (5)$$

4. Graphical evidence of the over-reaction hypothesis was tested for using the output of steps 1 to 3 above by plotting $AACR_{WT}$ and $AACR_{LT}$ for each set of sub-periods outlined in table 1, panel A.

   The graphs are presented with the number of months post formation date (T) plotted along the horizontal axis. In terms of the hypothesis, for T>0, the loser portfolios should exhibit a positive overall average cumulative abnormal return while the winner portfolios should exhibit a negative overall average cumulative abnormal return.

5. As a final step in the research procedure, statistical testing of the significance of the difference between the loser and winner portfolios was carried out using the Students-t distribution with a pooled variance estimate (Nie, Hull, Jenkins, Steinbrenner and Bent, 1975: 268). For each post formation date (T>0) the null hypothesis H_0 is that $AACR_{LT} - AACR_{WT} = 0$ and the alternative hypothesis H_1 is that $AACR_{LT} - AACR_{WT} > 0$. Rejection of the null hypothesis therefore implies evidence of stock market over-reaction. For each T between one and thirty-six months post portfolio formation the pooled variance and t-statistic were calculated as;

$$s_{pT}^2 = \frac{(n_1 - 1)s_{LT}^2 + (n_2 - 1)s_{WT}^2}{(n_1 - 1) + (n_2 - 1)} \text{; where } n_1 = n_2 = 50 \quad (6)$$

$$s_{diff,T}^2 = s_{pT}^2/n_1 + s_{pT}^2/n_2 \quad (7)$$

$$t_{diff,T} = (AACR_{LT} - AACR_{WR})/s_{diff,T} \text{ ; with degrees of freedom} = n_1 + n_2 - 2 \quad (8)$$

4.2 Limitations of the test procedure

As emphasised by Brown and Warner, sample size is always an important factor in statistical design because of its impact on the power of the test (1980: 243). Because of the limitations imposed on this study by virtue of both the thin trading on the Johannesburg Stock Exchange and the unavailability of long time series of share prices, the difference variance given in equation (7) had to be estimated directly from the individual share CR_{jT}s instead of by using the set of ACR_{LT}s and ACR_{WT}s directly. The latter approach was adopted by DeBondt and Thaler (1985, 1987) who had fifty years of data with which to work.

As outlined earlier, given the use of formation dates at twelve month intervals (table 1, panel A) there were one and two year overlaps for the two and three year formation periods respectively. This suggests non-independence of the successive sub-period CR_{jT}s and consequent biases in the test statistics. In order to mitigate against this, additional analysis was therefore done using shorter sequences of sub-periods where the portfolio formation periods did not overlap. As shown in table 1, panel B this involved choosing formation dates of the 30th of June and 31th of December in every second year for the two year formation periods, and in every third year for the three year formation periods.

Although the above size and possible dependency issues throw into question the appropriateness of attempting to use rigorous statistical analysis it was decided to use t-tests in conjunction with the graphical procedure because, as has been suggested by Brown and Warner, since returns follow a random walk, just examining curves of cumulative average return can easily result in type I errors. (1980: 229).

5. RESULTS

5.1 Graphical Analysis

The graphs of average performance for the sub-period sets A, B, C and D presented in table 1, panel A are given in figures 2 (a) and (b), and 3 (a) and (b). Figures 2 (a) and (b) show the test period plots of the average cumulative abnormal returns for the portfolios formed on the basis of two year formation periods and relate to sub-period sets A and B respectively. Figures 3 (a) and (b) show the test period plots of the average cumulative abnormal returns for the portfolios formed on the basis of three year formation periods and relate to sub-period sets C and D respectively.

JSE: INVESTOR OVERREACTION
CUMULATIVE AVERAGE RESIDUALS
(FORMATION DATE: JUNE, FORMATION PERIOD: 24 MONTHS)

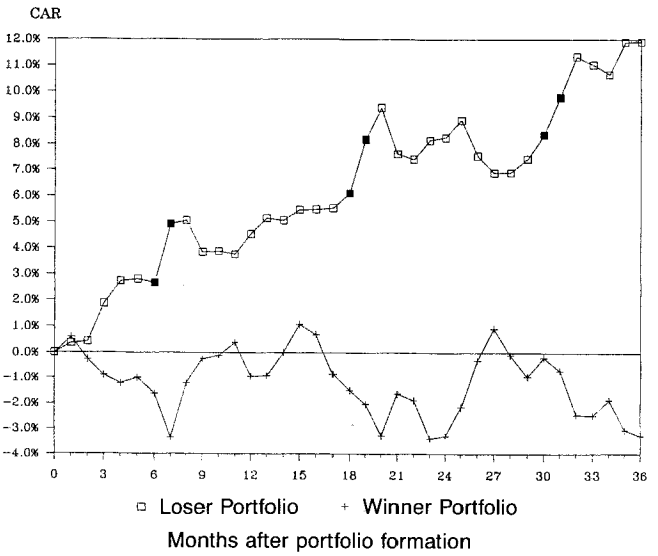

Figure 2a: Johannesburg Stock Exchange results for eleven two year formation periods between 07/1974 to 06/1986 with June formation dates.

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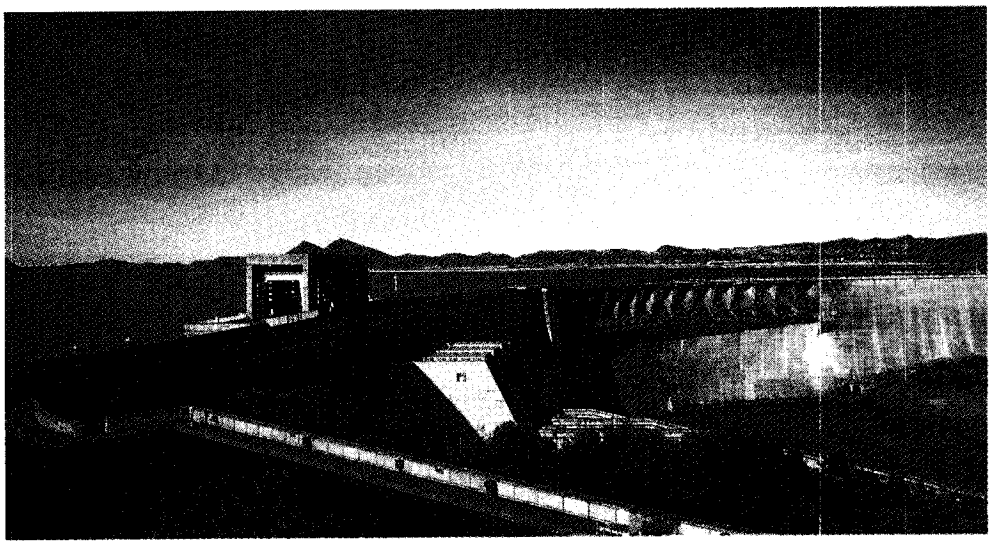

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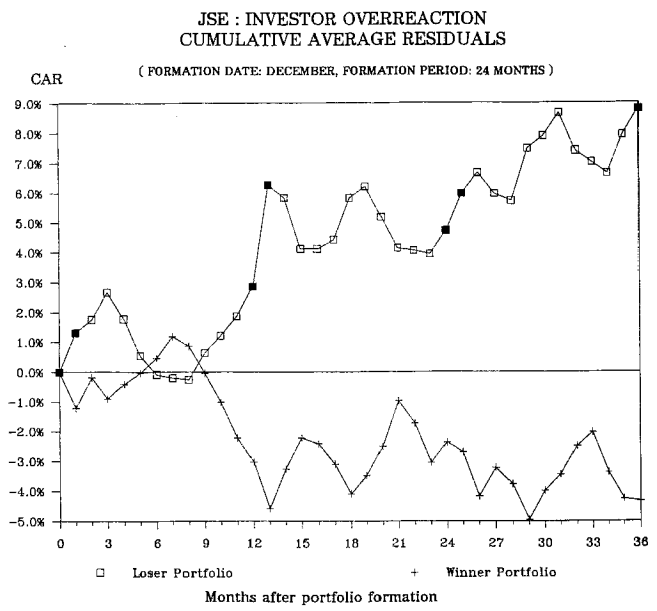

Figure 2b: Johannesburg Stock Exchange results for ten two year formation periods between 01/1975 to 12/1985 with December formation dates.

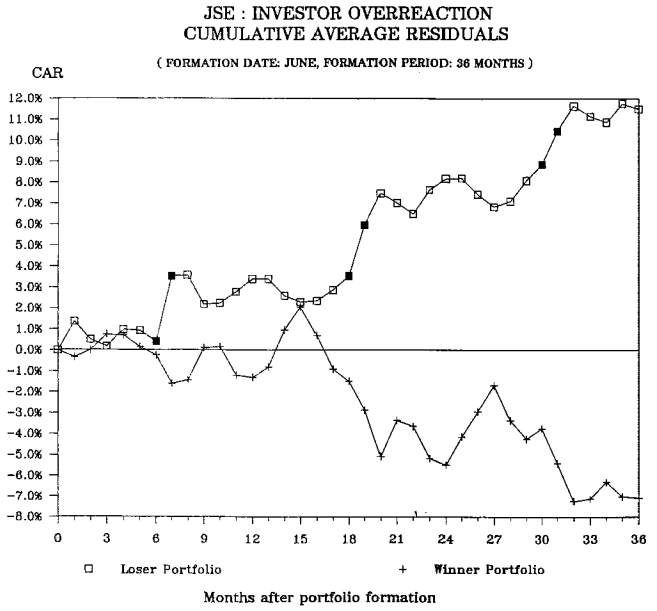

Figure 3a: Johannesburg Stock Exchange results for ten three year formation periods between 07/1974 to 06/1986 with June formation dates.

An overall examination of the figures highlights three pervasive features. Firstly, there is a substantial divergence between prior loser and winner portfolios over the thirty-six month post formation period in all of the graphs with the prior losers attaining an average overperformance of between 9% and 12% and the prior winners attaining an average underperformance of between 3% and 7%. Secondly, for the first six to twelve months, in all but figure 2 (a), the over-reaction is not that apparent and the major differences accumulate in the second and third year after the formation date. Finally, the efficient market hypothesis would predict that, for both loser and winner portfolios formed on the basis of historical returns data, the average cumulative abnormal returns will not be significantly different from zero. Based on the graphical evidence presented in the tables this is clearly not the case.

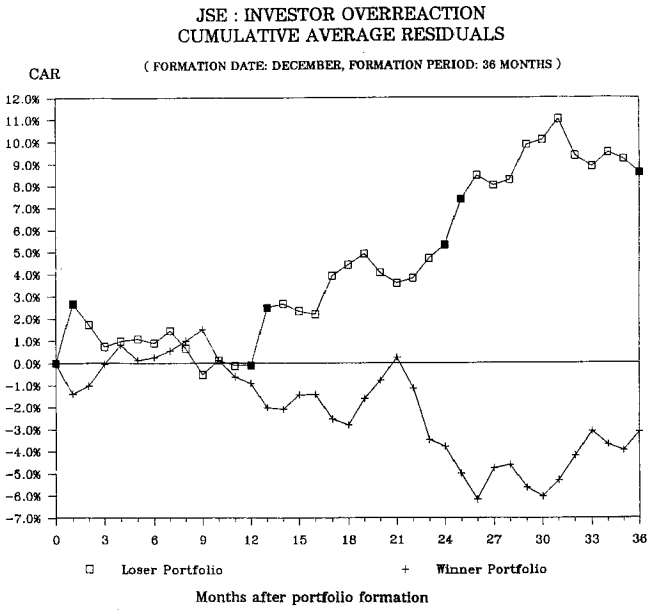

Figure 3b: Johannesburg Stock Exchange results for nine three year formation periods between 01/1975 to 12/1985 with December formation dates.

The volatility of the curves relative to the loser and winner portfolio curves of De Bondt and Thailer presented in figure 1 is directly the result of the reduced number of sub-periods used in the analysis and possibly because of the dependences introduced through the use of overlapping formation periods.

5.2 Statistical Analysis

Table 2 presents the results of the statistical analysis undertaken. The rigorous analysis using independent replications with non-overlapping formation periods is presented in panel B, while panel A gives the results when all the sub-periods in each set are used. The critical values for the appropriate degrees of freedom are given at the bottom of the table.

From panel A it can be seen that, aside from one month post formation where the 30th June formation date results are not significant, almost all of the differences between the overall average cumulative abnormal returns for the loser and winner portfolios are significant at the 5% level, with most also being significant at the 1% level. Only for the December formation date two year formation period six and twenty-four month post formation differences, and the June formation date two year formation period thirty month post formation difference, are the results not significant at the 5% level.

The results given in panel A are in most cases consistent with panel B and therefore provide additional verification when advantage is taken of the somewhat larger sample sizes (increased replications) and possible dependency is ignored.

6. DISCUSSION

The results presented in the previous section are clear evidence of investor over-reaction on the Johannesburg Stock Exchange over the last sixteen years. On average over the thirty six months after portfolio formation the loser portfolios achieved average returns of about 10% above the market and the winner portfolios average returns of about 4,5% below the market. The loser portfolios therefore outperformed the winner portfolios by a total of almost 15% which is significant at the 1% level. Two differences are immediately apparent between the evidence on the Johannesburg Stock Exchange and the New York Stock Exchange. The previous fifty years of American data indicates an average difference in performance

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between the loser and winner portfolios of about 26% over the thirty-six months post formation date, which is substantially larger than the evidence of this study. Additionally, the extent of the asymmetry in the pattern of average cumulative abnormal returns is greater for the New York Stock Exchange.

DIFFERENCES IN CUMULATIVE AVERAGE RESIDUALS BETWEEN WINNER AND LOSER PORTFOLIOS FOR TEST PERIODS OF UP TO 36 MONTHS POST PORTFOLIO FORMATION DATE

PANEL A	**Overlapping formation periods at single year intervals**							
Length of formation period and number of replications	Formation month	Difference in CAR (t-statistics) Months after portfolio formation 1	6	12	18	24	30	36
11 two year periods [a]	June	-0.0022	0.0428	0.0550	0.0762	0.1154	0.0855	0.1519
		(-0.2909)	(2.3424)	(2.2398)	(2.4559)	(3.2678)	(2.2283)	(3.6433)
10 two year periods [b]	December	0.0252	-0.0054	0.0589	0.0991	0.0710	0.1188	0.1312
		(2.9514)	(-0.3339)	(2.3988)	(3.3021)	(2.1003)	(3.0602)	(3.0608)
10 three years periods [c]	June	0.0170	0.0065	0.0470	0.0503	0.1366	0.1261	0.1859
		(2.2764)	(0.3368)	(1.8762)	(1.6262)	(3.7623)	(3.1318)	(4.2137)
9 three year periods [d]	December	0.0404	0.0065	0.0078	0.0722	0.0910	0.1612	0.1174
		(4.3438)	(0.3788)	(0.3036)	(2.2323)	(2.3870)	(3.7469)	(2.4598)
PANEL B	**Independent replications with non-overlapping formation periods**							
Length of formation period and number of replications	Formation month	Difference in CAR (t-statistics) Months after portfolio formation 1	6	12	18	24	30	36
6 two year periods [e]	June	-0.0132	0.0854	0.1087	0.1630	0.1687	0.0541	0.1322
		(-1.1083)	(3.3674)	(3.1736)	(3.7884)	(3.4429)	(1.0438)	(2.3968)
5 two year periods [f]	December	0.0358	0.0013	0.0924	0.1016	0.0423	0.1197	0.2204
		(3.1259)	(0.0546)	(2.5498)	(2.3437)	(0.9117)	(2.2415)	(3.5722)
4 three year periods [g]	June	-0.0013	0.0585	0.1706	0.1620	0.2273	0.1862	0.2366
		(-0.1193)	(2.0798)	(4.8233)	(3.9358)	(4.5123)	(3.2053)	(3.4300)
3 three year periods [h]	December	0.0817	0.0809	0.0783	0.1656	0.2138	0.2822	0.2778
		(5.4332)	(3.1097)	(2.1779)	(3.4659)	(3.6496)	(3.9545)	(3.5621)

a Formation months – June 1976 to 1986; t-statistic d.o.f. = 548; critical values – 1.6480 (2.3336) at 5% (1%) level
b Formation months – December 1976 to 1985; t-statistic d.o.f. = 498; critical values – 1.6483 (2.3343) at 5% (1%) level
c Formation months – June 1977 to 1986; t-statistic d.o.f. = 498; critical values – 1.6483 (2.3343) at 5% (1%) level
d Formation months – December 1977 to 1985; t-statistic d.o.f. = 448; critical values – 1.6486 (2.3351) at 5% (1%) level
e Formation months – June 1976, 78, 80, 82, 84, 86; t-statistic d.o.f. = 298; critical values – 1.6503 (2.3394) at 5% (1%) level
f Formation months – December 1976, 78, 80, 82, 84; t-statistic d.o.f. = 248; critical values – 1.6514 (2.3419) at 5% (1%) level
g Formation months – June 1977, 80, 83, 86; t-statistic d.o.f. = 198; critical values – 1.6530 (2.3458) at 5% (1%) level
h Formation months – December 1977, 80, 83; t-statistic d.o.f. = 148; critical values – 1.6556 (2.3523) at 5% (1%) level

Table 2: Differences in overall average cumulative abnormal returns between winner and loser portfolios for varying test periods

From table 2, panels A and B, it can be seen that the difference in overall average cumulative abnormal returns between loser and winner portfolios tends to occur after six to twelve months into the test period. This is consistent with the graphical results presented earlier. In panel A the overall average cumulative abnormal returns up to six months after portfolio formation are not significantly different from zero in three of the four sets of sub-periods analysed. This again has parallels with the evidence for the New York Stock Exchange if the large January seasonal is ignored since the declining trend for the prior winner portfolios only occurs after thirteen months.

For all the figures presented in this report the pairs of consecutive solid squares plotted on the prior loser portfolio curves span the months of January. While it is apparent that the January effect evident for the New York Stock Exchange is also evident for the Johannesburg Stock Exchange, it must be noted that the pattern is not quite as pronounced for the J.S.E. and that a significant degree of dependence is present across the graphs of this study. The one clear indication of a January effect however, comes from panel B in table 2. For the first month, post portfolio formation, the June formation date overall average cumulative abnormal returns, for both two and three year formation periods, are not significantly different from zero while for the December formation dates the one month overall average cumulative abnormal returns are significant. This findings brings into question the hypothesis that the January effect in the United States is the result of investor tax loss selling. In South Africa firms are free to choose the month in which to end their financial and tax year. Although losses are tax deductable and tax loss selling may occur in South Afirca, it will not be concentrated only in the month of December. For all individual investors the tax year ends in February and additionally the majority of shares in South Africa are held by institutions.

An examination of the curves for each of the winner and loser portfolios by sub-period, while not reported or graphed in this paper, revealed that trends across the thirty-six months were not totally consistent and that, although evidence of over-reaction was present in most sub-periods, the magnitude and trend of the data was dominated by a subset of those analysed. The similarity between panels A and B of table 2 does however support a certain degree of consistency. Panel B omits half of the sub-periods analysed in panel A and still indicates overwhelming evidence of stock market over-reaction. The difference between each sub-period suggests that the period required for an over-reaction to correct itself varies in the long term, possibly as a result of economic cycles or fluctuations in investor sentiment which are characteristic of the Johannesburg Stock Exchange. De Bondt and Thaler do not

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Merchant Bank B	3	4	3
Merchant Bank C	4	3	3
Merchant Bank D	5	5	5
Merchant Bank E	6	6	6
Ranked by return on assets	**91**	**90**	**89**
FirstCorp	1	1	1
Merchant Bank A	2	5	2
Merchant Bank B	3	2	2
Merchant Bank C	4	3	5
Merchant Bank D	5	6	6
Merchant Bank E	6	4	4

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discuss the relative contribution of individual sub-periods in their papers and without knowing the details of their study, the relevance of attempting to draw comparisons in this area must be questioned.

As mentioned in section 4, the use of market adjusted returns is likely to bias the results against the over-reaction hypothesis. In this study the full market model approach using beta estimates could not be adopted since approximately five years of data prior to the portfolio formation period would have been necessary to estimate the beta for each stock. Given the limited time series of data available, this procedure would have made it impossible to have a sufficient number of replications for test purposes. This limitation is mitigated by the fact that, as is the case with the market model and Sharpe-Lintner approaches, the use of a market adjusted returns approach follows from the Capital Asset Pricing Model. Given the fairly large number of shares, namely fifty, making up the winner and loser portfolios for each sub-period the implicit assumption of unit beta on the portfolios is not unreasonable. Mis-specification problems may however still confound the results (Basu, 1983).

7. CONCLUSIONS

The empirical results of this study are consistent with the over-reaction hypothesis. Over the period from July 1974 to June 1989 portfolios of prior losers, on average, significantly outperformed porfolios of prior winners over a thirty-six month period by between 10% and 20% for both two year and three year formation periods. All the results were significant at the 1% level for the thirty-six month test period.

While the "January effect" that characterised the De Bondt and Thaler study is still evident in the return data for the Johannesburg Stock Exchange it is less pronounced. This can possibly be explained by the absence of a single specific statutory financial year end in South Africa (Huxham & Haupt., 1990. 215), and consequently contradicts the hypothesis that this phenomenon is purely the result of investor reaction to the American tax code. While some evidence of asymmetry in performance of prior winners and losers is evident it is significantly less pronounced than that found for the New York Stock Exchange. On average prior winners underperformed the market by about half the magnitude of the overperformance by prior losers, in contrast to the one-to-four ratio found by De Bondt and Thaler. This may also be a reflection of the differences in tax legislation, particularly the absence of a capital gains tax in South Africa.

Consistent with the U.S.A. evidence, abnormal returns predicted by the over-reaction hypothesis are mainly realised in the second and third years of the test period. Examination of abnormal return behaviour within the individual test periods, although not reported, suggests that the period required for correction after over-reaction may vary in the long term.

Finally, the results clearly provide evidence of long run weak-form inefficiency in the South African stock market over the period investigated. The information contained in historical share prices is significant and investors could therefore have achieved abnormal returns by studying past price movements only and then constructing and holding arbitrage portfolios for between two and three years. As this finding is inconsistent with evidence provided by other researchers (Knight and Affleck-Graves, 1985) further study might appear to be needed. Bernstein does however suggest that most "arguments about market efficiency are badly specified" (1985: 807). The market is probably highly efficient in the short-term but fails to efficiently incorporate information in the long-term because of increased complexity of the impact of that information in the longer term. Bernstein concludes by stating;

". . . the market will naturally provide arbitrage opportunities from long-run inefficiencies, but only a few investors have the neccessary psychological attitudes and will accept the necessary investment horizons to perform as true long-term invertors. On the other hand, if most investors ever developed those attitudes and revised their investment horizons, the long run inefficiencies would dissappear. Until then, let us give the Efficient Market Hypothesis its due as an explanation of how markets work in the short run, even if we can probably reject the hypothesis for the long run." (1985: 807)

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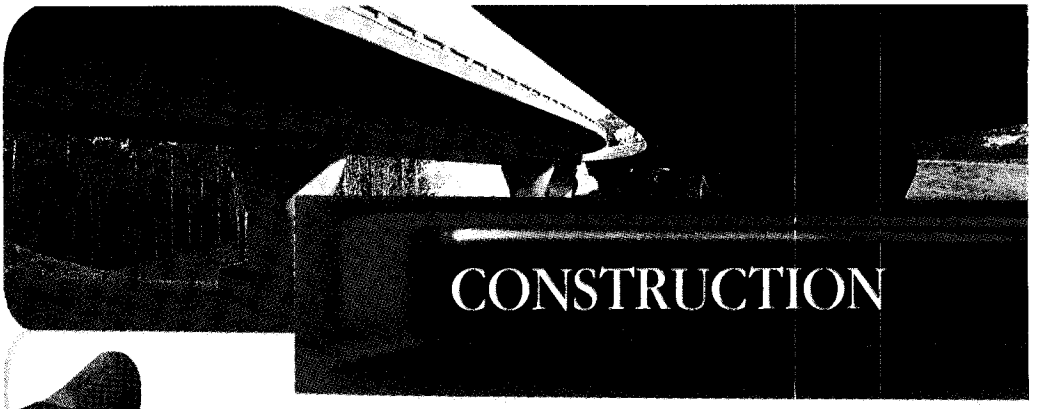
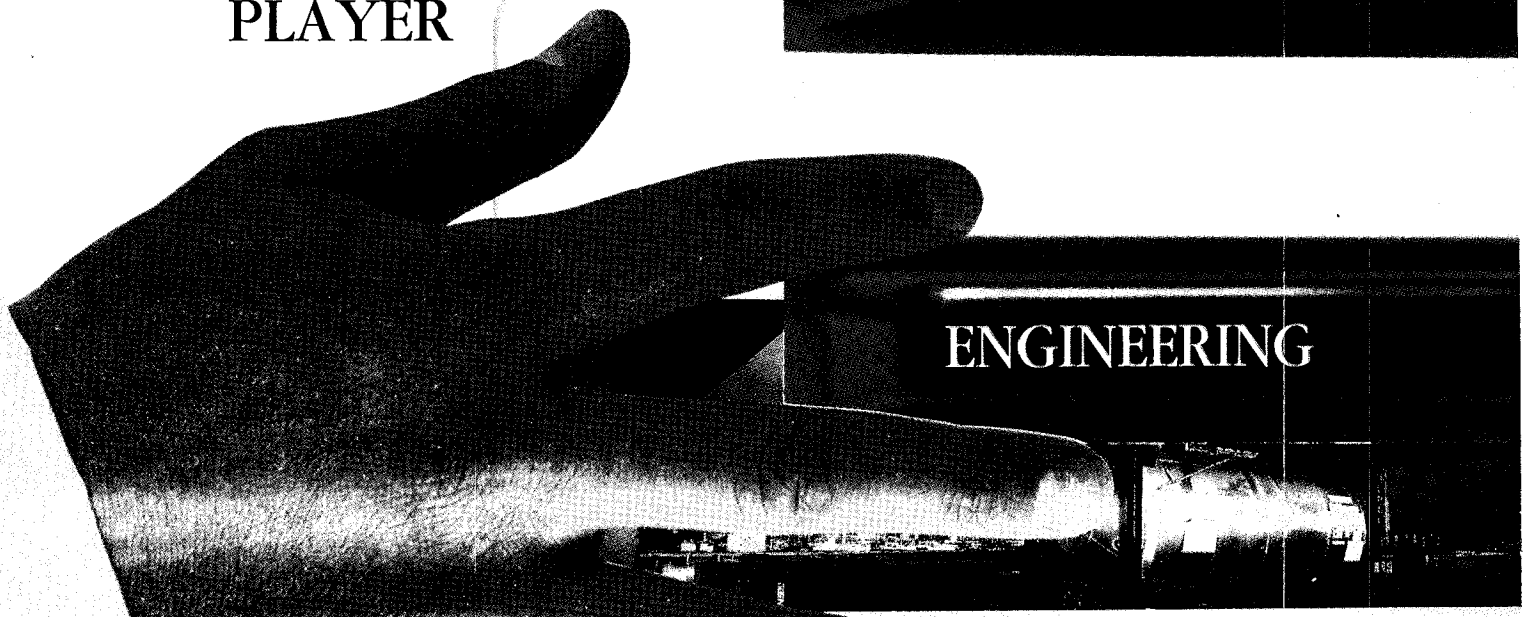
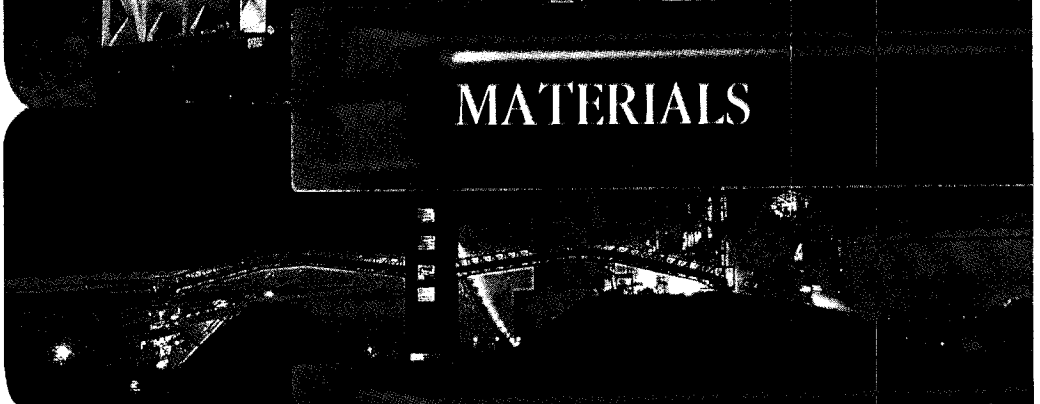
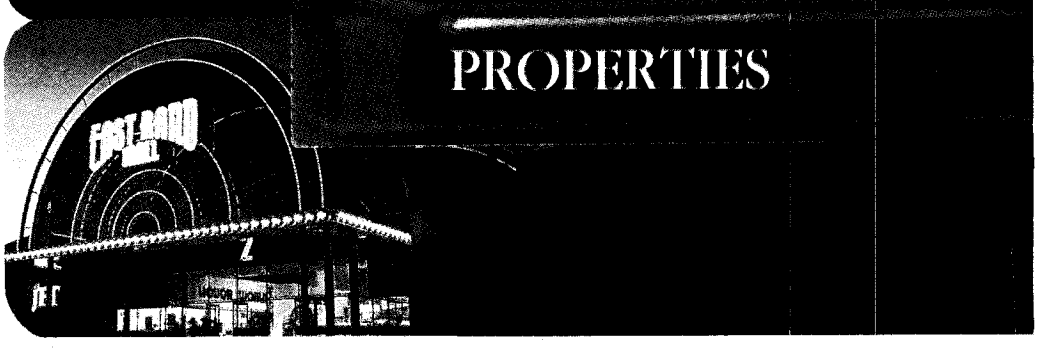
INDUSTRIAL HARMONY FROM A MAJOR PLAYER









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AECI	EAST DAGGAFONTEIN MINES	MASONITE (AFRICA)	SANLAND PROPERTY TRUST
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ALLIED TECHNOLOGIES	EDWARD L BATEMAN	MIDDLE WITS WERSTERN AREA	SIMMER & JACK MINES
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BOTSWANA RST	HIVELD STEEL & VANADIUM	PREMIER GROUP HOLDINGS	VADERLAND BELEGGINGS
BOUMAT	HORTORS	PRETORIA PORTLAND CEMENT	VEKA
BRACKEN MINES	HOSKEN CONSOL INVESTMENT	PROGRESS INDUSTRIES	VENTERSPOST GOLD MINING CO
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BTR DUNLOP	IMPALA PLATINUM HOLDINGS	RAND LONDON CORPORATION	VIERFONTEIN COLLIERY
BUFFELSFONTEIN GOLD MINING CO	IMPERIAL COLD STORAGE	RAND MINES	VILLAGE MAIN REEF GOLD MINING
C G SMITH	INCORPORATED GENERAL INS	RAND MINES PROPERTIES	VLAKFONTEIN GOLD MINING CO
CADBURY SCHWEPPES (SA)	INDUSTRIAL SELECTIONS	RANDFONTEIN ESTATES GOLD MINE	VOGELSTRUISBULT METAL HLDGS
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CHARTER CONSOLIDATED PLC	KANHYM INVESTMENTS	RENTMEESTER BELEGGINGS BPK	W&A INVESTMENT CORPORATION
CHEMICAL SERVICES	KINROSS MINES	RETCO	WELKOM GOLD HOLDINGS
CLAUDE NEON	KLOOF GOLD MINING COMPANY	REUNERT	WEST RAND CONSOLIDATED MINES
CNA GALLO	KOHLER	ROMATEX	WESTER AREAS GOLD MINING CO
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CORONATION SYNDICATE	LIBERTY LIFE ASSOCIATION	S A EAGLE INSURANCE	WITWATERSRAND DEEP
CULLINAN HOLDINGS	LION MATCH COMPANY	S M GOLDSTEIN	WITWATERSRAND NIGEL
DARLING AND HODGSON	LONDON FIN & INV GROUP PLC	S W A FISHING INDUSTRIES	WOOLTRU
DELTA ELECTRICAL INDUSTRIES	LONRHO PLC	S A LAND & EXPLORATION	WOOLTRU -A-
DOORNFONTEIN GOLD MINING CO	LORAINE GOLD MINES	SABLE HOLDINGS	ZAMBIA COPPER INVESTMENTS
DORBYL	LTA	SAFICON INVESTMENTS	ZANDPAN GOLD MINING

Appendix A: List of Companies used in the study

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Without paper, nothing will be printed. That's why we're planting trees for the future.

For growing trees is creating the background for tomorrow's news.

sappi

Growing trees for generations

D J Joubert & A F F Mason

Trading systems

ABSTRACT

All technical indicators suffer from limitations which makes it impractical to use the buy and sell signals they generate blindly for trading. On the other hand, a knowledge of limitations could enable the analyst to distinguish when the signals produced by some indicator are more likely to be correct.

Further, not all indicators suffer from the same limitations. While one indicator is generating incorrect or ambiguous signals, another indicator may well be more reliable, just because it is not subject to the problems and limitations of the first.

This means that the judicious use of different indicators in combination, should result in improved trading performance.

The procedures which govern the selection and interpretation of indicators, and also the way signals are translated into buy or sell orders, constitute a trading system. A trading system has the advantage of improving discipline, the most important single ingredient of successful trading.

Complex trading systems extend well beyond mere technical analysis, and could well include economic analysis and portfolio theory.

Every technical indicator has its own enthusiastic supporter group in the technical community. Usually, supporters will sustain their enthusiasm despite intermittent poor performance of an indicator, even though it may cost them money. This faith in the success of the concerned over the longer term may be misplaced. No objective evaluation has as yet shown that any indicator has the consistently high rate of success over the long term to justify anyone following its buy and sell signals blindly.

One indicator may do well for a period of time, generating signals that prove to be profitable. Later, the quality of the signals from that indicator may deteriorate, and become unprofitable. Investigation usually reveals that during periods when an indicator generates good signals the market conforms to a consistent pattern of behaviour.

The consistent behaviour is usually a sustained general trend, or a cyclical pattern with relatively constant cycle period, and sufficient amplitude to ensure good profitability.

Later, when the nature of the market's behaviour changes, indicators suddenly fail to repeat their earlier performance. An indicator may even become counterproductive, generating poor signals so that trading losses are incurred while the new pattern of behaviour lasts.

For example, moving averages in respect of suitable periods may generate successful signals when the market is oscillating with a cycle period that is at least twice as long as the period of the average. However, the amplitude of the oscillations must be large enough to meaningfully exploit the indicator.

Major trend reversals at the extremes of oscillation should also be relatively smooth, not jagged, or the incidence of false buy and sell signals would increase to uncomfortable levels.

In good trending markets, moving averages would do well to keep the trader full invested during a bull market, and completely out of a sustained bear market.

Momentum indicators, such as stochastics or RSI, too, may generate good signals during an oscillating market, where reversals occur as relatively smooth changes in trend. However, in trending markets, a momentum oscillator may be sensitive to the gradient of the indicated trend. Even a slight flattening of the gradient during a sustained bull or bear trend, for example, may cause momentum indicators to generate a premature sell or buy signal, respectively.

A false sell signal during a bull market may cost a trader the opportunity of making a larger profit. On the other hand, false buy signals during a sustained bear market can also be costly.

Some indicators are good at detecting trend reversals, while others are more suitable for identifying a ruling trend. Volume, interpreted in conjunction with other indicators, may improve the reliability of the signals. These different factors can be put to use by the trader. The combination of two or more indicators into a trading system, enable a trader or investor to capitalise on the strong points of each indicator and to compensate for any deficiencies.

Two considerations are essential when designing the trading systems.

One should only include indicators when one has confidence in their principles of operation, and in one's ability to use and interpret the signals they generate. Secondly, the signals must never be arbitrary; their generation and interpretation must be carefully defined as part of the specifications of the trading system.

Should a trader lack confidence in an indicator, its inclusion in a trading system could cause complications, and make interpretation more difficult without really improving the signals produced by the trading system. Despite careful specification for the interpretation of an indicator, quality may suffer. Traders should discount signals generated by particular indicator, in favour of signals from other indicators in the trading system.

The demand for specific user procedures may be justified on the following grounds. Firstly, when rigorous rules are applied, discipline may be improved, reducing the influence of subjective opinion, tips and market rumours.

Secondly, strict obedience to the system's procedures wil provide a consistent base for the measurement and evaluation of its performance. Consistency, and the recording of pertinent data will make it possible to identify the reasons for unprofitable decisions, and thereby to effect improvements to the trading system.

Strict reliance on procedures do not mean that trading system should be static. As the sources of poor decisions are identified, and rectified, and as the trader learns more about the indicators concerned, the system should change to reflect new knowledge.

A trading system need not be designed purely around technical indicators, and neither does, not should it only answer the question of which share to buy or sell.

For example a sophisticated trader may well require a comprehensive trading system to answer such questions as

* Which market(s) should be considered?
* What fraction of available capital should be invested/traded in each market?
* What should be the time horizon and profit target of the average – perhaps even individual – transaction in each market?

Only after answers to these questions have been obtained, can a trading system provide the detail of which share, futures index or gilt to buy or sell.

Because of rules which make bear sales on the JSE difficult, many people view an equity bull market as the only practical opportunity to trade or invest in shares. An overbought market, such as that experienced since 1991, leaves traders with no option but to hold cash, or to exploit other markets such as the capital and money markets, or even the markets for indices and futures.

Trading systems can range from unsophisticated systems, used by private investors to speculate in shares, to highly complex systems which could include elements of economic analysis and portfolio theory.

A study of the performance of private and professional investors or traders reveals that the single most important cause of a poor decision is the lack of discipline. From reliance on hunches, to short cuts in decision making which disregard some important factors, or the failure to validate a piece of information – these, and many other mistakes, including the influence of greed that drives one to seek larger than reasonable returns irrespective of risk, could be easily rectified if decisions were made with the required control.

Of course, every individual would require a trading system tailored to his or her needs. Each person presents a unique combination of profit expectations, risk profile, available capital, knowledge, fundamental and technical skills that should all be accommodated in a trading system. No two people have similar abilities, and exactly the same requirements. Therefore no two people should even try to use the same trading system.

Ideally, a trading system will evolve over time. At the time of first entry into a market, the novice trader should establish some basic ground rules to guide decisions – including the use that must be made of technical analysis. Over time, as experience grows, the system too should grow in sophistication and complexity to suit the requirements and abilities of the particular individual.

However, in practice, there are probably few examples of such evolution that has occurred right from the start. A number of patently wrong decisions, and the pain of paying for the losses that result from these, seem to be required before individuals can accept the need for a disciplined approach to trading and investment.

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