The Investment Analysts Journal

Number 43 – Winter 1996

Die Beleggings-ontleders Tydskrif

Nommer 43 – Winter 1996

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Long term study of trends on price charts using specially developed software, has shown that prices do not change direction at random; instead, prices display a distinct preference to change trend or direction at points on the price chart which correspond with a distinct preference for certain gradients. By itself, a preference for certain gradients does not prescribe future behaviour tightly enough to be of great value to the technical analyst. However, the presence of other, more complex structures on price charts reveals an underlying symmetry in the behaviour of the price that can be used to anticipate future price behaviour. This paper summarizes the more pertinent results of this phenomenon. Some examples are given to illustrate how in knowledge of the ground rule and of the higher order symmetries can be used for trading decisions. The findings presented here do not agree with elements of the Random Walk Hypothesis, but support the concept of emergent order implicit in complex adaptive systems.

Die Modellering van Heteroskedastisiteit in Daaglikse Rand/Dollar Wisselkoersbewegings: 1987-1992

'n Nuwe groep van modelle, bekend as Outoregressiewe Voorwaardelike Heteroskedastisiteitsmodelle (OVH), is sedert 1982 ontwikkel. Dié modelle maak dit nou moontlik dat voorwaardelike variansies van tydreekse gemodelleer kan word. Dit is bekend dat die verdelings van wisselkoersdata swaarder eindoppervlaktes as wat onder die normaalverdeling verwag word, het. Die OVH-modelle is geskik en spesifiek ontwikkel om voorsiening vir leptokurtose te maak. In die artikel word van die verdelingseienskappe van die Suid-Afrikaanse Rand/Dollar wisselkoerse met behulp van die OVH-model ondersoek. 'n Buite-steekproef doeltreffendheidsontleding word ook gedoen.

Modelling Systematic Risk and return using accounting-based information

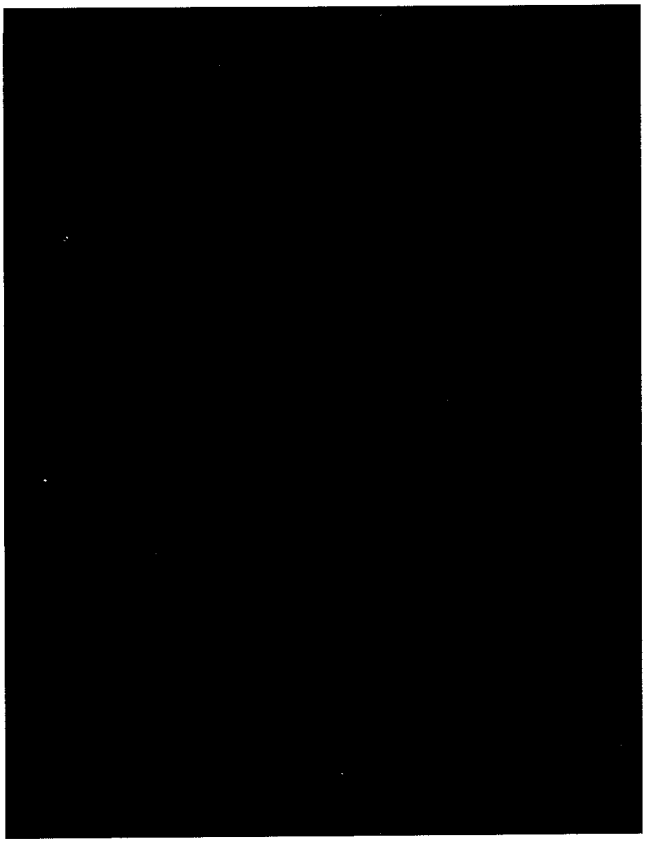
The study explored the linkages between the financial parameters of a firm derived from reported accounting data, and systematic risk as described by estimated market beta coefficients. The relationships between financial variables and risk proposed by previous theoretical and empirical research were tested for 135 JSE-listed Industrial companies, in each of three consecutive 5-year periods. Correlation analysis and stepwise multiple regression were used to establish significant explanatory beta models. Strong positive associations with risk were found for measures of firm growth, profitability, leverage and the variabilities of earnings and cashflows. Significant negative relationships emerged for liquidity, stock turnover and dividend yield. Secondly, the linkages between the same financial parameters and observed equity returns were tested in a multifactor asset-pricing model for the same sample. Measures of firm growth, profitability and size were positively correlated to share returns, while the variabilities of earnings and cashflows as well as debtors' collection period were negatively related. For both betas and equity returns, correlations with financial parameters improved for portfolios of shares. Several of the significant financial variables were derived from cashflow-based data, as opposed to standard accrual-accounting values. While significant regression models emerged for risk and return in each of the 5-year analysis periods, they were non-stationary across the periods. Consequently, fairly poor predictive performance was observed for the models over consecutive time intervals. Nevertheless, it was apparent that certain classes of fundamental financial data were strongly related to beta as a measure of systematic risk, and to *ex post* share returns.

The supply and demand effect of block transactions on share prices

The effect of supply and demand on the pricing of shares was investigated by analysing block transactions on the JSE. A sample of 291 block transactions was selected from the period 1 June 1993 to 1 June 1994 from the Financial and Industrial sectors and analysed using an event time methodology. The study compares the reaction of share prices of large block transactions with the expected price, as predicted using the market model. The analysis period covered twenty days before and twenty days after the block transaction. The data was subdivided into buyer induced trades and seller induced trades, the distinction being made on the sign of the market model residual (positive – buyer induced trade, negative – seller induced trade). The results show that there is a statistically significant increase/decrease in the share price for buyer/seller induced trades. A relationship between the size of the block trade and the absolute value of the price change was also found. Price reversals immediately after both buyer and seller induced trades were noted. Support was found for the price pressure hypothesis and the information hypothesis; no support for the substitution hypothesis was found. The results also support the weak and semi-strong forms of the Efficient Markets Hypothesis. Evidence was found to indicate that share prices are affected by supply and demand.

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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The Investment Analysts Journal

Forty-third issue – Winter 1996

Die Beleggings-ontleders Tydskrif

Drie-en-veertigste uitgawe – Winter 1996

The purpose of the editorials of this Journal is to provide readers with critical and evaluative comment on current issues of relevance to the field of investment and portfolio management. In this respect there can be no more important matter than the release this month (June) of the government's macroeconomic strategy document entitled *Growth, Employment and Redistribution*. To avoid misunderstanding, because of any critical comment that follows, it is necessary to say at the outset, and without ambiguity, that this is a reasonable document and one which deserves the support of those who accept that the restructuring of the South African economy is necessary for a variety of reasons, economic and political, domestic and external. It is a measure of the maturity of the ANC that it has been able to reformulate its position on macroeconomic strategy so completely and still remain loyal to the essential purposes of poverty alleviation, inequality reduction and development that brought it to power two years ago. To be sure, it has succeeded in marrying these concerns with the requirements of structural adjustment better than either business or labour in their two documents released earlier in the year. The business document, *Growth for All*, commissioned by the South Africa Foundation, contained much that was valuable but was too understating of the seriousness of the political problems posed by mass unemployment and extreme inequality for policy formulation in the real world. It was also abrasive in its 'If you want to get it right you had better listen to me!' approach. Little surprise, therefore, that the labour document went to the other extreme as if deliberately to counterbalance such business posturing. All that cost the country dear in the loss of the rand's exchange value and took the economic debate briefly back to the worst confrontational moments of 1989 when a still banned ANC was saying that redistribution and growth were mutually exclusive strategic alternatives and politics dictated a preference for the former compared with the latter. We thought we had got to the point where all parties accepted that growth and redistribution were inseparable and that the path to either one could not exclude the path to the other. The virtue of the government's strategy document is that once again growth and redistribution are brought together, and in an authoritative way, being linked by the requirement of sustainability. Without this neither can have credibility. It is useful to recall more specifically the reasons why the South African economy has to be restructured. It is not just an economy in need of reform after the apartheid era. There are three overriding considerations, viz

(i) Both its real GDP and employment growth must be raised to a level in excess of the growth rate of population. Currently, less than 15 per cent of new entrants to the labour market (about 375 000 per annum) are being absorbed by the formal sector. Without a recovery in growth, and this cannot happen without a restructuring of domestic expenditure away from consumption and towards saving and investment, unemployment and the social breakdown (including crime) that goes with it will increase to unmanageable proportions.

(ii) The mining sector of the country's economy is based on a wasting mineral endowment. The sector has now

Die hoofartikels van hierdie tydskrif is daarop gerig om die lesers van kritiese en evaluatiewe kommentaar oor aktuele sake op die gebied van beleggings- en portefeuljebestuur te voorsien. In hierdie verband is daar sekerlik nie 'n belangwekkender aangeleentheid nie as die bekendmaking vandeesmaand (Junie) van die regering se dokument oor 'n makro-ekonomiese beleidstrategie, getitel *Growth, Employment and Redistribution*. Om enige misverstand te voorkom wat uit moontlike kritiese kommentaar in hierdie hoofartikel kan voortvloei, word dit reg aan die begin ondubbelsinnig gestel dat hierdie dokument redelik is en die ondersteuning verdien van almal wat meen dat die herstrukturering van die Suid-Afrikaanse ekonomie om 'n verskeidenheid redes – ekonomies en polities, binnenslands en buitelands – noodsaaklik is. Dit dui op 'n mate van volwassenheid aan die kant van die ANC wat sy standpunt oor die makro-ekonomiese strategie ingrypend herformuleer het, maar steeds getrou gebly het aan essensiële doelwitte, soos die uitwissing van armoede, gelykberegting en ontwikkeling, wat hom twee jaar gelede aan die bewind geplaas het. Om die waarheid te sê, die ANC het beter daarin geslaag om hierdie kwessies met die vereistes vir strukturele aanpassings te versoen as wat die sake- of arbeidsektor vroeër vanjaar in hul twee dokumente dit kon regkry. Die sakesektor se dokument, *Growth for All*, wat in opdrag van die .Suid-Afrika Stigting saamgestel is, het weliswaar waardevolle inligting bevat, maar het die erns van die politieke probleme as gevolg van massa-werkloosheid en die uiterste ongelykheid in beleidsformulering in die werklike lewe grootliks onderbeklemtoon. Dit het ook aanstoot gegee met sy benadering: "As jy dit wil reg doen, sal jy vir my moet luister!" Geen wonder dus dat die arbeidsektor se dokument na die ander uiterste oorgehel het asof dit doelbewus so 'n toedrag van sake in die sakewêreld wou teenwerk nie. Dit alles het die land baie duur te staan gekom, want die rand se wisselkoerswaarde het geval en die ekonomiese debat is kortstondig verplaas na die ergste konfrontasie-oomblikke van 1989 toe 'n verbanne ANC gesê het dat herverdeling en groei twee wedersyds uitsluitende strategiese alternatiewe is en politici 'n voorkeur vir eersgenoemde bo laasgenoemde uitgespreek het. Ons het gedink ons het die stadium bereik dat alle partye dit eens is dat groei en herverdeling onlosmaaklik aan mekaar verbonde is en dat die pad na een van die twee nie die pad na die ander een moet versper nie. Die voortreflikheid van die regering se strategiedokument is daarin geleë dat groei en herverdeling weer eens saamgevoeg en boonop gekoppel is aan die vereiste van volhoubaarheid. Hiersonder sou nie een van die twee geloofbaar gewees het nie. Dit sal loon om die redes in herinnering te roep waarom die Suid-Afrikaanse ekonomie herstruktureer moet word. Hervorming was nie slegs vanweë die apartheidsera noodsaaklik nie. Daar is drie ander belangrike oorwegings, naamlik:

(i) Die groei in sowel die BBP as werkverskaffing moet tot op 'n vlak bo die bevolkingsgroeikoers verhoog word. Tans word minder as 15 persent van alle nuwe toetreders tot die arbeidsmark (ongeveer 375 000 per jaar) in die formele arbeidsektor geabsorbeer. Sonder 'n herstel van groei – en dit kan nie gebeur sonder 'n klemverskuiwing in binnelandse besteding sodat ver-

Man is the only creature that strives to surpass itself and yearns for the furthermost goals. ***In business, as in other forms of human endeavour, there are people who ceaselessly pursue superior performance. Who see opportunity beyond obstacles and are undaunted by a challenge. Who compete not so much with others as against their own high standards. And to whom each achievement is simply a step towards the next.***

MINING SERVICES CONCRETE PRODUCTS WASTE MANAGEMENT

reached a mature phase and over the next 50 years must be expected to go into decline with that becoming more rapid as time passes, and more obvious in the downphases of the business cycle. As a source of foreign exchange earnings it has to be replaced by secondary and tertiary activities the planning of which is a long term matter and cannot be delayed.

(iii) The global economy is itself restructuring and South Africa must accommodate to the associated changes if it is to maintain international viability. There are a number of aspects to global economic restructuring, eg secular shifts away from mineral-based exporters linked a process of deindustrialisation in the developed world, rapid technological change especially in the area of information technology and the emergence of a global web economy in which the nationality of product output is confused by the dispersion of component production across countries.

To be part of such a world system, South Africa must adapt or die. Its recognition of this imperative is clearly spelled out in the government's macroeconomic strategy. Also, there is evidence that an important turnaround has begun to happen helped by a cyclical recovery in the economies of the country's main trading partners, the United States, Britain, Germany and Japan, and by the lifting of economic sanctions. The effects of this have been enormous especially with regard to an easing of the previously severe balance of payments constraint, although it has not been without increased capital account volatility. Since 1993, real GDP growth has recovered led by a recovery in domestic capital formation, and this stands a reasonable chance of being carried further if the government now moves ahead in implementing its strategy and if the global business cycle continues to be supportive.

The most important thing about the government's new macroeconomic strategy is its commitment to a broad, integrated vision for the economy for the objectives it has set for itself are all attainable if it acts with sufficient resolution. A serious weakness of the strategy is its failure to acknowledge the uncertainty of its econometric projections linked as they must inevitably be to global cyclical fluctuations. Also, there is no acknowledgement of the extent to which the performance of the South African economy is dependent on forces totally beyond the control of the government because they are sourced exogenously. Put more simply, it is possible to be confident that this new strategy will succeed only if the global economy continues to grow between now and the end of the century. Were the major countries mentioned above to lapse back into recession, reaching the real GDP and job creation targets of 6 per cent and 400 000 per annum respectively in the year 2 000 might prove to be difficult and would become impossible were such a recession to be more pervasive.

However, the most disappointing feature of the government's strategy document is its inflation projection which more-or-less sketches an unchanged scenario between now and the year 2 000. With the targets just referred to, this implies the retention of a belief, which should be discredited by now even in South Africa, that there is a trade-off between sustainable job creation and a policy-led debacement of the currency. By projecting so high a level of South African inflation when trading partner inflation continues (as it most likely will) at around 3 per cent or even less, the document could be interpreted as arguing

bruik plek maak vir besparing en belegging nie – sal werkloosheid en die gepaardgaande maatskaplike agteruitgang (waaronder misdaad) 'n onbeheerbare omvang aanneem.

(ii) Die mynsektor van die land se ekonomie is op kwynende mineraalbronne aangewese. Hierdie sektor verkeer tans in sy versadigde fase en sal na verwagting oor die volgende 50 jaar 'n afwaartse fase deurmaak wat mettertyd al hoe sneller gaan verloop en veral opvallend in die afwaartse fase van die sakesiklus sal wees. As 'n verdiener van buitelandse valuta moet dit vervang word deur sekondêre en tersiêre aktiwiteite waarvan die beplanning 'n langtermyn-taak is wat nie durf uitgestel kan word nie.

(iii) Aangesien ook die wêreldekonomie tans herstruktureer word, moet Suid-Afrika die daaruit voortspruitende veranderings akkommodeer indien hy internasionaal lewenskragtig wil bly. Die globale ekonomiese hervorming word onder meer gekenmerk deur 'n stadige verskuiwing weg van mineraalgebaseerde uitvoer, gepaard met 'n proses van de-industrialisasie in die ontwikkelde lande, snelle tegnologiese verandering op die gebied van veral die inligtingstegnologie en die opkoms van 'n wêreldwye ekonomiese netwerk waarin die nasionaliteit van produksie-opbrengs oorskadu word deur die verspreiding van komponenteproduksie oor lande heen.

Indien Suid-Afrika deel van so 'n wêreldwye stelsel wil wees, sal hy hom moet aanpas, anders sal hy ten gronde gaan. Dat die land wel deeglik die noodsaaklikheid hiervan besef, blyk duidelik uit die regering se makro ekonomiese strategie. Ook is daar tekens van 'n belangrike ommekeer te bespeur. Dit word gerugsteun deur 'n sikliese herstel in die ekonomieë van die land se vernaamste handelsvennote, te wete die Verenigde State van Amerika, Brittanje, Duitsland en Japan, en deur die opheffing van ekonomiese sanksies. Die uitwerking hiervan is enorm, veral ten opsigte van 'n verslapping van die eens streng beperkings op die betalingsbalans, hoewel dit nie sonder toenemende kapitaalvloei onbestendigheid plaasgevind het nie. Sedert 1993 het die reële BBP-groei herstel en is dit opgevolg deur 'n herstel in binnelandse kapitaalvorming. Al hierdie ontwikkelinge het 'n redelike kans om nog verder gevoer te word mits die regering nou dadelik sy strategie begin toepas en die globale sakesiklus dit steeds ondersteun.

Die belangrikste kenmerk van die regering se nuwe makro-ekonomiese strategie is die feit dat hy hom verbind tot 'n breë, geïntegreerde visie vir die ekonomie, omrede al doelwitte wat hy vir homself gestel het, haalbaar is indien hy met die nodige vasberadenheid optree. 'n Ernstige leemte in die strategie is naamlik dat dit nie agslaan op die onsekerheid van sy ekonometriese projeksies, wat uiteraard aan die globale sikliese skommelings onderhewig is nie. Ook word nie voldoende rekening gehou nie met die mate waarin die prestasie van die Suid-Afrikaanse ekonomie afhanklik is van kragte wat totaal buite beheer van die regering is omdat hulle van 'n eksogene oorsprong is. Eenvoudiger gestel: Daar kan met stelligheid aanvaar word dat hierdie nuwe strategie sal slaag, maar slegs indien die wêreldekonomie aanhou groei tussen nou en die einde van die eeu. Indien die belangrike ekonomieë wat hierbo genoem is, weer 'n resessie sou beleef, sal dit moeilik wees en selfs onmoontlik raak om die doelwitte van 'n reële BBP en werkskepping van onderskeidelik 6% en 400 000 per jaar teen die jaar 2 000 te verwesenlik indien so 'n resessie meer verspreid blyk te wees.

that a steady erosion of the exchange value of the rand is going to be necessary in order to preserve the country's international competitiveness. It would have been preferable had inflation been set lower as a prime objective with the intermediate target of a lower fiscal deficit being linked to it. As the strategy presently is formulated, the prime objectives are real GDP growth and job creation, and the inflation projection is simply a residual.

All this notwithstanding, one must applaud the new course upon which the government has set the economy. Clearly, it is going to become something quite different from what it has been for the past 100 years. Until now, the South African economy has been primarily a supplier of raw materials into the world system receiving in exchange capital goods needed for industrial development. Its main global linkages have been with the developed countries of North America, Western Europe and Japan. In the immediate aftermath of the lifting of sanctions, these linkages are logically being strengthened. But that is in the short run only. In the medium to long run the linkages are going to change especially if manufacturing exports and tourism are going to replace mineral exports as the main source of foreign exchange. Here, the Indian Ocean Rim initiative takes on a special importance as does an emerging relationship with China, South-East Asia and the Middle-East. Latin America, too, holds out promise, not to mention Africa itself with which South Africa already has substantial, and rapidly growing, ties. It is not often realised that India alone, a country mistakenly thought of as poor, has a middleclass (ie around 250 million) as large as the entire population as the United States. It is an exciting new world, and one South Africa is well positioned to penetrate if it can get its act together. The government's macroeconomic strategy is a indication that it realises this. Now it must persuade its coalition partners to go along with it despite their understandable reserve concerning the short term costs of the necessary structural adaptation.

THE EDITOR

Die teleurstellendste aspek van die regering se strategiedokument is egter die inflasieprojeksie wat 'n min of meer onveranderde scenario tussen nou en die jaar 2 000 skets. Met inagneming van die voorgenoemde doelwitte veronderstel dit die aanwesigheid van 'n opvatting – wat teen hierdie tyd selfs nie in Suid-Afrika gehuldig moes gewees het nie – dat daar 'n verband tussen volhoubare werkskepping en 'n beleidsgerigte daling in die rand se wisselkoerswaarde is. In die lig daarvan dat Suid-Afrika se inflasie op so 'n hoë vlak geprojekteer word wanneer die inflasie van sy handelsvennote rondom 3% of selfs laer neig (wat na alle waarskynlikheid die geval sal wees), kan die dokument geïnterpreteer word as sou die regering van die standpunt uitgaan dat 'n volgehoue erodering van die waarde van die rand noodsaaklik sal wees ten einde die land se internasionale mededingendheid te behou. Dit sou meer aanvaarbaar gewees het as die inflasie laer as die hoofdoelwit geprojekteer is met as tussentydse doelwit 'n kleiner fiskale tekort daaraan gekoppel. Aangesien die strategie tans geformuleer word, is die vernaamste doelwitte groei in die BBP en werkskepping terwyl die inflasieprojeksies bloot 'n bysaak is.

Hoe ook al sy, 'n mens moet die nuwe rigting waarin die regering die ekonomie stuur, verwelkom. Dit is duidelik dat die ekonomie heelwat verskillend daar gaan uitsien as in die afgelope 100 jaar. Tot op hede het die Suid-Afrikaanse ekonomie hoofsaaklik grondstowwe aan die wêreldsisteem gelewer in ruil vir kapitaalgoedere wat vir nywerheidsontwikkeling noodsaaklik was. Sy vernaamste internasionale handelsbande was met die ontwikkelde lande van Noord-Amerika, Wes-Europa en Japan. Dit is logies dat hierdie bande onmiddellik na die opheffing van sanksies verstewig is. Dit geld egter net vir die kort termyn. Hierdie situasie gaan op medium- en lang termyn verander, veral wanneer vervaardigingsuitvoere en toerisme mineraaluitvoer as die vernaamste bron van buitelandse valuta vervang. In hierdie verband is die aanvoor-gesprekke met lande aan die soom van die Indiese Oseaan van besondere belang, asook die ontluikende verhoudinge met China, Suidoos-Asië en die Midde-Ooste. Daarbenewens hou Latyns-Amerika groot belofte in en moet daar nie vergeet word van Afrika met wie Suid-Afrika reeds aansienlike en vinnig groeiende betrekkinge handhaaf nie. Iets wat dikwels uit die oog verloor word, is dat Indië alleen – 'n land wat allerweë as arm gereken word – 'n middelklas (ongeveer 250 000 miljoen lede) het wat so groot soos die ganse bevolking van die Verenigde State is. Dit is 'n opwindende nuwe wêreld en Suid-Afrika is goed geposisioneer om 'n vastrapplek daar te verkry mits hy sy kaarte reg speel. Die regering se makro-ekonomiese strategie is 'n aanduiding daarvan dat hy dit terdeë besef. Nou moet hy dit net aan sy koalisievennote verkoop wat, begryplikerwys, hul voorbehoude het weens die korttermynkoste verbonde aan die noodsaaklike strukturele aanpassings.

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An underlying symmetry on price charts

ABSTRACT

Long term study of trends on price charts using specially developed software, has shown that prices do not change direction at random; instead, prices display a distinct preference to change trend or direction at points on the price chart which correspond with a distinct preference for certain gradients.

By itself, a preference for certain gradients does not prescribe future behaviour tightly enough to be of great value to the technical analyst. However, the presence of other, more complex structures on price charts reveals an underlying symmetry in the behaviour of the price that can be used to anticipate future price behaviour.

This paper summarizes the more pertinent results of this phenomenon. Some examples are given to illustrate how in knowledge of the ground rule and of the higher order symmetries can be used for trading decisions.

The findings presented here do not agree with elements of the Random Walk Hypothesis, but support the concept of emergent order implicit in complex adaptive systems.

PREFERRED GRADIENTS

Points on a chart, with coordinates of time and price, where the price changes direction or trend, do not happen at random. Careful examination of price charts will reveal that trend reversals and trend changes tend to cluster along lines with certain specific gradients.

An intimation of this underlying order has been part and parcel of technical analysis for a long time through the use of support and resistance lines. These lines have been used to isolate chart formations for many years. To qualify as an established support or resistance line, the price must have made three or more trend reversals along that line and ideally should have done so without penetrating the line at all. [Murphy P70, Edwards and Magee Pp240-241].

A line through two significant reversals is of no consequence – too many such lines can be generated tangent to a price chart. It is only after a third reversal at a line that it begins to attract attention. Should the price later approach the line a fourth time, another trend reversal can be anticipated. If this does not materialize, so that the price breaks through the line, it is a significant event as it denies the earlier trend and establishes a new trend.

Knowledge of the earlier behaviour of the price at a trend line enables the analyst to anticipate either another trend reversal, or a break and a significant extension of the ruling trend. Whichever happens, the event will be of value for decision making, provided observations are made with sufficient accuracy to reduce indecision and risk to a minimum.

The problem in using trend lines in this manner, though, is that the price seldom maintains a trend along the same support or resistance line long enough for it to return to the line four or more times.

Traditional support and resistance lines offer the earliest evidence for what proves to be much more generalized price behavior.

Perhaps the traditional concept of a trading channel is a better illustration of the preference for a specific gradient. Trading channels develop when the price changes direction so as to remain between two parallel lines. These trend changes result in chart bottoms along one side of the channel and tops along the opposite side [Murphy Pp 83-88, Edwards and Magee P 249]. Since the sides of a channel are parallel or very nearly so, they effectively represent the same gradient.

Extensive analysis using trend lines over many years suggests major resistance and support lines that act as boundaries for parts of a price chart are only special cases of a general preference for certain gradients. If lines are generated parallel to a known support or resistance line at appropriate positions on a chart, so that these lines pass through the chart formations, it will be found that they tend to attract more trend changes than what would appear due to chance alone. It was noticed, for example, that trading channels often have a line down the center of the channel where the price changes direction frequently enough to effectively divide the channel into two distinct halves.

Fig. 1 shows such a channel. The master line from which the other two lines were derived, is indicated with an 'M'. It was generated by using the actual coordinates of the points marked with an 'X' to calculate the gradient.

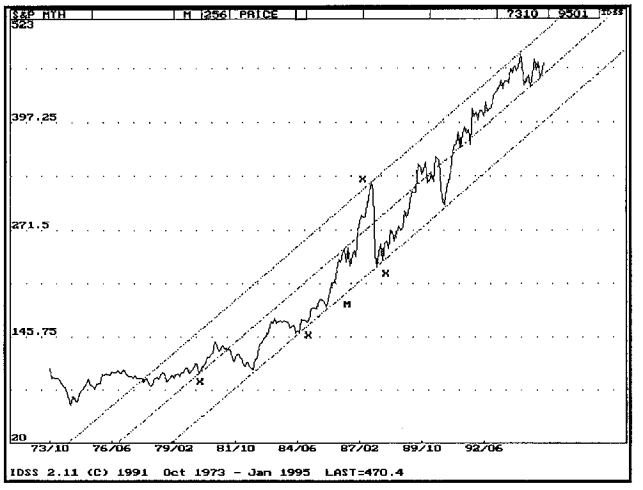

Fig.1. Standard & Poor 500 Index. Monthly close.

The two other lines on the chart were generated with the same calculated gradient to be exactly parallel to the master line. The origin of each derived line is the single point along the line indicated by an 'X'.

Figs. 2 and 3 each present a set of four parallel trend lines. In both instances the master line was defined using the actual price data of two unique chart bottoms; the other three lines were generated as before, exactly parallel to the master line, using the single points marked with an 'X' as the origin.

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Two observations deserve mention. Firstly, the lines pass relatively cleanly through the charts with few false breaks. Secondly, there is a relatively large number of trend reversals along the lines, if the small and often brief changes in direction at or very close to the lines are included – as they ought to be, since the hypothesis that prices prefer certain gradients in principle does not distinguish between major and minor trend changes.

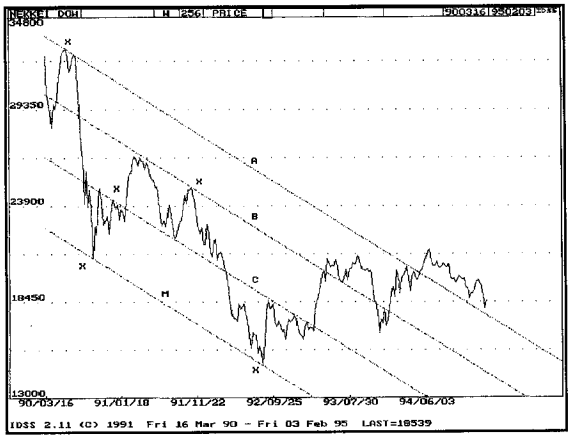


Fig. 2. Nikkei 225 Index. Weekly close.

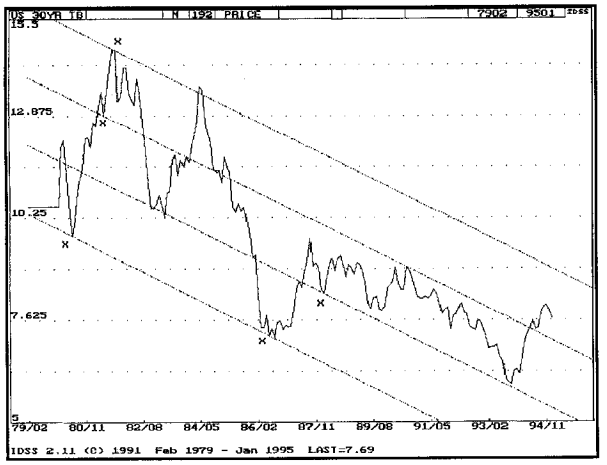


Fig. 3. US 30 year Treasury bond. Monthly close.

This is exactly the behaviour that would be expected if prices had preferred gradients.

IDENTIFYING PREFERRED GRADIENTS

Exploration of a chart to identify the trend lines associated with the preferred gradients is facilitated by software that enables the user to draw accurate trend lines through two selected reversal points. The software should use the internal values of the prices data at those chart points to ensure a high degree of accuracy; the process should not depend merely on a visual fit of a line image to the chart on the screen. Results have shown that such high accuracy is required because the phenomenon itself is surprisingly accurate.

Once a trend line has been generated, the software should be able to generate additional lines with that same gradient at other places on the chart, again using internal values to maintain high accuracy.

Two facts are important in the search for preferred gradients. Firstly, not all gradients that can be defined using pairs of significant reversals are preferred gradients. When a new gradient is defined, the degree to which its gradient is preferred by the price must be validated. This is done by generating parallel lines at other prominent points on the chart and observing whether these lines also attract trend changes and trend reversals. If the parallel lines prove to be poor trend lines by failing this test, the gradient is not a preferred gradient.

Secondly, even if the initial line is found to be a preferred gradient, not all lines with that same gradient are equally successful in attracting trend reversals or changes. Some of the parallel lines will prove to be good and effective trend lines while others will be largely disregarded by the price. While this lack of consistency might be considered by some to be proof of the random nature of price behaviour, i.e. that the observed abundance of trend changes along certain lines are due to chance alone, careful analysis will show that success as a trend line is at least partly the result of some kind of order in the positioning of the derived lines.

Good trend lines do not appear at random on the chart, but obey rules of symmetry and thereby provide further evidence of emergent order in price behavior.

CHANNEL SYMMETRY

Just like trading channels, where a distinct center line is often present, channels defined by parallel trend lines also display some form of symmetry. The most common type of this symmetry consists of a set of equally spaced trend lines, which results in a number of channels of near equal width. Figs. 2 and 3 are examples of such channel systems.

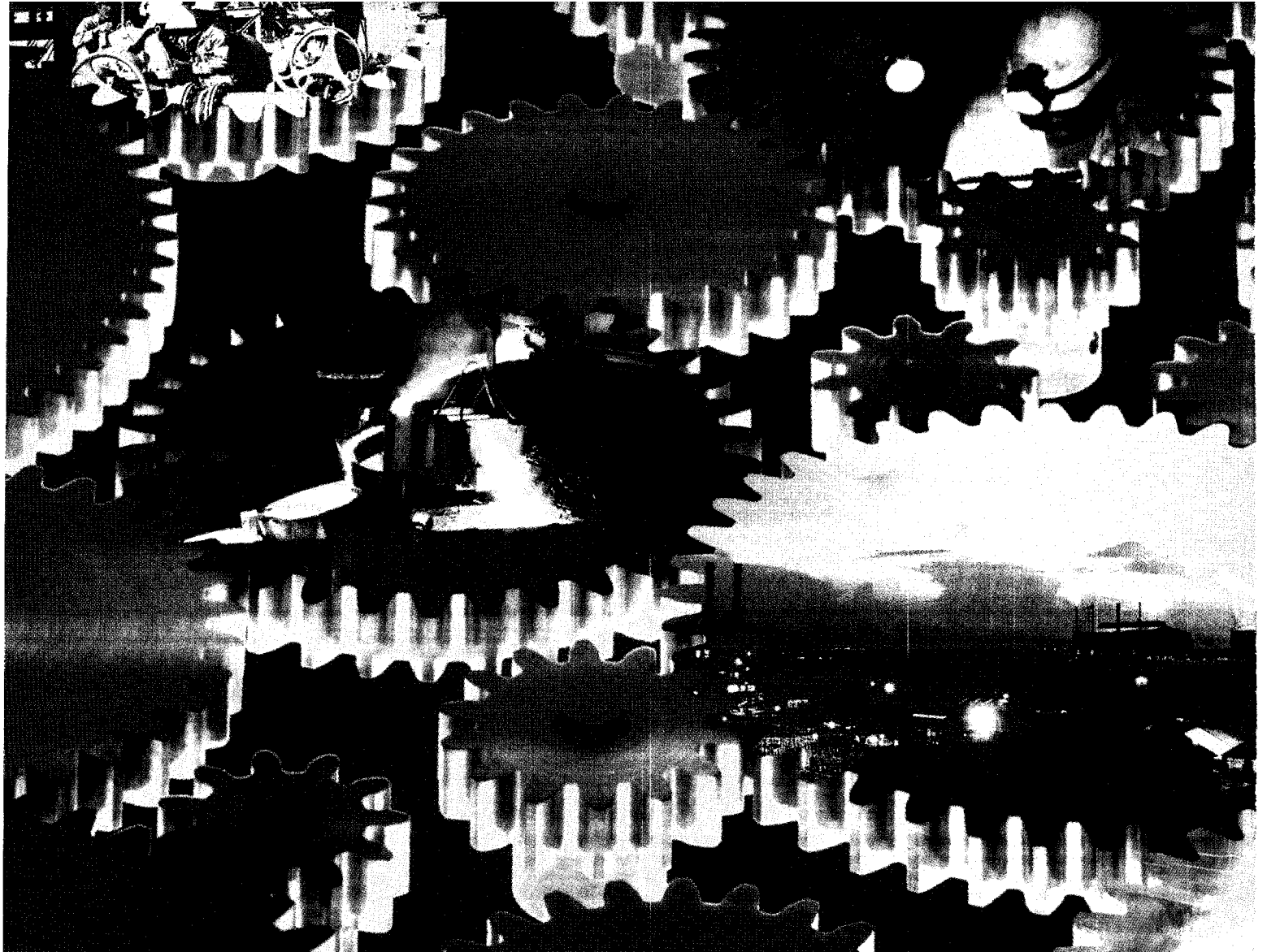
Positioning of prominent trend lines to satisfy requirements of channel symmetry is a major extension of the initial observation that prices prefer certain gradients, as revealed by the behavior of the price along a single trend line. Channel symmetry operates across the preferred gradient and can therefore be said to represent a second dimension of price symmetry.

INVERTED LINES

Sideways translation of a proven trend line to result in a parallel line is only one of three transformation procedures that can be used to identify effective trend lines. The second transformation is inversion – changing the sign of the gradient, but keeping its magnitude constant.

It was found that lines with opposite gradient to a known preferred gradient, generated at appropriate points on the chart, also prove to be effective trend lines. The most striking examples of this transformation arise when the resistance line of a bull market is inverted at the apex to become a resistance line of the subsequent bear trend, or when the support line of a bear market after inversion becomes the support line of the subsequent bull market [Joubert].

Fig. 4 contains two examples of this phenomenon. In both cases, the resistance line of the bull trend was defined as the master line and the resistance line of the bear trend was generated as the exact inverse of the master line. Observe that in the second example of Fig. 4 the inverse line later acted as support after first behaving as the expected resistance. This dual role is typical of price



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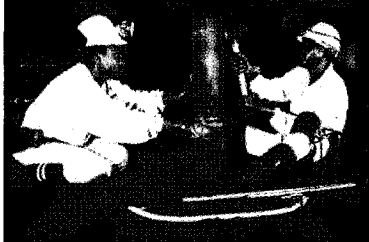

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symmetry and further confirms the validity of that gradient.

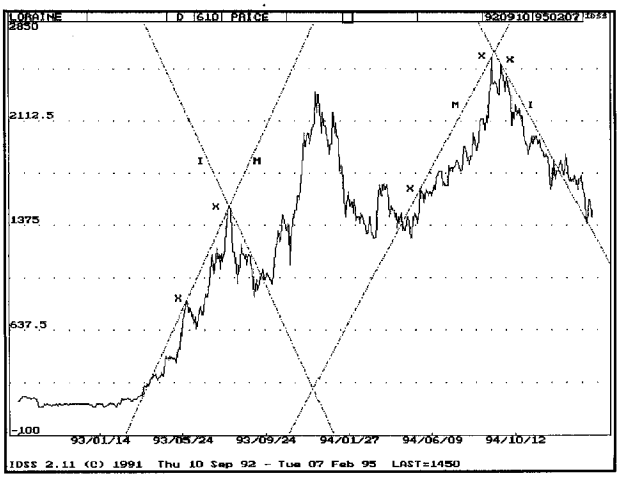

Fig. 4. Loraine Gold Mine Co. Daily close.

RELATIONSHIP BETWEEN GRADIENTS

In most consecutive bull and bear trends, direct inversion does not produce good results. The reason is that the gradients of two consecutive trends seldom have the same magnitude, as they do in Fig. 4.

However, there is a third transformation procedure that can be used to change one preferred gradient into another. When this gradient transformation is applied to a known preferred gradient, the result – a gradient that differs by a fixed ratio from the original gradient – is usually also a preferred gradient.

In nearly all cases of inverted trends where direct inversion fails to provide a good fit to the chart, a gradient transformation will succeed. Fig. 5 contains two such examples. In both cases the master line of the pair is on the left, while the right hand line of the pair is a steeper transformation of the associated master line.

Observe that in this historical chart of the dollar-yen weekly close, the high in the value of the dollar in 1990 formed a small double top. The top on the left was used to define the master line, while the second top was used as origin for the derived line so that it would be tangent to the chart.

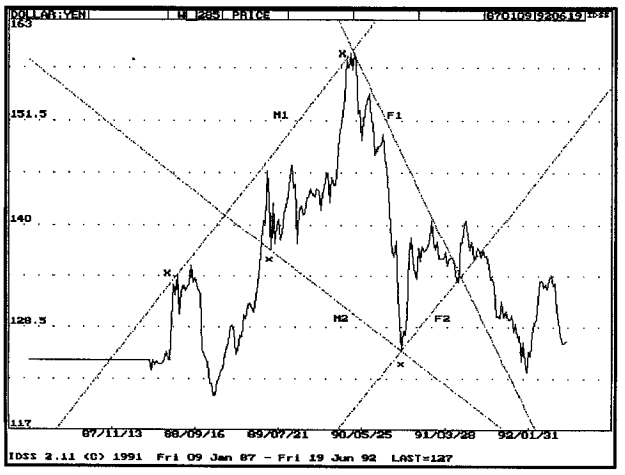

Fig. 5. US dollar – Yen. Weekly close.

The ratio used for the gradient transformation is the Fibonacci ratio. Apart from empirical evidence, there is no known reason why this particular ratio should work best.

When one preferred gradient has been identified, other gradients can be derived from it by multiplying or dividing the known gradient by the Fibonacci ratio (0.618034 . . .) to result in either a shallower or steeper gradient than the original, respectively. If the derived gradient is subjected to a similar transformation, an even steeper or, alternatively, even shallower gradient is generated.

Additional repetitions of the transformation, in both directions, to result in lines with ever steeper and shallower gradients, results in a fan of lines from near the vertical to near horizontal. While all the lines in the fan have gradients of the same sign as the original gradients, inversion of the fan will result in a complete 360 degree fan.

Any line in the fan can be used as master line to generate the whole fan. Further, each of the fan lines can also serve as master for many parallel lines. It follows that a specific trend line can give rise to a relatively large number of derived trend lines on a chart, through the use of various combinations of the three standard transformations – translation, inversion and the gradient transformation.

Such a set of lines is called a 'family' of lines, as they are all related. Any member of the family can be used to generate the rest of the family. Early indications are that usually only two such families of lines are active on a chart.

TRADITIONAL FORMATIONS

Apart from trading channels, a number of other chart formations have long been recognized. These include triangles, wedges, pennants and widening formations or megaphones [Murphy Pp 147-160].

Investigation has shown that in the majority of cases, the sides of these formations belong to the same family; in other words, the one side of a wedge, pennant, triangle or megaphone can be derived from the other through the appropriate combination of the three standard transformations.

The transformation that has to be performed to generate a trading channel or a flag is only the sideways translation of the master line, as the two sides are parallel. It is only narrowing or widening formations that require one or more gradient transformations and perhaps an inversion procedure as well.

In the relatively few cases where the one side of a well defined formation can not be transformed into the other, the two boundary lines belong to the two different families of gradients that are active on the chart.

Fig. 6 is an example of a narrowing formation where one side was derived from the other though one application of the gradient transformation. The master line, M, is the resistance line through two major tops of the weekly close of the Dow Jones Industrial index – one in 1987 and the other in 1994. The lower line was generated using the low in October 1990 as its origin, with a gradient that is steeper than that of the master line by the Fibonacci ratio.

The fit between the derived line and the low reached in December 1994 is excellent.

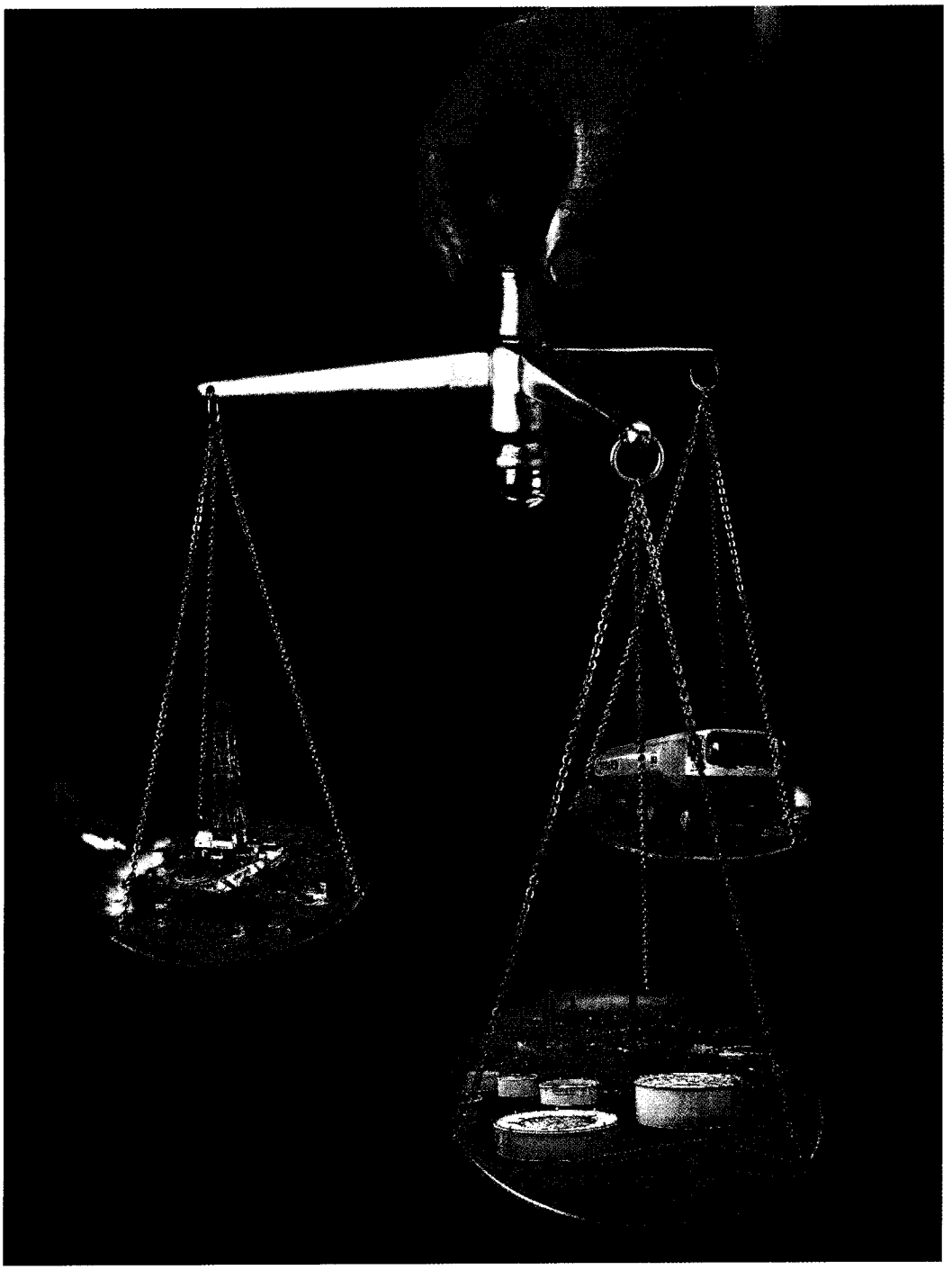

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Fig. 6. Dow Jones Industrial Index. Weekly close.

Fig. 7 illustrates how one basic pattern on the weekly close of DeBeers Consolidated Diamond Mines remained consistent over a period of more than 10 years. The support line of the whole formation, M, is the master line, Its inverse, I, was generated from the spike top of the 1990 bull market to become the upper boundary of the large symmetrical triangle, I-M.

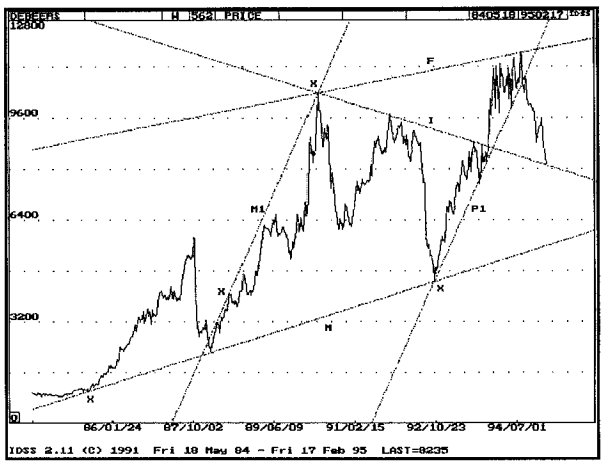


Fig. 7. DeBeers Cons. Diamond Mines. Weekly close.

When wedges and triangles act as continuation formations, they have an unequal number of legs, usually five. Knowledge of the relationship between the two sides improves the ability to recognize the true positions of the boundaries and thus the correct count of the legs. This has revealed that the price often breaks from narrowing formations before the usual five legs have been completed. Such abnormal breaks tend to be sharp and volatile, as can be seen in this example where the upwards break through line I on leg 4 of the triangle I-M moved 29% in 6 weeks.

The shallower Fibonacci derivative of the master line, line F, also generated from the spike top in 1990, is the upper boundary of the large wedge, F-M, which encloses the whole chart formation. The reversal from this line in August 1994, was the beginning of leg 4 of the wedge, which is still current.

A second master line, M1, is drawn as the very steep resistance line of the 1988-1990 bull market in DeBeers. Its parallel, from the low in 1992, is the lower, or right hand, boundary of a broad, steeply rising channel, M1-P1. The break from this channel just after the reversal at the top of the wedge, confirmed the weakness that was implicit in that reversal.

In Fig. 8 the master line, M, is the base support line of the monthly chart of the Standard & Poor 500 index for the period before the major bull market started in 1982. The other four lines were all derived from this master line. Three successive Fibonacci gradient transformations were needed to generate channel B-D, while a fourth transformation was required to generate the even steeper channel A-C. The points used as the origin for each of the channel boundaries are indicated as usual.

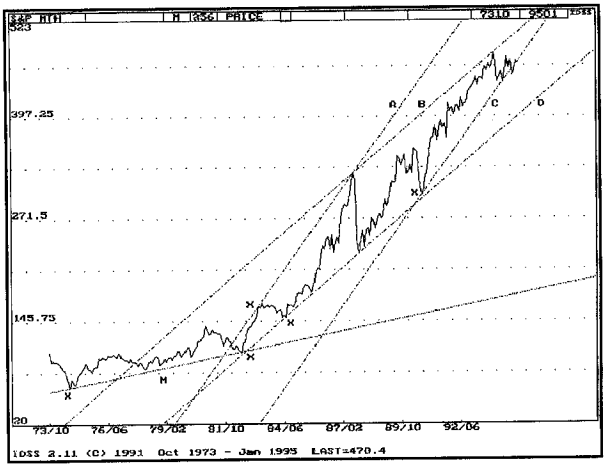


Fig. 8. Standard & Poor 500. Monthly close.

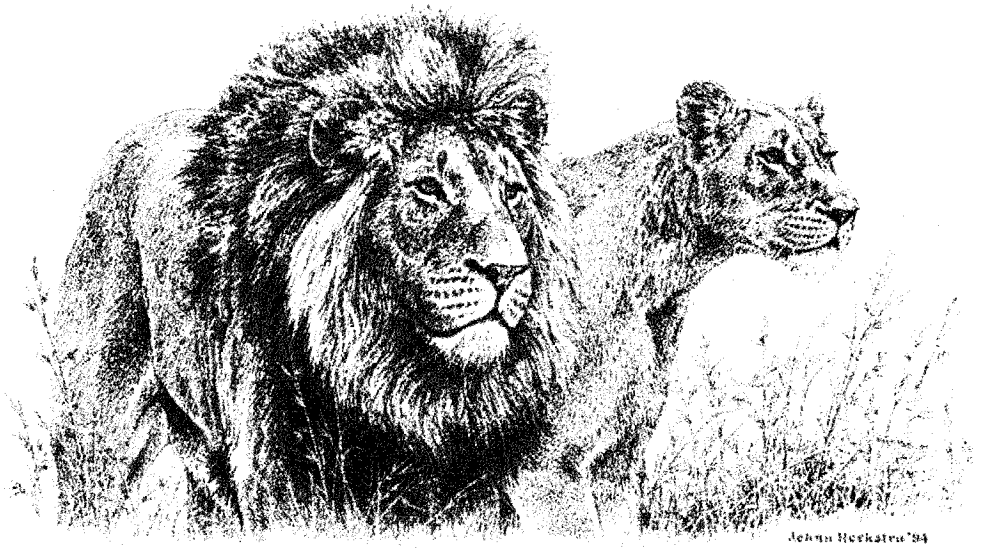
The fit of the derived lines to the chart is very accurate, despite the number of transformations used to generate them. The two channels both contain the full bull market since late 1981, except for the recent break from channel A-C. The wedge pattern between lines B and C corresponds to the wedge on the Dow Jones weekly chart shown in Fig. 6. Observe that the formation between lines A and D is a well defined steep megaphone.

Chart formations that can be isolated using different gradients of the same family of lines, as illustrated in the last three examples, represent a major extension of the first two dimensions of symmetry, namely single trend lines and channel symmetry. The existence of this third dimension of price symmetry provides further evidence of order on price charts.

USING CHART SYMMETRY FOR ANALYSIS.

Knowledge of preferred gradients and how they combine into formations, together with other observations of consistent behaviour within and around formations, have been used to develop a systematic methodology for chart analysis. It begins with a search for major trend lines, which are seen as representative of the preferred gradients of that particular chart. Once such a line or lines have been identified, a structered trial and error method is used to find other prominent members of the particular family of gradients that is uniquely defined by the selected master line.

A validation process then eliminates less relevant lines of this family to leave only those that contribute to the



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definition of patterns and formations which, in the judgement of the analyst, improve anticipation of the future behavior of the price.

Recognition of the gradients to select and which patterns to construct from among the relatively large number of alternatives, is a skill that improves with practice.

Two characteristics of price symmetry are useful in this process.

Firstly, the changes in direction of the price at preferred gradients is amazingly accurate – usually well within 1%. Secondly, the behavior of the price within chart formations tend to follow a limited number of standard options. Therefore, once the nature and shape of the current formation or formations have been identified, the degree to which they have been completed can be used to deduce how the price should continue to behave within these formations and what ought to happen when a boundary is reached.

As a result of this insight, timing is improved, reactions can be faster and major trend changes can be anticipated. Furthermore, while false or temporary breaks from major formations are quite rare, the high degree of accuracy means that their occurrence can be identified quickly when they do happen, so that corrective action can be taken quickly.

Fig. 9 is an intra day chart of 6-hourly values of the gold price, recorded 4 times a day. All of the lines were derived from one master line, M, which is the base line of the whole formation.

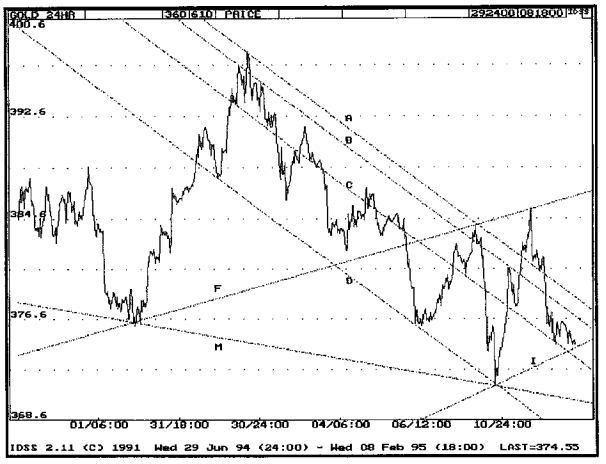

Fig. 9. Gold price. 6-hourly values, 24 hours per day.

Channels A-B-C-D make it possible to monitor changes in the gold price against a relatively short term progress scale. If support at line I should hold, inverse symmetry between lines D and I and also lines M and I will apply and perhaps provide the boost that is needed to reach resistance at the top of channel A-D. A break below line I could form either a double bottom or find support at line M to complete the megaphone F-M.

As changes in the price unfolds, such alternative scenarios guide the anticipation of future developments. Scenarios are of course updated and new scenarios defined as the chart progresses.

In Fig. 10 all the lines were again derived from the same master line, M, the resistance line of the dollar during the volatile bull market of late 1992 to 1993. Features of interest here include the rising wedge formation between lines M and D and a declining wedge between lined E and F. The first wedge had the usual 5 legs – the first leg is off screen on the left – and thus completed normally. The return right up to the bottom of this wedge is a common occurrence after a break from a major formation and has been termed a 'good-bye kiss'.

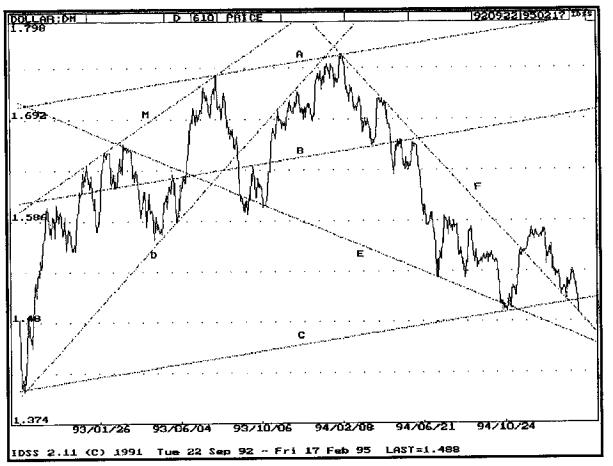

Fig. 10. US Dollar – Deutschmark rate. Daily close.

The second wedge broke abnormally after leg 3, again followed by a return to the penetrated line. Note that both formations are Fibonacci wedges, as either side of the formation can be derived from the opposite boundary by means of the standard transformations.

Line D has significantly more reversals along its length than the number of times it has been penetrated. Such lines are known as 'watershed lines'. Line F is the inverse of line D and so far is also behaving as a watershed line. Lines A, B and C are members of a major channel system.

A bounce off watershed line, F, which would complete a good-bye kiss on wedge F-E, will be positive for the dollar, provided it can then recover back into the channel A-C. While the dollar could weaken further by a slide down the outside of wedge E-F, a break to below the watershed line,F, will precipitate a major decline in the value of the dollar.

CONCLUSIONS

Two observations mitigate against random price changes as an explanation of the observed phenomena.

Firstly, the very accurate fit between derived lines and changes in the trend of the price is difficult to explain as the result of mere chance.

Secondly, the fact that similar price behavior – channel symmetry, inverse symmetry, formations with boundaries that are Fibonacci-related – appears on such diverse charts, is almost certainly evidence of some underlying order common to all price behavior. The high degree of consistency of this complex behavior can nevertheless be explained by three observations, namely that prices have preferred gradients, that these gradients share a definite relationship through the Fibonacci ratio and thirdly, that preferred gradients combine into more complex yet regular structures.

The examples support two other conclusions: firstly, preferred gradients are fractal by nature – evidence of their presence can be found on charts of widely different time scales. Secondly, preferred gradients have a long latency period relative to the time scale of the chart. It could be speculated that for a given time scale, one or two families of lines may influence the behavior of the price indefinitely.

Discovery of the transformations that can be used to generate additional preferred gradients makes it possible to identify and isolate cohesive chart formations where all boundary lines belong to the same family. This ability, together with the knowledge how prices behave within regular formations, provides a powerful and accurate method for proactive chart analysis.

Existence of underlying symmetry on price charts raises many questions. Among others, there are implications for the Random Walk Hypothesis and its corollary which states that it is in principle not possible to use the history of a price to forecast or anticipate its future behavior [Murphy, Pp 20-23 Summary of prevailing theory, and additional references].

Lastly, speculation on the cause of this phenomenon is certain to use complexity theory and the study of complex self adjusting systems as its point of departure [Waldrop Pp 103-105, 273-274, 288-292, Lewin Pp 12-13]. Price symmetry may prove to be the elusive emergent order that could be expected to arise in markets as examples of complex, adaptive systems.

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Die modellering van heteroskedastisiteit in daaglikse rand/dollar wisselkoersbewegings: 1987-1992

OPSOMMING

'n Nuwe groep van modelle, bekend as Outoregressiewe Voorwaardelike Heteroskedastisiteitsmodelle (OVH), is sedert 1982 ontwikkel. Dié modelle maak dit nou moontlik dat voorwaardelike variansies van tydreekse gemodelleer kan word.

Dit is bekend dat die verdelings van wisselkoersdata swaarder eindoppervlaktes as wat onder die normaalverdeling verwag word, het. Die OVH-modelle is geskik en spesifiek ontwikkel om voorsiening vir leptokurtose te maak.

In die artikel word van die verdelingseienskappe van die Suid-Afrikaanse Rand/Dollar wisselkoerse met behulp van die OVH-model ondersoek. 'n Buite-steekproef doeltreffendheidsontleding word ook gedoen.

1. INLEIDING

Kennis betreffende die statistiese eienskappe van daaglikse koerse van verandering in wisselkoerse het belangrike ekonomiese toepassings, onder andere in die studie van internasionale goedere- en kapitaalvloeie, risikoopbrengsontledings van internasionale bateportefeuljes en in die prysbepaling van wisselkoersopsies. In 'n effektiewe spekulatiewe mark reflekteer pryse onmiddellik beskikbare inligting en behoort dit vir handelaars onmoontlik te wees om 'n abnormale wins te maak. Die effektiewe markhipotese impliseer dat prysveranderings as stogastiese beweging ("random walks") gemodelleer kan word. Hiervolgens is daaglikse prysveranderings onafhanklik en identies (oiv) verdeel, wat beteken dat die eienskap van witruis bevredig word. Volgens Taylor (1995:14):
"In its simplest form, the efficient market hypothesis can be reduced to a joint hypothesis that foreign exchange market participants are, in an aggregate sense a) endowed with rational expectation and b) risk-neutral. If agents are risk-neutral and have rational expectations, the disturbance term – the rational expectations forecast error under the null-hypothesis – will be uncorrelated with information available at time t."

In die praktyk word dikwels waargeneem dat die eindoppervlaktes van die verdelings wat tot stand kom swaarder is as wat onder die normale verdeling verwag word (kyk bv. Westerfield (1977), Hsieh (1988, 1989), Milhj (1987), Diebold en Nerlove (1989), Baillie en Bollerslev (1989) en Pahn en Smit (1992)). Twee hipoteses is voorgestel in 'n poging om leptokurtose te verklaar. Volgens die eerste is die waarnemings onafhanklik afkomstig uit 'n verdeling met swaar eindoppervlaktes wat onveranderd bly oor tyd; volgens die ander hipotese is die waarnemings afkomstig uit verdelings wat oor tyd varieer. Friedman en Vandersteel (1982) oorweeg die volgende drie hipotese: (i) dat die waarnemings onafhanklik en identies verdeel is, afkomstig van 'n stabiele Pareto-verdeling, (ii) dat die waarnemings onafhanklik en identies verdeel is, afkomstig van 'n mengsel van normale verdelings; of (iii) dat die waarnemings onafhanklik getrek is uit 'n normale verdeling waarvan die gemiddelde en variansie oor tyd varieer. Hul vind getuienis wat op die derde alternatief dui. Calderon-Rossell en Ben-Horim (1982) toets direk vir die onafhanklik identies-verdeelde (oiv) eienskappe sonder om aannames omtrent die verdeling te maak en verwerp die oiv-hipotese ten opsigte van die meerderheid van geldeenhede in hulle studie. Hsieh (1988) bevind dat: (i) wisselkoersveranderinge nie onafhanklik en identies verdeel is nie; (ii) elke weeksdag 'n ander verdeling mag hê, maar dat dit nie voldoende is om die oiv-aanname te verwerp nie; (iii) daar min reekskorrelasie in die data bestaan; en (iv) dat gemiddeldes en variansies oor tyd verander en dat dit voldoende is om die verwerping van die oiv-aanname t.o.v. 'n aantal wisselkoerse te verklaar.

2. DIE DATA

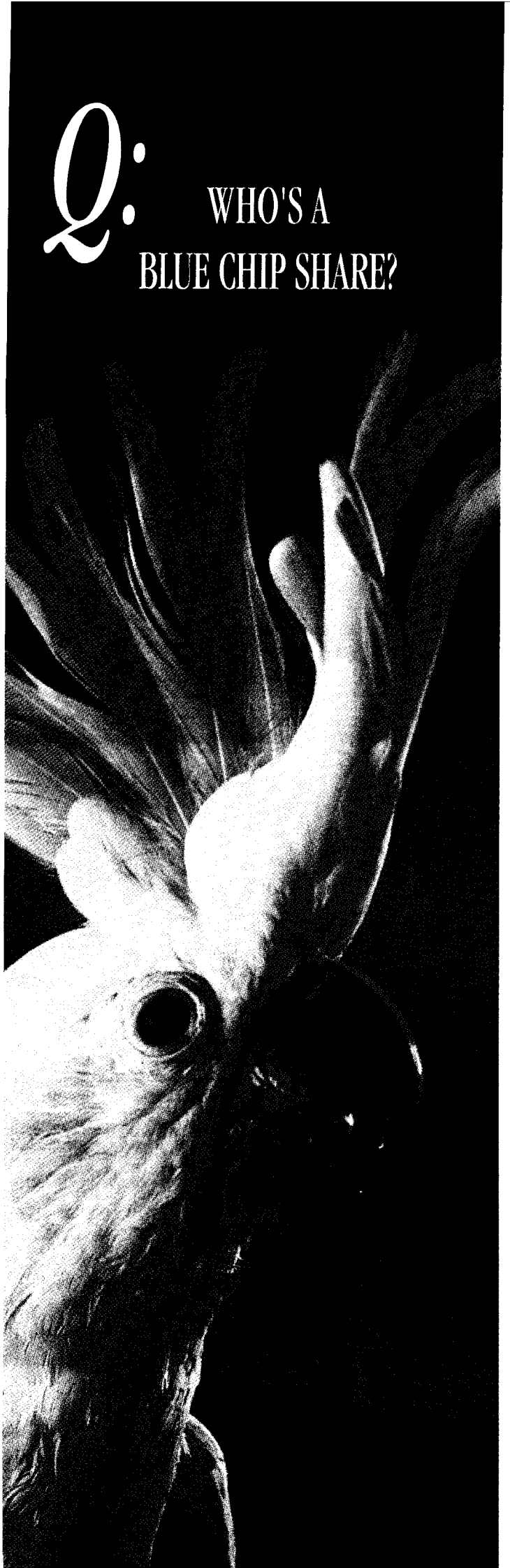
Die data betaan uit die daaglikse sluitingspryse ten opsigte van beide die Kommersiële en Finansiële Rand/Dollar-wisselkoerse verkry vanaf die Sanlam databasis. Die periode van ontleding strek vanaf 2 Februarie 1987 tot 18 September 1992. Die keuse van die periode word beperk deur die vermoë van die programmatuur. 'n Belangrike oorweging was egter ook die uitsluiting van die atipiese wisselkoersgedrag van die volatiele 1985/1986 periode. Koerse van verandering word bepaal deur die verskil van die logaritmes van die sluitingspryse tussen twee opeenvolgende dae te bereken, d.i.

$$R_t = Log\left(\frac{S_t}{S_{t-1}}\right) \times 100$$

waar R_t die relatiewe verandering in die wisselkoers vanaf dag t-1 na dag t is met S_t die wisselkoers ten opsigte van dag t. 'n Sodanige R_t kan geïnterpreteer word as die benaderde persentasie verandering in die wisselkoers vir klein veranderinge (tot 15% volgens Westerfield (1977:183)). Die gebruik van logaritmiese verskille het die verdere voordeel dat dit stasionariteit in die modelleringsproses skep, dat dit simmetries is ten opsigte van die keuse van die "tuis"-geldeenheid en dat dit neutraal is ten opsigte van die metingseenheid en dus die vergelyking tussen verskillende geldeenhede vergemaklik.

Tabel 1 bevat 'n aantal opsommende statistiese maatstawwe van die Suid-Afrikaanse Rand/Dollar-wisselkoers wat vergelyk word met soortgelyke maatstawwe ten opsigte van die Britse Pond (BP), Kanadese Dollar (KD), Duitse Mark (DM), Japanese Jen (JY), Switserse Frank (SF) en die Kommersiële Rand (KR) en die Finansiële Rand (FR) bereken deur De Kock (1991), maar oor die onderskeie periodes 1 Augustus 1985 tot 7 Desember 1990 en 4 Februarie 1986 tot 7 Desember 1990. Alle geldeenhede is in terme van VSA Dollars uitgedruk.

Die gemiddeldes is baie klein. Die variasiebreedtes is egter betreklik hoog, veral in die geval van die Kommersiële Rand gedurende Augustus/September 1986 toe omvattende sanksies teen Suid-Afrika ingestel is, met 'n maksimum waarde van 10,8204% en 'n minimum waarde van -25,5074%. Histogramme (nie ingesluit nie) toon dat die data unimodaal en nagenoeg simmetries is wanneer 1985 uit die steekproef uitgesluit word. Die eindgedeeltes van die verdelings is egter swaarder as wat onder die normale verdeling verwag word. Hierdie gevolgtrekking word bevestig deur die koëffisiënte van kurtose in die



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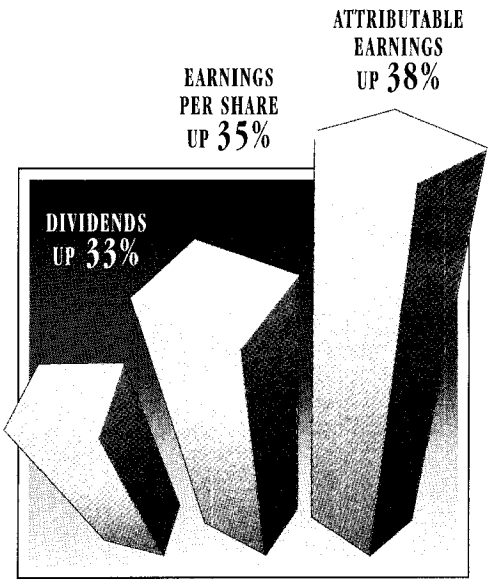

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geval van al die wisselkoersverdelings. Die resultate bevestig ook die leptokurtiese gedrag wat Pahn en Smit (1992) in Suid-Afrikaanse wisselkoerse waargeneem het.

TABEL 1

Opsommende maatstawwe van 'n aantal wisselkoerse*

	Steekproef periode	Gemiddelde	Standaardafwyking	Skeefheid	Kurtose
Britse Pond	02/01/74-30/12/83	-0,0184	0,5921	-0,4136	8,8997
Kanadese Dollar	02/01/74-30/12/83	-0,0089	0,2234	-0,3149	8,6144
Duitse Mark	02/01/74-30/12/83	0,0005	0,6372	-0,4249	12,7913
Japanese Yen	02/01/74-30/12/83	0,0077	0,6260	-0,2044	11,2712
Switserse Frank	02/01/74-30/12/83	0,0171	0,7889	-0,2835	10,2244
KR (De Kock)	01/08/85-7/12/90	0,0093	1,2014	-5,7798	158,9390
FR (De Kock)	04/02/86-07/12/90	0,0133	1,6816	0,2736	6,5261
Kommersiële Rand	02/02/87-18/09/92	0,0213	0,5009	0,0732	8,3037
Finansiële Rand	02/08/87-18/09/92	-0,0053	1,3679	0,1486	6,6954

*Data is uitgedruk as $R_t=Ln(S_t/S_{t-1})*100$

3. TOETSE VIR ONAFHANKLIKE IDENTIESE VERDELINGS

In navolging van Hsieh (1988), wat bevind dat die verdelings ten opsigte van al vyf wisselkoerse nie identies oor substeekproewe is nie, verdeel De Kock (1991) sy datastelle in gelyke dele deur die toepassing van 'n chi-kwadraat toets vir die gelykheid van multinomiale verdelings. Na gebruikmaking van 'n verskeidenheid klasintervalkeuses, toon hy aan dat die oiv-aaname telkens verwerp word.

Een van die moontlikhede wat hieruit volg, is dat die verdelings oor tyd mag verander, 'n sub-moontlikheid waarvan weer is dat die verdelings mag verskil oor verskillende weeksdae, 'n analoog aan die sogenaamde dag-van-die-week effek wat goed ten opsigte van aandelemarkdata gedokumenteer is. De Kock (1991) verdeel sy datastel in vyf substeekproewe volgens die dag van die week en vergelyk die dae paarsgewys ten opsigte van die oiv-aanname. In vier uit die tien gevalle kan die nulhipotese van identiese verdelings by die 1% betekenispeil verwerp word.

In 'n poging om vas te stel of die dag-van-die-week effek verantwoordelik is vir die oorhoofse verwerping van die oiv-hipotese, word elke sub-steekproef in twee verdeel en die chi-kwadraat toetse herhaal. In alle gevalle word die hipotese nog steeds by die 1% betekenispeil verwerp, wat lei tot die gevolgtrekking dat dit nie die dag-van-die-week effek is wat tot die oorhoofse verwerping van die oiv-hipotese lei nie.

4. TOETSE VIR OUTOKORRELASIE

'n Alternatiewe afleiding wat uit die verwerping van die hipotese van onafhanklike en identiese verdelings gemaak kan word, is dat die data outogekorreleerd mag wees. Betekenisvolheid is ontleed met behulp van Diebold (1986) se heteroskedastisiteitskonsekwente standaardfoute. Dieselfde ontledings word weergegee ten opsigte van die gekwadreerde data.

Die resultate van sogenaamde saamgestelde toetse, nl. die Ljung-Box toets, die Box-Pierce toets en die heteroskedastisiteitskonsekwente Box-Pierce toets word in Tabel 2 verstrek.

By die Finansiële Rand is daar geen outokorrelasie teenwoordig nie, terwyl die Ljung-Box en Box-Pierce toetse op die teenwoordigheid van outokorrelasie in die Kommersiële Randwaardes dui. Hsieh (1988) waarsku egter teen hierdie interpretasie in die teenwoordigheid van heteroskedastisiteit omdat dit lei tot die onderskatting van die standaardfout van die outokorrelasiekoëffisiënt. Daarom behoort meer vertroue in die aangepaste Box-Pierce waardes gestel te word. Alhoewel hierdie statistieke vir die Kommersiële Rand neig in die rigting van betekenisvolheid, is dit beide ten opsigte van 12- en 50-periode sloerings nie betekenisvol by die 1% betekenispeil nie. Dit impliseer dat die verwerping van outokorrelasie in die geval van die standaard Box-Pierce maatstaf aan die teenwoordigheid van heteroskedastisiteit toegeskryf kan word.

TABEL 2

Saamgestelde toetse vir outokorrelasie*

Maatstaf en sloerings	Kommersiële Rand		Finansiële Rand	
	R_t	R_t^2	R_t	R_t^2
Ljung-Box (12)	41,6381 (0,0000)	126,6751 (0,0000)	19,2884 (0,0818)	144,7354 (0,0000)
Box-Pierce (12)	41-4173 (0,0000)	126,0827 (0,0000)	19,2045 (0,0837)	144,1736 (0,0000)
Aangepaste Box-Pierce (12)	24,9738 (0,0150)		12,4444 (0,4107)	
Box-Pierce (50)	102,5912 (0,0000)	284,8515 (0,0000)	57,7810 (0,2098)	247,4472 (0,0000)
Aangepaste Box-Pierce (50)	69,6192 (0,0346)		44,4798 (0,6937)	

*p-waardes word tussen hakies aangetoon

In die geval van beide wisselkoerse is daar egter ten opsigte van die gekwadreerde data 'n baie sterk aanduiding van outokorrelasie, wat op die teenwoordigheid van voorwaardelike heteroskedastisiteit dui. De Kock (1991) het sy datastel aan die gemodifiseerde Levene toets (Browne en Forsythe, 1974) onderwerp, deur die data in kalendermaande te groepeer en te toets vir verskille tussen die variansies. Sterk tekens van heteroskedastisiteit (by die 1% betekenispeil) het gematerialiseer.

Die aanvanklike data-ontleding dui dus, soos in ander studies:

(i) op leptokurtiese verdelings;
(ii) die afwesigheid van outokorrelasie in daaglikse verskille, maar die duidelike teenwoordigheid van outokorrelasie in die gekwadreerde verskille (sogenaamde tweede- of hoër-orde outokorrelasie); en
(iii) op gemiddeldes en variansies wat oor tyd verander.

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INCE

5. MODELBOU EN -IDENTIFIKASIE

'n Nuwe klas modelle, die sogenaamde outoregressiewe voorwaardelike heteroskedastisiteitsmodelle, wat in die literatuur verskyn het, poog om hierdie datakarakteristieke te modelleer. Onder andere het Hsieh (1988, 1989), Milhj (1987), Diebold en Nerlove (1989) en Baillie en Bollerslev (1989) wisselkoersbewegings met verskillende variante van die outoregressiewe voorwaardelike heteroskedastisiteitsmodelle (OVH-modelle) beskryf.

In hierdie artikel is drie tipes OVH-modelle oorweeg. Die eerste hiervan is die suiwer OVH-model wat as volg gespesifiseer word (Engle, 1982):

$$R_t = B_0 + \sum_{i=1}^{r} \beta_i X_{it} + \epsilon_t \qquad (1)$$

met

$$h_t = \alpha_0 + \sum_{j=1}^{s} \delta_j Y_{ij} + \sum_{k=1}^{p} \alpha_k \epsilon_{t-k}^2 \qquad (2)$$

waar vergelyking (1) die gemiddelde term verteenwoordig met X_i 'n verklarende veranderlike wat sloeringswaardes van R_t kan insluit, en ϵ_t die fouteterm is wat normaal (o, h_t) verdeel is. Vergelyking (2) beskryf h_t, die sogenaamde voorwaardelike variansie, wat 'n funksie is van verklarende veranderlikes Y_j, wat nie die X_i's uitsluit nie. Verder moet $\alpha_0 > 0$ en $\alpha_k \geq 0$ en

$$\sum_{k=1}^{p} \alpha_k < 1.$$

'n Variant van bogenoemde model is die sogenaamde veralgemeende OVH-model (VOVH) (Bollerslev, 1986) wat as volg gespesifiseer word:

$$R_t = \beta_0 + \sum_{i=1}^{r} \beta_i X_{it} + \epsilon_t$$

met

$$h_t = \alpha_0 + \sum_{j=1}^{s} \gamma_j Y_{jt} + \sum_{k=1}^{p} \alpha_k \epsilon_{t-k}^2 + \sum_{l=1}^{a} \lambda_l h_{t-1}$$

waar die gemiddelde term identies is aan dié van die OVH-model en die res van die simbole soos voorheen gedefinieer is. Verder moet $\alpha_0 > 0$, en $\alpha_k, \lambda_l \geq 0$ en

$$\sum_{k=1}^{p} \alpha_k + \sum_{l=1}^{q} \lambda_l < 1.$$

'n Tweede variant van die OVH-model, is die sogenaamde geïntegreerde VOVH-model (IVOVH), met dieselfde gemiddelde term as voorheen, en dieselfde voorwaardelike variansie as tevore, maar met

$$\sum_{k=1}^{p} \alpha_k + \sum_{l=1}^{q} \lambda_l = 1.$$

Die gemiddelde term is ten aanvang gespesifiseer in navolging van De Kock (1992), deur die keuse van vyf fopveranderlikes, vier ten opsigte van die eeste vier weeksdae en 'n vyfde ten opsigte van vakansiedae, tesame met 'n een-periode sloering in die afhanklike veranderlike. As gevolg van 'n programmatuurtekortkoming, kon die fopveranderlikes nie in die gemiddelde term van die Finansiële Rand ingesluit word nie, daar dit tot negatiewe skattings van variansies aanleiding gegee het.

Die volgende werkswyse is gebruik om die finale modelle te identifiseer en te skat. In die eerste plek is die gemiddelde term, soos hierbo uiteengesit, geskat met behulp van die metode van kleinste kwadrate. Die gekwadreerde foutterme uit die geskatte model word gebruik om die orde van die voorwaardelike variansie te bepaal. Bollerslev (1986) toon aan dat die outokorrelasies en parsiële outokorrelasies van die foutterme van die gemiddelde vergelyking gebruik kan word in modelidentifikasie op analoë wyse as in Box-Jenkins identifikasie. Die aantal betekenisvolle parsiële outokorrelasies dui op die orde van p, terwyl die aantal betekenisvolle outokorrelasies 'n aanduiding bied van die orde van q. Vervolgens is die maksimum-aanneemlikheidsverhoudingstoets gebruik om die finale model te identifiseer.

Die proses het gelei tot die skatting van 'n VOVH(1,1)-model ten opsigte van die Kommersiële Rand en 'n VOVH(1,2)-model ten opsigte van die Finansiële Rand. Die modelparameters word in Tabel 3 weergegee. Die geskatte VOVH-modelle word telkens met 'n standaard outoregressiewe model van orde 1 vergelyk, ten einde die foutegedrag te bestudeer. Die eerste vier β's verteenwoordig die parameters van die eerste 4 weeks-dae, terwyl β_5 die parameter is ten opsigte van 'n fopveranderlike wat vakansiedae aandui. β_6 's die koëffisiënt van die gesloerde waarde van die afhanklike veranderlike en die konsekwente afwesigheid van betekenisvolheid dui op stogastiese lopiegedrag in die gemiddelde term. Die hoogs betekenisvolle OVH- en VOVH-koëffisiënte impliseer dat die data wel in die tweede orde afhanklik en dus heteroskedasties is.

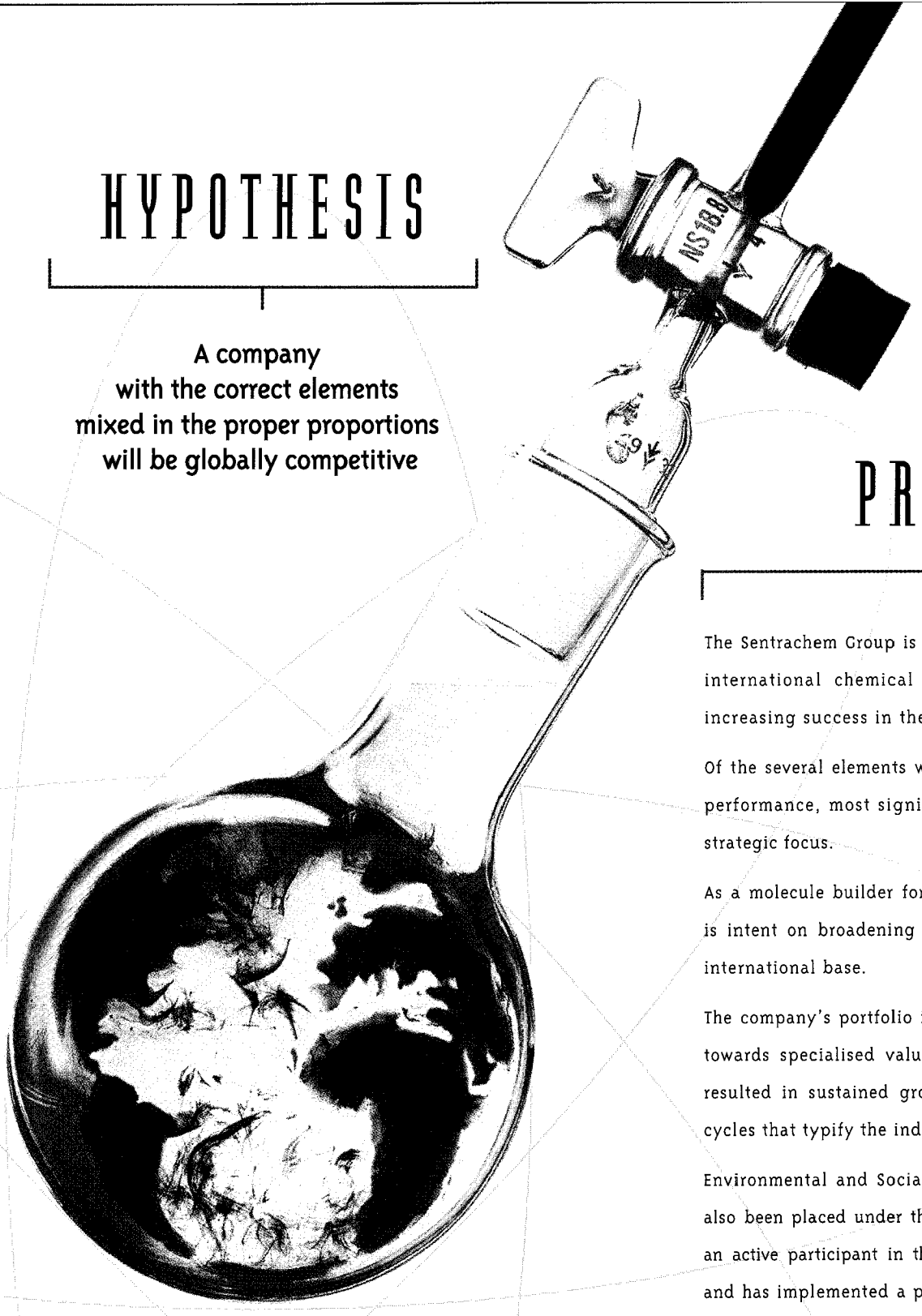
TABEL 3
Geskatte parameters*

		Kommersiële Rand		Finansiële Rand	
	Parameters	OR(1)	VOVH(1,1)	OR(1)	VOVH(1,2)
Gemiddelde vergelyking	β_0	0,02387 (0,3518)	0,03307 (0,1352)	-0,00622 (0,8764)	0,01275 (0,6774)
	β_1	-0,1098 (0,7514)	-0,05037 (0,1032)		
	β_2	-0,00424 (0,9182)	-0,03778 (0,2516)		
	β_3	-0,00650 (0,8694)	-0,00917 (0,7770)		
	β_4	0,00115 (0,9718)	0,00418 (0,9056)		
	β_5	-0,04450 (0,9498)	-0,03702 (0,9126)		
	β_6	-0,03633 (0,1238)	-0,01348 (0,6254)	0,02789 (0,0558)	0,04935 (0,0878)
Voorwaardelike variansie	α_0	0,2323 (0,0000)	0,00526 (0,0000)	1,82208	0,10223 (0,0000)
	α_1		0,09585 (0,0000)		0,13455 (0,0000)
	α_2		0,0000		-0,03442 (0,1304)
	λ_1		0,88868 (0,0000)		0,84950 (0,0000)
	Som		0,98453		0,94964

*Betekenispeil tussen hakies

HYPOTHESIS

A company
with the correct elements
mixed in the proper proportions
will be globally competitive



PROOF

The Sentrachem Group is a leading South African and international chemical company that is enjoying increasing success in the global marketplace.

Of the several elements which are key to the Group's performance, most significant is its clearly defined strategic focus.

As a molecule builder for world markets, Sentrachem is intent on broadening its already well established international base.

The company's portfolio is being balanced by a shift towards specialised value added products. This has resulted in sustained growth even during the down cycles that typify the industry.

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Conclusion? The Sentrachem formula is working. And it's one that augurs well for the future. Of both the company and all its stakeholders.

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Daar die somme van die geskatte koëffisiënte van die VOVH-modelle onderskeidelik 0,94964 en 0,98453 beloop het (waardes na aan 1 is 'n aanduiding van IVOVH-gedrag) is daar ten opsigte van beide wisselkoerse ook IVOVH-modelle geskat, wat die volgende resultate opgelewer het ten opsigte van die voorwaardelike variansie (betekenisperke tussen hakies):

Finansiële Rand:

h_t = 0,0568 + 0,1441 ϵ^2_{t-1} +(1-0,1441) h_{t-1}.
(0,0000) (0,0000)

Kommersiële Rand

h_t = 0,0032 + 0,1021 ϵ^2_{t-1} +(1-0,12128) h_{t-1}.
(0,0000) (0,0000)

In beide gevalle is die OVH- en VOVH-koëffisiënte hoogs betekenisvol. Geen verdere ontleding ten opsigte van hierdie twee modelle is uitgevoer nie, aangesien die maksimum-aanneemlikheidswaardes telkens domineer is deur die modelle vervat in Tabel 3.

Vervolgens is die foutterme van elke model ontleed. Die foutterme is as volg gestandaardiseer:
$A_t = \epsilon_t s^{-1}$ en $A'_t = \epsilon^2_t s^{-2}$ vir die OR(1)-model met A_t en A'_t die foutterme en die gekwadreerde foutterme en $s^2=\alpha_0$. Vir die VOVH-modelle is die volgende standaardiserings-proses toegepas:

$$Z_t = \epsilon_t h_t^{-\frac{1}{2}} \text{ en } Z'_t = \epsilon^2_t h_t^{-1}$$

Tabel 4 bevat opsommende statistiese maatstawwe ten opsigte van die gestandaardiseerde foutterme van die Kommersiële Rand terwyl dieselfde gegewens ten opsigte van die Finansiële Rand in Tabel 5 verstrek word.

TABEL 4
Kommersiële Rand: Gestandaardiseerde foutterme*

	OR(1)		VOVH(1,1)	
Maatstaf	A_t	Z_t	A'_t	Z'_t
Steekproefgrootte	1471	1471	1471	1471
Gemiddelde	0,0076	1,0777	0,0172	1,0037
Standaard-afwyking	1,0385	2,9093	1,0021	2,3416
Minimum	-6,4179	0,0000	-5,6547	0,0000
Maksimum	6,8672	47,1589	5,0574	31,9743
Kurtose	8,2749	93,1664	6,4233	57,8962
Skeefheid	0,0696	7,9975	0,1935	6,3693
Ljung-Box (12)	39,0386 (0,0000)	126,3882 (0,0000)	25,2000 (0,0139)	10,1485 (0,6029)
Box-Pierce (12)	38,8199 (0,0000)	125,7937 (0,0000)	25,0609 (0,0145)	10,0885 (0,6082)
Aangepaste Box-Pierce (12)	23,3402 (0,0250)		22,0609 (0,0282)	
Box-Pierce (50)	100,5279 (0,0000)		70,0715 (0,0320)	53,0590 (0,3571)
Aangepaste Box-Pierce (50)	68,0112 (0,0459)		65,1743 (0,0755)	

*Betekenispeil tussen hakies

TABEL 5
Finansiële Rand: Gestandaardiseerde foutterme*

	OR(1)		VOVH(1,2)	
Maatstaf	A_t	Z_t	A'_t	Z'_t
Steekproefgrootte	1471	1471	1471	1471
Gemiddelde	0,0007	1,0253	-0,0033	0,9879
Standaard-afwyking	1,0129	2,4471	0,9942	2,5428
Minimum	-4,8161	0,0000	-5,2010	
Maksimum	5,1267	26,2831	7,1721	0,0000
Kurtose	6,6877		7,6219	
Skeefheid	0,1412		0,4321	
Ljung-Box (12)	18,5186 (0,1008)	145,595 (0,0000)	12,9775 (0,3707)	3,6808 (0,9885)
Box-Pierce (12)	18,43652 (0,1031)	145,034 (0,0000)	12,9088 (0,3757)	3,6612 (0,9888)
Aangepaste Box-Pierce (12)	11,9588 (0,04490)		12,3876 (0,4151)	
Box-Pierce (50)	57,5629 (0,2156)	246,634 (0,0000)	47,5518 (0,5722)	28,2409 (0,9940)
Aangepaste Box-Pierce (50)	44,4796 (0,6937)		47,7893 (0,5655)	

*P-waardes tussen hakies

Wat van belang is, is die toetsmaatstawwe ten opsigte van die gekwadreerde data. Soos reeds uitgewys, is die Ljung-Box en Box-Pierce maatstawwe hoogs betekenisvol vir die oorspronklike data. Na passing van die VOVH-modelle het daar egter 'n merkbare verbetering by die maatstawwe ingetree. Vir die Finansiële Rand het die Ljung-Box (12) maatstaf vir die gekwadreerde residu van 'n hoogsbetekenisvolle 145,60 tot 'n nie-betekenisvolle 3,6808 in die VOVH-model afgeneem. Dieselfde tendens is ook waarneembaar in die geval van die Box-Pierce (12) maatstaf. Dieselfde tendens is ook waarneembaar by die Kommersiële Rand waar die maatstawwe verander vanaf hoogs betekenisvol tot nie-betekenisvol.

Hierdie ontleding het dus: (i) die teenwoordigheid van voorwaardelike heteroskedastisiteit in wisselkoersbewegings aangetoon en (ii) modelle opgelewer wat hiervoor voorsiening maak. Dit dien egter vermeld te word dat die gestandaardiseerde foutterme nog steeds leptokurties is wat daarop dui dat na modellering van tydveranderlike gemiddeldes en variansies nog steeds nie volledige verklaring bied vir swaar eindoppervlaktes in die verdelings van wisselkoersveranderings nie. Die onderliggende normaliteitsaanname bly dus onder verdenking.

6.'N BUITE-STEEKPROEF DOELTREFFENHEIDSONTLEDING

Ten einde die akkuraatheid van die variansie-skattings te ontleed, is in navolging van Akgiray (1989) die data opgedeel in twee dele naamlik R_1, R_2,....., R_{T-240}, en R_{T-239}, R_{T-238},...., R_{T-20} met T die steekproefgrootte. Die aanvanklike model word nou geskat deur die eerste T-240 waardes te gebruik. Hierna is 'n vooruitskatting van die volgende maand se variansie (20 werksdae) gedoen.

Vir die daaropvolgende maand word modellering gedoen deur die eerste 20 waardes te ignoreer en 'n daaropvol-

gende 20 waardes by te voeg. In totaal word daar dus 12 vooruitskattings gemaak. In die geval van die Kommersiële Rand kon slegs 9 vooruitskattings gemaak word, aangesien dit gebeur het dat die voorwaardelike variansie in enkele gevalle 0 en kleiner as 0 geword het.

Die werklike variansie vir maand s (s = 1, 2,...., 12) wat dag z (z = T-240, T-220,...., T-20) volg, word deur Akgiray (1989) gegee as:

$$V_{s,z} = \sum_{i=1}^{20}(R_{z+i} - \bar{R})^2 \left[1 + 0,10\sum_{j=0}^{19}(20-j)\phi^j\right]$$

met $\bar{R}$ die rekenkundige gemiddelde en ϕ die outokorrelasie vir sloerperiode een. Hierdie $V_{s,z}$-waardes word vervolgens vergelyk met die volgende twee vooruitskattings van die variansie:

(i) Historiese gemiddelde

$$V'_{s,z} = \frac{20}{T-240}\sum_{t=z-T+241}^{z}(R_t - \bar{R})^2.$$

wat die beste skatting onder witruis behoort te wees.

(ii) VOVH-vooruitskattings

Akgiray (1989:74) toon aan dat die voorwaardelike variansie geskryf kan word as

$$V''_{s,z} = \sum_{i=1}^{20}\left(\frac{1-\phi^i}{1-\phi}\right)^2\left[A^{20-i}V_{z+1} + \sum_{j=0}^{19-i}\alpha_0 A^j\right]$$

met ϕ die outokorrelasie vir sloerperiode 1, *A* die som van die OVH- en VOVH-koëffisiënte en V_{Z+1} soos bepaal deur die vergelyking van die voorwaardelike variansie. Die laaste term onder die sommasieteken is gelyk aan 0 vir i=20.

Die vooruitskattingsakkuraatheid word geëvalueer deur die berekening van die volgende maatstawwe:

Definieer E_s as die vooruitskattingsfout dan is:

Gemiddelde fout (GF): $\frac{1}{12}\sum_{s-1}^{12}E_s$;

Vierkantswortel van die gemiddelde van die gekwadreerde foute (VGKF): $\left[\frac{1}{12}\sum_{s=1}^{12}E_s^2\right]^{\frac{1}{2}}$;

Gemiddelde absolute fout (GAF): $\frac{1}{12}\sum_{s=1}^{12}\left|\frac{E_s}{V}\right|$; en

en Gemiddelde absolute % fout (GAPF): $\frac{1}{12}\sum_{s=1}^{12}\left|\frac{E_s}{V}\right|$.

Die foutemaatstawwe word in Tabel 6 opgesom. Sydigheid, soos gemeet deur die gemiddelde fout, is kleiner in die geval van beide wisselkoerse onder die VOVH-model as onder die historiese model. Die akkuraatheid van vooruitskattings het verder toegeneem deur gebruikmaking van die VOVH-model soos gemeet deur al drie ander foutmaatstawwe.

TABEL 6
Foutemaatstawwe

	Kommersiële Rand		Finansiële Rand	
Maatstaf	VOVH	Histories	VOVH	Histories
GF	0,8213	2,8979	-0,3663	-0,6014
VGKF	2,1209	3,2661	22,8645	24,0753
GAF	1,9062	2,8979	19,4127	19,4033
GAPF	0,1277	0,2246	1,0093	1,1201

Die gevolgtrekking is dat die VOVH-model die potensiaal inhou om die risikoberamings van wisselkoersbewegings, soos gemeet deur variansies, te verbeter.

7. GEVOLGTREKKINGS

In aansluiting by Hsieh (1988) word bevind dat in die geval van die Suid-Afrikaanse Rand/Dollar wisselkoers:

(i) die verdelings ten opsigte van dae van die week verskil, maar dat dit nie voldoende is om die oiv-aanname te verwerp nie;

(ii) dat daar min eerste-orde outokorrelasie in die data bestaan;

(iii) daar wel hoër-orde afhanklikheid teenwoordig is deurdat die voorwaardelike variansies oor tyd verander;

(iv) dat hierdie proses deur middel van die OVH- en VOVH-modelle gemodelleer kan word en dat hierdie modelle tot beter risikovooruitskattings as tradisionele histories modelle lei; en

(v) dat hierdie modellerings nie voldoende verklaring bied vir die leptokurtose wat daar in die verdelings van wisselkoersveranderings bestaan nie. Verdere navorsing aangaande verdelingsvorme verdien aandag.

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Modelling systematic risk and return using accounting-based information

ABSTRACT

The study explored the linkages between the financial parameters of a firm derived from reported accounting data, and systematic risk as described by estimated market beta coefficients. The relationships between financial variables and risk proposed by previous theoretical and empirical research were tested for 135 JSE-listed Industrial companies, in each of three consecutive 5-year periods. Correlation analysis and stepwise multiple regression were used to establish significant explanatory beta models. Strong positive associations with risk were found for measures of firm growth, profitability, leverage and the variabilities of earnings and cashflows. Significant negative relationships emerged for liquidity, stock turnover and dividend yield.

Secondly, the linkages between the same financial parameters and observed equity returns were tested in a multifactor asset-pricing model for the same sample. Measures of firm growth, profitability and size were positively correlated to share returns, while the variabilities of earnings and cashflows as well as debtors' collection period were negatively related.

For both betas and equity returns, correlations with financial parameters improved for portfolios of shares. Several of the significant financial variables were derived from cashflow-based data, as opposed to standard accrual-accounting values. While significant regression models emerged for risk and return in each of the 5-year analysis periods, they were non-stationary across the periods. Consequently, fairly poor predictive performance was observed for the models over consecutive time intervals. Nevertheless, it was apparent that certain classes of fundamental financial data were strongly related to beta as a measure of systematic risk, and to *ex post* share returns.

INTRODUCTION

The pricing of financial assets is a key concern of finance research. In particular, much effort has been directed at incorporating the concept of risk into valuation models to reflect the variability of returns. The measurement of systematic risk as defined by beta has attracted criticism since the Capital Asset Pricing Model (CAPM) was originally postulated, with Fouse, Jahnke and Rosenberg (1974 p.70) summing up the controversy in likening beta to an imaginary substance called "phlogiston", a concept invented to explain the disappearance of matter during combustion and described as "a stepping stone between alchemy and modern chemistry". The analogy characterised beta as merely a technical signal with mysterious underpinnings and little association to any comprehensible characteristics of either the firm or the stock market.

Recently, the questioning of asset pricing based on beta estimates has intensified. A landmark paper by Fama & French (1992) cast doubts on the validity of the CAPM by finding no significant relationship between average return and systematic risk of common stocks. Instead, their research indicated that market capitalisation and the price-to-book ratio for a firm dominated return. A flood of commentary and counter-research has ensued. Bernstein (1992) claimed that by eliminating the traditional relationship between risk and return, the Fama-French research implied some kind of 'free lunch', while Amihud, Christensen and Mendelson (1992) repeated the Fama-French study using two novel econometric methods which improved estimation efficiency and provided more powerful test statistics, resulting in a highly significant relationship between average portfolio returns and systematic risk. However, their methods were controversial. Roll & Ross (1993) highlighted the sensitivity of the risk-return relationship to the choice of market proxy, which they claimed could produce spurious statistical results. As strong proponents of Arbitrage Pricing Theory, the CAPM's main rival, they have suggested that models based on macroeconomic variables such as inflation and interest rates offer better explanatory power and are less prone to estimation error.

Beta estimation has been criticised in similar vein to other time-series forecasting methods, namely that *ex post* returns are used to develop a model for forecasting *ex ante* returns. Marston and Harris (1993) stated that while the assumption of realised historical returns as a proxy for future expectations may be true over long sweeps of history, it was inappropriate for shorter time frames in a risky market. The authors studied the relationship between beta and *expected* returns, as derived from several analysts' forecasts, and showed a strong positive risk-return relationship.

In particular, while betas based on historical returns have been widely applied in asset pricing, researchers have noted that the beta estimation procedure is subject to the following statistical problems:

- Non-stationarity of estimated betas between different measurement periods. This has been highlighted by many authors (Levy 1971, Blume 1971). Non-stationarity has been ascribed in part to estimation errors, for which Vasicek (1973) offered a Bayesian approach to combining cross-sectional information in the estimation of betas which reduced such errors.

- The effect of thinly traded markets on beta estimation has also been extensively researched. Dimson (1979) observed that significant downward biases in estimates could result for securities that were thinly traded, and proposed an 'aggregated coefficients' method for providing an unbiased beta estimator. Bowie and Bradfield (1993a and b) showed that South African beta estimates could be further improved by using a trade-to-trade measurement technique.

- An inherent 'survivorship bias' exists in the market return, since market index performance is measured only on shares which are listed at a given point in time.

A further significant shortcoming of traditional beta estimation is that it cannot be applied to unlisted firms or

business units of conglomerates for which no market return data is available. The 'similar firm' or 'pure play' approach has been suggested for these cases, whereby the beta for a listed firm wholly or largely engaged in the same type of business as the private firm is used as a proxy. The practicality of this method has been questioned (Ehrhardt & Bhagwat, 1991), and is particularly problematic in South Africa where very few single-activity firms are listed on the Johannesburg Stock Exchange (JSE) (Firer & Thompson, 1993). Baer (1993) showed empirically that neither financial categories nor industry groups provided good proxies for systematic risk classes.

The primary goal of this research has been to extend previous work done in the area of microeconomic modelling of systematic risk. In broad terms, several firm-specific factors have been tested for significance in determining measured betas. The choice of factors was based on the results of existing studies of the theoretical and empirical relationships between financial parameters of firms and their systematic risk.

A further objective was to examine the relationship between firm-specific parameters and the returns achieved by shareholders.

LITERATURE REVIEW

The empirical studies in this area have taken two broad directions, namely those that have sought to establish univariate relationships between systematic risk and a single explanatory variable, and multivariate studies using numerous independent variables.

Univariate Studies

Hamada (1972) combined his theoretical derivation of the positive impact of financial leverage on systematic risk with an empirical exercise, which explained up to 24% of systematic risk over 304 firms by using gearing levels. Lev (1974) also carried out a confirmatory study to demonstrate modest explanatory power for systematic risk using his theoretically postulated operating leverage measure. Research into Canadian firms (Belkaoui, 1978) found significance for both the current ratio and long-term debt ratio in explaining beta. A South African study by Retief, Affleck-Graves & Hamman (1984) used several definitions of financial leverage, finding the highest correlation with risk when gearing was defined as:

$$\textit{Financial Leverage} = \frac{\textit{Total Assets} - \textit{Equity}}{\textit{Total Assets}}$$

Mandelker & Rhee (1984) combined operating and financial leverage in a single model, and found significant joint impact for the two types of leverage on systematic risk. Huffman (1989) repeated this study on more recent data, with mixed results. Another study (Bhandari, 1988) concluded that financial leverage was a highly significant determinant of systematic risk, with the relationship being robust to variations in market proxy and estimation technique. Ro, Zavgren & Hsieh (1992) assessed the change in beta for firms approaching bankruptcy, observing a steady rise as gearing and financial distress increased.

Several researchers have sought a relationship between market beta and an accounting-based beta. Gonedes (1973) defined an accounting beta based on earnings divided by book value of assets, but found no significant correlation between this measure and market beta. Beaver & Manegold (1975) tested three variants of accounting beta, and found significant correlations to market beta for all of them. The correlations were stronger for larger portfolios of securtities.

Moyer & Chatfield (1983) examined a composite measure of a firm's market power derived from asset size, total sales, proportion of industry sales and the industry's four firm concentration ratio. They demonstrated only a weak relationship between this market power measure and systematic risk, but found a significant negative relationship between risk and industry concentration. Sudarsanam (1992) demonstrated for a sample of UK firms that industry growth rate increased systematic risk, while capital intensity reduced it.

Multivariate Studies

The first significant multivariate study was undertaken by Beaver, Kettler & Scholes (1970), using dividend payout, growth in net book assets, financial leverage, liquidity, size, earnings variability and an accounting beta which attempted to measure cyclicality of earnings. Using a sample of 307 firms, both leverage and accounting beta showed strong positive correlations to systematic risk, and earnings variability together with dividend payout were also significant, with the expected signs.

Rosenberg & McKibben (1973) tried thirty-two variables, finding financial leverage, earnings volatility and growth in sales and earnings to be significantly positively related to beta. However, no significance was found for accounting beta or dividend payout. Some of the other significant variables had unexpected signs, and their model had only 2% more explanatory power than the naive assumption that beta equalled one for all firms.

Beta was found by Lev & Kunitzky (1974) to be significantly negatively related to dividend payout, as well as to indicators of 'smoothing' in a company's reported financial data, particularly smoothness of capital expenditure, dividends, sales and earnings. 'Smoothness' was defined effectively as the inverse of volatility, and thus this research confirmed earlier positive associations between earnings volatility and risk.

Melicher (1974) examined the electric utility industry, and found a significant multivariate model for beta incorporating dividend payout, ROE, market activity, plant to total capitalisation, and size. Although the pattern of signs was as expected, poor repeatability of results was found over different periods of measurement.

A study by Thompson (1976) used earlier research on corporate behaviour and characteristics to formulate 43 variables for explaining beta. Only three factors emerged as significant, stemming from fluctuations in earnings, dividends and an earnings multiple of the firm.

A South African study by Retief, Affleck-Graves & Hamman (1986) used eight variables, including financial and operating leverage, asset turnover, current ratio, return on assets, cash flow variability, an equity beta and a cashflow beta measure. They concluded that a share's market risk was sensitive to three classes of accounting data: financial structure, cash flow and liquidity. They also found that the correlation coefficients of their models improved as portfolios were formed, and suggested that

this was due to a reduction in measurement errors through portfolio averaging.

METHODOLOGY

Population: This was defined simply as the South African traded equity market, focusing only on the Industrial sector. The rationale for excluding other sectors lay in the differences in accounting procedures applied in the other major sectors, notably Mining and Financials, which presented significant problems in standardisation of accounting variables.

Sample Selection: The sample was constrained by the period for which shares were continuously listed, and particularly by the availability of financial data for the firms represented by these share returns. A large sample was sought to allow for reliable statistical analysis. A total of 135 Industrial shares were continuously listed from January 1978 to January 1993, for which monthly share returns could be calculated to allow beta estimation, and online financial data was available for these shares for the same period.

Data Collection: Two online sources were used to capture financial data for firms. Since the basis for standardisation of the financial data differed between these two sources, one was used to gather all firm-specific financial variables, while the other was used only to provide share price and market index information. Annual beta estimates were provided by the UCT Department of Mathematical Statistics' Financial Risk Service, using their most recent trade-to-trade algorithm with Bayesian adjustment (Bowie & Bradfield 1993a & b), shown to minimise the statistical estimation problems mentioned earlier.

Data Analysis: The primary statistical tool used was correlation analysis followed by multiple regression. In the latter case, stepwise methods were employed to determine which variables added significant explanatory power to the model, and to detect any multicollinearity which may have existed.

Since the betas were estimated over a 5-year period, all annual financial data were aggregated over 5 years to match the dependent variable. This was consistent with the methodology described by Stewart (1991 p. 453). The data collected spanned a 15-year period, and was divided into three 5-year subperiods to be used in three separate beta analyses. This allowed each set of betas used as dependant variables to be estimated using 60 months' non-overlapping returns. The variable names and definitions are included as Appendix 1.

The individual propositions were explored as follows:

Proposition 1: The significance of gearing was examined by correlating the financial leverage variable with levered betas, ie. beta estimates derived using actual market returns.

Proposition 2: The components of business risk were examined firstly by finding correlations between financial variables and unlevered betas, derived from the Hamada (1972) degearing formula:

$$\beta_U = \frac{\beta_L}{(1 + \frac{D_L}{S_L})}$$

with

β_L = Beta of levered firm
β_U = Beta of unlevered firm (Business risk β)
D_L = total market value of firm L debt
S_L = total market value of firm L equity

Since leverage was shown to have a strong impact on systematic risk in previous studies, the unlevering procedure was used to expose significant residual business risk relationships, and followed previous research (Stewart 1991). Furthermore, Chung (1989) demonstrated a theoretical link between financial leverage and business risk itself, suggesting an inverse relationship between them. If this were found to occur in an empirical context, it would possibly obscure other significant correlations.

Secondly, propositions 1 and 2 were combined in a composite analysis of all financial variables including leverage as independent variables, against levered market betas. In this case, correlation analysis was used to highlight significant relationships, and these financial variables were used to develop regression models for levered betas in each of the three data periods.

The predictive power of the regression models was assessed by performing two forecasting exercises, which predicted betas for the second and third data intervals based on the models developed for the first and second intervals' data respectively. The forecasts were then compared with the actual measured betas for these latter two periods.

Finally, an overall regression model was produced using the full 15-year data set by row-wise combination of the three data blocks.

Proposition 3: Portfolio effects were implicitly explored in propositions 1 and 2, by ranking the full sample of firms by their betas and aggregating groups of adjacent firms into portfolios, using equally-weighted averages to find portfolio betas. This was done to avoid creating a set of random portfolios with all aggregate betas tending to the market average, which would defeat the objective of this study. Correlation and regression analysis was then performed on equally-weighted averages of the corresponding financial variables, with portfolio sizes of 3,5 and 7 shares being tested.

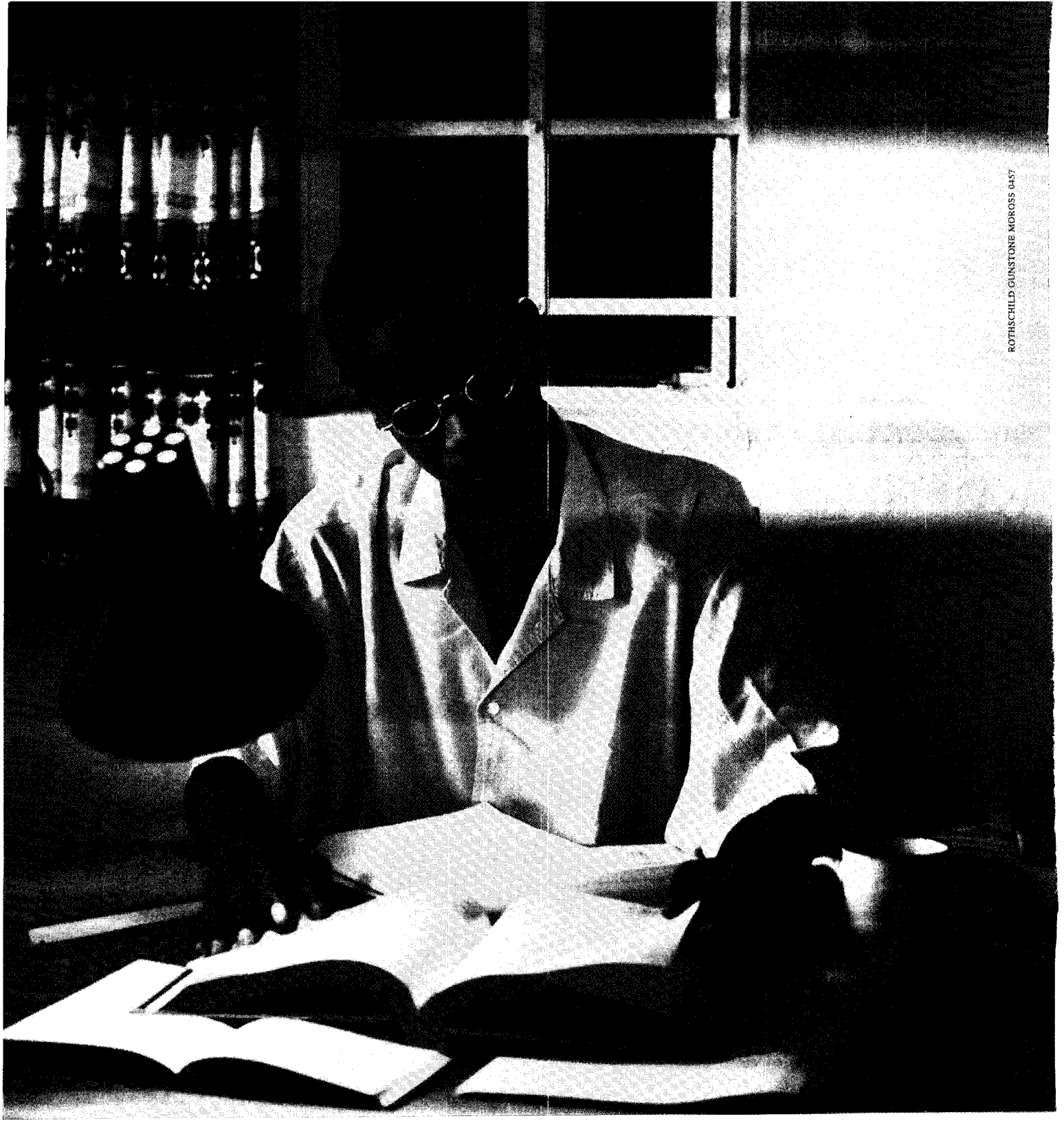
Proposition 4: A general multifactor form of the asset-pricing model was tested, as follows (after Sharpe, 1984):

$$R_a = R_f + b_m\beta_a(R_m - R_f) + \sum_{i=i}^{n} b_i X_i$$

where

R_a = Return on Security a
R_f = Risk Free Rate of Return
R_m = Market Rate of Return
β_a = Measured beta for security a
b_m = Regression
b_o = Intercept
X_i = Financial Variable i
b_i = Regression coefficient for X_i

This form was applied to a stepwise regression, preceded by correlation analysis, to indicate which financial variables contribued to determining share returns, either in addition to or in place of the return on the overall market. In effect, this analysis bypassed the traditional CAPM,



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making it possible to assess which financial parameters of the firm were significantly priced in total by investors in the shares of each firm.

This analysis used the same 5-year aggregates of financial variables for the independent variables. The corresponding 5-year returns on individual shares as well as for the market portfolio were derived as follows:

- Firstly, the annual return on each share was measured using the year-on-year percentage gain in annual average share price, where annual average share price was calculated from the total value of shares traded divided by total number of shares traded during the financial year of each firm. Annual returns were found for each year of the 15 year period, and then three 5-year averages were taken to derive share returns for the three separate analyses.
- For the market return, annual average values for the All-Share Index were found by taking the arithmetic mean of twelve monthly values. An annual average market return was found using the year-on-year percentage gain in annual average value of the index, for each year of the 15-year analysis period. Finally, three sets of 5-year averages were taken as above. However, to match the return on the market with the individual share returns (which were measured during each firm's financial year), it was necessary to find 5-year average market returns for each month of the year and extract the 5-year value corresponding to each respective firm's financial year-end.

It was not considered necessary to dividend-adjust either the share returns or the market returns used in the regressions, since the averaging described above would limit the observable 5-year effects.

Once again, three separate analyses were conducted to derive individual regression models for each consecutive 5-year period. The predictive power of these models was tested by forecasting returns for the latter two data intervals as described for the beta analysis. Finally, an overall explanatory model for returns was developed using the full 15-year data set through row-wise combination of the sub-intervals. Portfolio analysis was also conducted throughout, as per the procedure described in Proposition 3, but ranking shares by their returns prior to aggregating into portfolios.

Limitations: The research was subject to a few limitations:

- The problems surrounding beta estimation were not addressed in this study. The betas used may thus have been subject to measurement errors for a number of reasons, as discussed. Furthermore, no attempt was made to constrain the sample to well-traded shares, and hence thin-trading bias may have had an effect on the results.
- The question of market segmentation was not addressed in this study. The betas used were derived from the covariances of share returns against the Actuaries' All-Share Index, and CAPM testing of multifactor models was done using the same index as market proxy.
- The macroeconomic approach to asset pricing, based on Arbitrage Pricing Theory, was not addressed at all. Only microeconomic variables specific to individual firms were tested for significance.

The study was limited to a sample and survivor bias may exist. The issue of beta stationarity could not be comprehesively addressed in this study, which may have an effect on the applicability of the results to other time periods. Furthermore, the research was restricted to using financial variables for which published financial information was available. For example, the international diversity factor proposed by Stewart (1991) could not be tested since South African firms do not generally report the percentage of their revenues derived from offshore sources.

RESULTS

Financial leverage was tested for significant correlation to measured market betas, to assess the contention that financial risk due to gearing is a significant component of systematic risk. The leverage ratio used was

$$Financial\ Leverage = \frac{Total\ Assets - Equity}{Total\ Assets}$$

Separate analyses were carried out for each of the three time periods, namely 1978-1982, 1983-1987 and 1988-1992 and the results are shown on table 1.

TABLE 1
Financial leverage correlations with market Betas

PORTFOLIO SIZE	1	3	5	7
TIME PERIOD		1978 TO 1982		
Correlation Coeff. (r)	0.13908	0.28680	0.40097	**0.49670**
Significance Prob. (S)	0.1331	0.0691	0.0522	0.0425
TIME PERIOD		1983 TO 1987		
Correlation Coeff. (r)	**0.25445**	**0.46583**	**0.51977**	**0.66089**
Significance Prob. (S)	0.0040	0.0019	0.0077	0.0028
TIME PERIOD		1988 TO 1992		
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.17874**	**0.32423**	**0.36594**	**0.47239**
Significance Prob. (S)	0.0452	0.0362	0.0420	0.0478

It is notable that significant positive correlations were found at the 5% probability level (shown in bold) in all cases except for the 1978-1982 sample. For each of the three sample periods, the correlations improved as portfolio size increased, and for the first sample period this resulted in a significant correlation for a portfolio size of 7 shares.

This result agreed with the theoretical relationship postulated by Hamada (1972), as well as with the numerous empirical studies cited earlier. Specifically, the results confirmed the previous South African work by Retief *et al.* (1984), although their correlations were much higher than those above. However, their sample size was approximately half of that used for this research, being restricted to firms with a June year-end.

A number of firm-specific financial parameters were tested for significant correlations to an unlevered beta measure, calculated by applying the Hamada degearing formula to measured market betas. The results of the correlation analysis are summarised in three separate tables, describing each 5-year time period respectively. Only significantly correlated variables are listed.

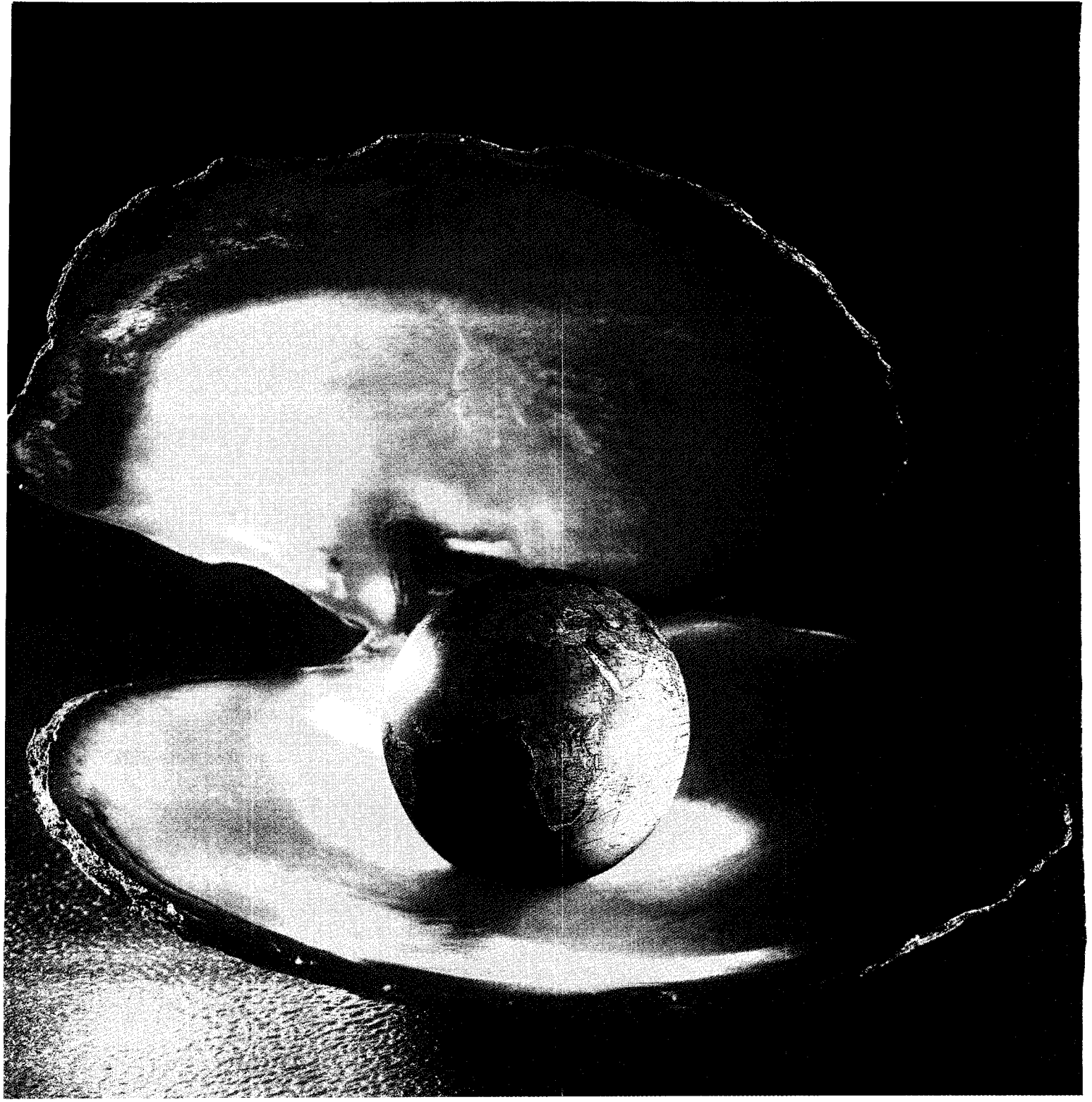

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TABLE 2
Correlations between financial variables and unlevered Beta

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.35705**	**0.61803**	0.19765	0.19404
Significance Prob. (S)	0.0011	0.0000	0.3546	0.4555
FINANCIAL VARIABLE	STOCKTO: Turnover Rate of Stock			
Correlation Coeff. (r)	**-0.22999**	-0.27722	-0.19496	-0.35811
Significance Prob. (S)	0.0201	0.0793	0.3613	0.1581

Only two variables showed significant correlations for the first time period, and these became insignificant for larger portfolio sizes. Nevertheless, the relationships had the expected signs, with a growth measure being positively correlated to beta, agreeing with Fewings' (1975) theoretical model, as well as Stewart's (1991) 'strategic risk' factor. The negative relationship for stock turnover agreed with the risk-reduction effects of good asset management proposed by Stewart (1991). Examining the data for this variable, it became evident that a few firms in the sample, such as Pick 'n Pay, were strongly affecting the result. Excluding these as outliers rendered the correlations insignificant.

Numerous financial variables showed strong correlations with unlevered betas for the second time period, although some correlations were not significant for certain portfolio sizes. It must be noted that the online financial data collected was somewhat sparse for certain variables in particular time periods, and hence the degrees of freedom differed between individual pairwise correlations.

Nevertheless, growth in absolute turnover, operating profit, total assets and total available cashflow were positively related to beta, as well as year-on-year percentage growth in operating profit and total assets. The latter two were a more rigorous test of the relationship, since inflation effects were eliminated. Firm size measured by total assets was also positively correlated to beta, which was contrary to the negative relationship proposed by Stewart (1991). He claimed that this could be observed in the fact that larger firms had longer track record of managerial competence, and that the risk impact of decisions taken under uncertainty would be small relative to the firm's total assets. However, in this sample the *positive* correlation was attributed to the fact that larger firms on the JSE tended to be well-traded relative to the smaller ones, and the thin-trading effect (Dimson, 1979) caused a significant downward bias on the measured betas of the latter shares.

Liquidity was negatively related to beta, corroborating the finding of Retief *et al.* (1986), as were both measures of dividend yield. The latter agreed with the theoretical relationship postulated by Gurney (1982), but contradicted the classical Miller & Modigliani (1961) proposition of dividend irrelevance. It is suggested that this was an 'information effect' due to the co-movement of dividends with earnings.

Two of the profitability ratios were positively correlated to beta, supporting the contention that a component of business risk is due to investor uncertainty that future earnings will be sustained by highly profitable firms (Stewart, 1991). In addition, the variabilities of total available cashflow and of one of the profitability ratios were positively related to beta, confirming the findings of

TABLE 3
Correlations between financial variables and unlevered Beta

TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.23133**	**0.49184**	**0.62383**	**0.68515**
Significance Prob. (S)	0.0137	0.0013	0.0011	0.0024
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.33919**	**0.59310**	**0.74321**	**0.77724**
Significance Prob. (S)	0.0001	0.0001	0.0000	0.0002
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.41456**	**0.54657**	**0.68306**	**0.69089**
Significance Prob. (S)	0.0000	0.0003	0.0002	0.0021
FINANCIAL VARIABLE	GTOTCASH: Y/Y Growth in Total Cashflow			
Correlation Coeff. (r)	0.14871	0.29598	**0.46851**	**0.57597**
Significance Prob. (S)	0.1035	0.0637	0.0209	0.0155
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.33489**	**0.51014**	**0.62339**	**0.70032**
Significance Prob. (S)	0.0002	0.0008	0.0011	0.0017
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	-0.14829	**-0.42651**	**-0.44528**	**-0.54623**
Significance Prob. (S)	0.1045	0.0061	0.0292	0.0233
FINANCIAL VARIABLE	DIV1: Dividend Yield Measure 1			
Correlation Coeff. (r)	-0.16457	-0.31101	**-0.40617**	**-0.48517**
Significance Prob. (S)	0.0713	0.0508	0.0489	0.0484
FINANCIAL VARIABLE	DIV2: Dividend Yield Measure 2			
Correlation Coeff. (r)	-0.16544	**-0.31235**	**-0.40767**	**-0.48757**
Significance Prob. (S)	0.0697	0.0497	0.0480	0.0471
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	**0.19508**	**0.33834**	0.38646	0.44310
Significance Prob. (S)	0.0393	0.0327	0.0621	0.0749
FINANCIAL VARIABLE	PROFIT 2: Profitability Ratio 2			
Correlation Coeff. (r)	**0.19782**	**0.33408**	0.32368	0.53359
Significance Prob. (S)	0.0374	0.0351	0.1228	0.0274
FINANCIAL VARIABLE	VARTOTCF: Variability of Total Cashflow			
Correlation Coeff. (r)	**0.34476**	**0.46865**	**0.54059**	**0.62838**
Significance Prob. (S)	0.0001	0.0023	0.0064	0.0069
FINANCIAL VARIABLE	VARPROF 2: Variability in Profit Ratio 2			
Correlation Coeff. (r)	**0.28874**	**0.37243**	**0.45422**	0.17366
Significance Prob. (S)	0.0013	0.0180	0.0258	0.5050
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Profit			
Correlation Coeff. (r)	**0.21791**	**0.36864**	**0.41701**	0.36594
Significance Prob. (S)	0.0438	0.0209	0.0426	0.1486
FINANCIAL VARIABLE	GROWAST%: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.22101**	**0.46313**	**0.56359**	**0.57400**
Significance Prob. (S)	0.0296	0.0026	0.0041	0.0160

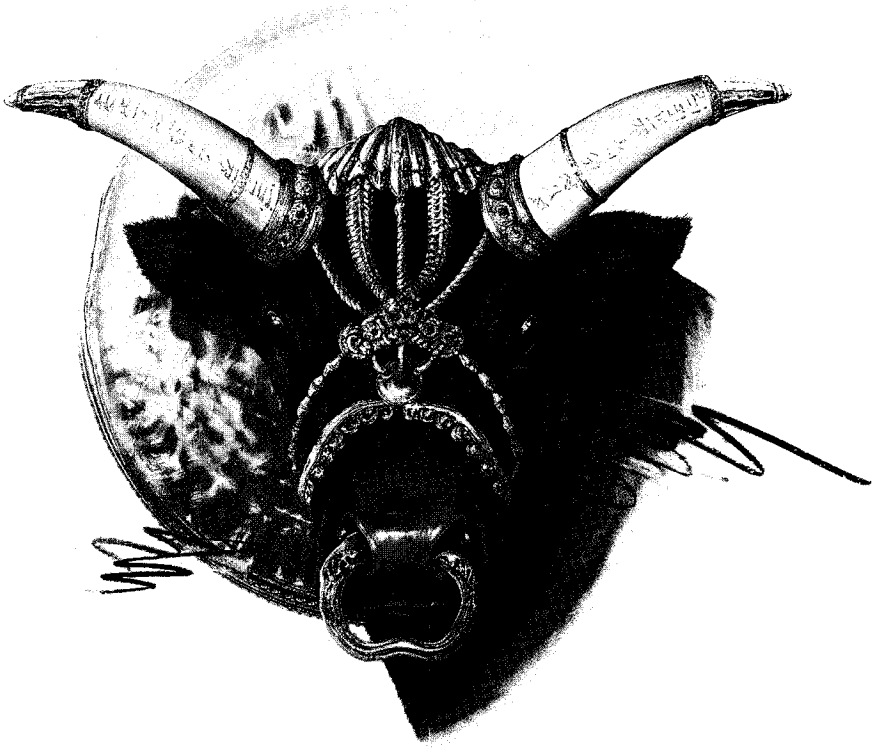
The intrinsic nature of gold has always inspired craftsmen to create items of beauty, not only for adornment but also as symbols of wealth and power. So, when gold coinage was introduced some 2 500 years ago, it was natural to relate its worth to something as prized, but of known value: namely, a healthy and mature ox.

Thus established, gold and gold coinage progressively contributed to wealth creation by stimulating international trade and expediting the development of rural societies.

As the twentieth century progressed, gold's monetary role dimmed and, for a brief period, it also lost some of its investment allure.

But gold is once again regaining strength and its significance as a measure of value is as relevant today as it was to the ancients.

It is said that he who ignores the lessons of history is condemned to repeat them. Although we no longer relate gold's value to that of an ox, we remain bullish about gold, reinforcing as it does our commitment to enriching man through minerals.



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Beaver *et al.* (1970), Rosenberg & McKibben (1973), Lev & Kunitzky (1974), Thompson (1976), Retief *et al.* (1986), and Stewart's (1991) 'operating risk' element. This was also intuitively logical, since beta as a convariance measure is intended to gauge risk as embodied in variability of return.

As for the previous time period, growth in turnover and total assets as well as year-on-year percentage growth in operating profit and total assets showed significant correlations in period 3, although not for every portfolio size tested. As before, firm size was positively correlated to beta, and liquidity showed negative correlations, although the latter was not significant at the 5% probability level. One variability measure, that of total available cashflow, was significantly positively correlated to beta.

The correlation analysis was repeated against market betas to expose significant relationships to allow for regression models to be constructed, with the levered beta as the dependent variable and those financial parameters found to be significant as independent variables. The summary regression statistics appear in Table 5.

It is apparent from Table 5 that while the regression models were fairly consistent for different portfolio sizes, they differed across the three time periods. This non-stationarity was due to changes in the relative significance of different financial variables over the time periods studied, and supported the notion that individual accounting parameters proxied for one another to some extent. Those with the greatest explanatory power in the stepwise regressions for each respective period contained the most risk information for that particular sample.

TABLE 4
Correlations between financial variables and unlevered Beta

TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.28214**	**0.47589**	**0.53839**	**0.56826**
Significance Prob. (S)	0.0032	0.0039	0.0118	0.0271
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.19554**	**0.34196**	0.40300	0.50124
Significance Prob. (S)	0.0435	0.0444	0.0701	0.0570
FINANCIAL VARAIBLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.23153**	**0.39900**	0.47589	0.59653
Significance Prob. (S)	0.0164	0.0176	0.0292	0.0189
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	-0.16500	-0.27870	-0.39823	-0.44989
Significance Prob. (S)	0.0894	0.1050	0.0738	0.0924
FINANCIAL VARIABLE	VARTOTCF: Variability in Total Cashflow			
Correlation Coeff. (r)	**0.23196**	**0.39576**	0.43031	0.48657
Significance Prob. (S)	0.0162	0.0186	0.0515	0.0659
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Proft			
Correlation Coeff. (r)	**0.32397**	**0.41200**	0.37147	**0.59056**
-Significance Prob. (S)	0.0032	0.0139	0.0973	0.0205
FINANCIAL VARIABLE	GROWAST%: Y/Y % Growth in Total Assets			
Correlation Coeff. (r)	**0.23088**	0.33015	0.28212	0.46539
Significance Prob. (S)	0.0286	0.0527	0.2153	0.0804

TABLE 5
Regression models for market Beta using financial variables

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	GROWTO (0.0022) -STOCKTO (0.0102)	-STOCKTO (0.0345) LEVERAGE (0.0273)	-STOCKTO (0.0413) LEVERAGE (0.0349)	-STOCKTO (0.0598) LEVERAGE (0.0674)
R^2	0.1798	0.1856	0.3149	0.4204
Adjusted R^2	0.1574	0.1416	0.2497	0.3376
Total D.O.F.	75	39	23	16
F-test Model Prob. Level	0.001	0.022	0.019	0.022
TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	SIZE (0.0013) -LIQUID (0.0007) VARPROF 2 (0.0299)	GROWPROF (0.0003) PLNTLIFE (0.0179) PROFIT 2 (0.0076) VARPROF 2 (0.0082)	SIZE (0.0006) PLNTLIFE (0.0074) LEVERAGE (0.0733)	SIZE (0.0000) -LIQUID (0.0010)
R^2	0.3024	0.6075	0.6845	0.7678
Adjusted R^2	0.2711	0.5626	0.6394	0.7368
Total D.O.F.	70	39	24	17
F-test Model Prob. Level	0.000	0.000	0.000	0.000
TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	VARTOTCF (0.0185) GROWPRF% (0.0367)	VARTOTCF (0.0000) GROWPRF% (0.0113)	VARTOTCF (0.0544) PROFIT 4 (0.0568) GROWTO (0.0697)	GROWTO (0.0003) PROFIT 4 (0.0629)
R^2	0.1534	0.4478	0.5856	0.7170
Adjusted R^2	0.1299	0.4195	0.5264	0.6793
Total D.O.F.	74	41	24	17
F-test Model Prob. Level	0.002	0.000	0.000	0.000

Despite the non-stationarity, the usefulness of these beta models was tested in a predictive sense as follows:

- The regression models produced using the first period's data (1978-1982) were used to generate beta forecasts for firms based on the values of the relevant financial independent variables in the next period (1983-1987). This was done for each portfolio size individually. The actual beta estimates for the second period were then compared with these forecasts.

- The above procedure was repeated for the second two data intervals, ie. predicted betas were generated using the regression models from the second period with actual financial data for the third period, for comparison with actual betas for the third period.

The residuals for these forecasting exercises were too poor to allow meaningful error analysis. However, the correlations between forecasts and actual beta values appear in Table 6.

TABLE 6
Correlations between forecast and actual Betas

PERIOD FORECAST	1983 TO 1987			
PERIOD OF MODEL BUILT	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	0.02528	0.17796	0.07043	0.03039
Significance Prob. (S)	0.8162	0.2656	0.7437	0.9078
PERIOD FORECAST	1988 TO 1992			
PERIOD OF MODEL BUILT	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.35718**	**0.42673**	**0.54965**	**0.70272**
Significance Prob. (S)	0.0000	0.0073	0.0044	0.0011

It was clear that there was no meaningful correlation between forecast and actual betas over the first two periods. However, significant correlations emerged over the second two periods. While the latter would not be particularly useful in a forecasting context, the result offered some support to the continuity of the relationships between financial parameters and beta over multiple time periods.

To further explore this, a combined model was sought for the total 15-year data sample. This overall regression simply attempted to extract those financial variables which appeared to be significant determinants of beta over a longer time frame. Table 7 lists the significant financial variable correlations, and the overall model is described in Table 8.

TABLE 7
Correlations between financial variables and market Beta

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.30194**	**0.40332**	**0.44371**	**0.49165**
Significance Prob. (S)	0.0000	0.0000	0.0001	0.0002
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.24173**	**0.39893**	**0.50582**	**0.58854**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.23884**	**0.39795**	**0.49013**	**0.56363**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.30475**	**0.40147**	**0.48776**	**0.57368**
Significance Prob. (S)	0.0000	0.0000	0.0000	0.0000
FINANCIAL VARIABLE	LIQUID: Current Ratio Liquidity			
Correlation Coeff. (r)	**-0.12596**	**-0.18797**	**-0.25676**	**-0.37477**
Significance Prob. (S)	0.0146	0.0358	0.0272	0.0062
FINANCIAL VARIABLE	LEVERAGE: Financial Leverage			
Correlation Coeff. (r)	**0.18632**	**0.33938**	**0.40797**	**0.50662**
Significance Prob. (S)	0.0003	0.0001	0.0003	0.0001

Only the measures of growth, firm size, liquidity and financial leverage were significant in total over the full period. Each had the expected signs, in accordance with the research cited earlier.

The regressions were reasonably stable for different portfolio sizes, with all of the significantly correlated variables except for liquidity appearing in the models. The R^2-values were lower than those for the subperiod models, but highly significant nevertheless.

To test proposition four, the product of the overall market return with each share's beta was included as an independent variable in the regressions, and by applying stepwise methods, it was hoped to assess the relative explanatory power of the financial variables in determining asset prices in the presence of the classical CAPM's market return variable. The individual correlations between share returns and each variable are summarised in

TABLE 8 Combined regression models for market Beta using financial variables

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	SIZE (0.0000) GROWTO (0.0001) LEVERAGE (0.0141)	GROWASST (0.0071) GROWTO (0.0047) LEVERAGE (0.0541)	GROWASST (0.0148) GROWTO (0.0274) LEVERAGE (0.0168)	SIZE (0.0007) LEVERAGE (0.0045)
R^2	0.1764	0.2554	0.3523	0.4347
Adjusted R^2	0.1687	0.2368	0.3245	0.4117
Total D.O.F.	322	123	73	51
F-test Model Prob. Level	0.000	0.000	0.000	0.000

Tables 9,10 and 11, followed by a summary of the corresponding regression models in Table 12.

TABLE 9
Correlations between financial variables and share returns

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GOPCASH: Y/Y Growth in Op. Cashflow			
Correlation Coeff. (r)	0.12405	0.29159	**0.46413**	**0.53169**
Significance Prob. (S)	0.1946	0.0799	0.0296	0.0340
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	**-0.23665**	**-0.46255**	**-0.57505**	**-0.62889**
Significance Prob. (S)	0.0120	0.0039	0.0051	0.0091
FINANCIAL VARIABLE	VARPROF 2: Variability of Profit Ratio 2			
Correlation Coeff. (r)	**-0.28560**	**-0.53669**	**-0.69824**	**-0.74857**
Significance Prob. (S)	0.0023	0.0006	0.0003	0.0008
FINANCIAL VARIABLE	VARPROF 3: Variability of Profit Ratio 3			
Correlation Coeff. (r)	**-0.34940**	**-0.43673**	**-0.52926**	**-0.61247**
Significance Prob. (S)	0.0014	0.0069	0.0113	0.0117
FINANCIAL VARIABLE	VARPROF 4: Variability of Profit Ratio 4			
Correlation Coeff. (r)	**-0.39290**	**-0.51251**	**-0.68258**	**-0.75425**
Significance Prob. (S)	0.0003	0.0012	0.0005	0.0007
FINANCIAL VARIABLE	VARPROF 5: Variability of Profit Ratio 5			
Correlation Coeff. (r)	**-0.23776**	**-0.46472**	**-0.57792**	**-0.63155**
Significance Prob. (S)	0.0116	0.0038	0.0048	0.0087
FINANCIAL VARIABLE	VARPROF 6: Variability of Profit Ratio 6			
Correlation Coeff. (r)	**-0.31211**	**-0.42588**	**-0.50256**	**-0.59943**
Significance Prob. (S)	0.0046	0.0086	0.0171	0.0141

In the first time period (1978-1982), a single measure of growth was significantly positively correlated with share returns, namely operating cashflow growth. This was attributed to the presence of firms offering strong growth prospects, with the promise of superior returns in future periods being incorporated into share prices. Given that 5-year average data was used, the share price returns probably also reflected some realised performance due to growth opportunities. This was consistent with the market reality of high-growth firms typically trading at high P/E ratios. In addition, several measures of variation in profitability were significantly negatively correlated to returns. This was also as expected, since variability was shown to be correlated with risk and has been discounted in share prices for such firms.

For the second sample interval (1983-1987), the growth measures of turnover, operating profit and operating cashflow were significantly positively correlated, along with useful plant life. Once again, in explaining the latter result, it is believed that firms enjoying strong growth were undertaking capital expansion or replacement such that the plant life ratio was high, and thus the short-term negative effect of capital expenditure on reported accounting profits was not discounted for these firms in share prices. A working capital management ratio, namely debtors collection period, was significantly negatively correlated with returns. This was as expected, with firms employing superior working capital management enjoying better revenue performance and higher stock market ratings.

In addition, three of the profitability ratios were significantly positively correlated to returns, which although being a fairly obvious result indicated that such profitability measures offered useful pricing information to investors. It is notable that the three measures which were significant, closely approximated the free cash flow-based profitability formulations proposed by Stewart (1991) to better reflect real economic operating performance. Lastly two measures of variation in profitablility were significantly negatively correlated with returns in the second period, as expected.

TABLE 10
Correlations between financial variables and share returns

TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWTO: Y/Y Growth in Turnover			
Correlation Coeff. (r)	**0.22145**	**0.41890**	**0.64268**	**0.71658**
Significance Prob. (S)	0.0179	0.0071	0.0007	0.0012
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.32675**	**0.52249**	**0.65053**	**0.67197**
Significance Prob. (S)	0.0002	0.0005	0.0006	0.0031
FINANCIAL VARIABLE	GOPCASH: Y/Y Growth in Op. Cashflow			
Correlation Coeff. (r)	**0.24773**	**0.49700**	**0.63861**	**0.67420**
Significance Prob. (S)	0.0059	0.0011	0.0008	0.0030
FINANCIAL VARIABLE	PLNTLIFE: Useful Plant Life			
Correlation Coeff. (r)	0.15503	0.28264	**0.42308**	**0.50538**
Significance Prob. (S)	0.1255	0.0772	0.0394	0.0385
FINANCIAL VARIABLE	DBTRDAYS: Days in Debtors			
Correlation Coeff. (r)	-0.17293	-0.30357	**-0.49332**	**-0.55922**
Significance Prob. (S)	0.0646	0.0569	0.0143	0.0196
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	0.17808	**0.35285**	**0.44120**	**0.51451**
Significance Prob. (S)	0.0580	0.0255	0.0309	0.0346
FINANCIAL VARIABLE	PROFIT 2: Profitability Ratio 2			
Correlation Coeff. (r)	**0.19370**	**0.33639**	**0.46961**	**0.48351**
Significance Prob. (S)	0.0389	0.0338	0.0206	0.0493
FINANCIAL VARIABLE	PROFITS 5: Profitability Ratio 5			
Correlation Coeff. (r)	**0.20978**	**0.38664**	**0.47704**	**0.59353**
Significance Prob. (S)	0.0251	0.0137	0.0184	0.0120
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	-0.16621	**-0.34645**	-0.39531	**-0.60806**
Significance Prob. (S)	0.0673	0.0285	0.0559	0.0096
FINANCIAL VARIABLE	VARPPROF 5: Variability of Profit Ratio 5			
Correlation Coeff. (r)	-0.17053	**-0.35347**	**-0.40111**	**-0.61797**
Significance Prob. (S)	0.0604	0.0253	0.0521	0.0082

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TABLE 11
Correlations between financial variables and share returns

TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	GROWPROF: Y/Y Growth in Operating Profit			
Correlation Coeff. (r)	**0.21700**	**0.47496**	**0.52916**	**0.56908**
Significance Prob. (S)	0.0118	0.0017	0.0065	0.0137
FINANCIAL VARIABLE	GROWASST: Y/Y Growth in Total Assets			
Correlation Coeff. (r)	**0.17351**	**0.41482**	**0.49412**	**0.59829**
Significance Prob. (S)	0.0450	0.0070	0.0121	0.0087
FINANCIAL VARIABLE	GOPCASH: Growth in Operating Cashflow			
Correlation Coeff. (r)	**0.19917**	0.29101	0.39005	**0.48812**
Significance Prob. (S)	0.0210	0.0649	0.0539	0.0399
FINANCIAL VARIABLE	GTOTCASH: Growth in Total Cashflow			
Correlation Coeff. (r)	**0.18834**	**0.33670**	**0.41469**	**0.53977**
Significance Prob. (S)	0.0293	0.0314	0.0393	0.0208
FINANCIAL VARIABLE	SIZE: Measured by Total Assets			
Correlation Coeff. (r)	**0.17044**	**0.47001**	**0.50134**	**0.53864**
Significance Prob. (S)	0.0490	0.0019	0.0107	0.0211
FINANCIAL VARIABLE	PROFIT 1: Profitability Ratio 1			
Correlation Coeff. (r)	**0.43578**	**0.40940**	**0.51012**	**0.56334**
Significance Prob. (S)	0.0000	0.0079	0.0092	0.0149
FINANCIAL VARIABLE	PROFIT 5: Profitability Ratio 5			
Correlation Coeff. (r)	**0.42345**	0.28910	0.39498	**0.53801**
Significance Prob. (S)	0.0000	0.0668	0.0507	0.0213
FINANCIAL VARIABLE	VARPROF 1: Variability of Profit Ratio 1			
Correlation Coeff. (r)	**-0.18117**	**-0.48519**	**-0.58667**	**-0.69336**
Significance Prob. (S)	0.0362	0.0013	0.0021	0.0014
FINANCIAL VARIABLE	VARPROF 2: Variability of Profit Ratio 2			
Correlation Coeff. (r)	**-0.20626**	**-0.45382**	**-0.58523**	**-0.68013**
Significance Prob. (S)	0.0168	0.0029	0.0021	0.0019
FINANCIAL VARIABLE	VARPROF 4: Variability of Profit Ratio 4			
Correlation Coeff. (r)	**-0.24691**	-0.27960	**-0.46481**	-0.46243
Significance Prob. (S)	0.0084	0.0766	0.0192	0.0533
FINANCIAL VARIABLE	VARPROF 5: Variability in Profit Ratio 5			
Correlation Coeff. (r)	**-0.17782**	**-0.47932**	**-0.57917**	**-0.68073**
Significance Prob. (S)	0.0389	0.0015	0.0024	0.0019
FINANCIAL VARIABLE	GROWPRF%: Y/Y % Growth in Operating Profit			
Correlation Coeff. (r)	**0.19500**	**0.49057**	**0.54375**	**0.65957**
Significance Prob. (S)	0.0484	0.0013	0.0050	0.0029

In the final analysis period (1988-1992), once again measures of growth in operating profit, total assets, operating cashflow and total cashflow were significantly positively correlated to returns. Firm size was also positively correlated, which ran completely contrary to the controversial small-firm effect discussed earlier. However, the JSE appears to be subject to a 'blue is beautiful' effect whereby major institutional investors seek and tightly hold the shares of larger firms, with the consequent bidding up of share prices. This is done at the expense of smaller second-tier stocks which are often less sought after despite their value-creation potential. It is possible that the politically volatile South African business environment has led investors to prefer larger firms in the belief that they may be more robust to variations in business circumstances.
As in the second sample period, profitability was positively related to return for this analysis. It is notable that only those measures closely approximating Stewart's (1991) cash-based formulations were again highly correlated. Lastly, several measures of variability in the profit ratios were negatively related to return as before. The regression models developed for each time period appear in Table 12.

It is important to note that although the product of each share's beta and the overall market return was tested in each of the above analyses, this variable was not found to be significant in any of the measurement periods, or for any size of portfolio. This was of some concern, since the indication given was that the classical CAPM was unsuccessful in describing share returns for this data.

The regressions indicated reasonably stable models for different portfolio sizes, with only minor differences in the most significant financial variables extracted by the stepwise regression procedure. However, some differences emerged between the models across the three time periods. Despite this, a forecasting exercise was again carried out for share returns to assess the predictive performance of the models over consecutive time periods. This followed the same procedure as described for beta forecasting. The residuals were once again too large to allow for meaningful error analysis. However, the correlations between the forecast and actual share returns are given in Table 13.

The results for the first two periods indicated only one significant correlation, for portfolios of 5 shares, while the second two data intervals yielded forecasts which were quite strongly correlated to actual returns for each size of portfolio. These results did not indicate particularly successful predictive performance, but again offered some support to the underlying continuity of relationships between financial variables and returns.

Finally, an overall model was again sought for the entire 15-year analysis period, and it was notable that only two variables were significantly correlated to returns, as shown in table 14.

It appeared from this result that the non-stationarity of the relationships between individual time periods was sufficient to render almost all of the financial variables insignificant in determining returns over the total period, with the exception of financial leverage and the product of a firm's beta with return on the overall market portfolio. These relationships were themselves very weak, with significant correlations occurring for only one size of portfolio in each case. For example, an explanatory regression model using the product of beta and market return as the independent variable would have an R^2-value of only 0.075 in the very best case, for a portfolio size of 7 shares. Although this was extremely inconclusive, the emergence of the market return variable in this analysis gave some renewed support to the classical CAPM.

TABLE 12
Regression models for share returns using financial variables

TIME PERIOD	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	-VARPROF 2 (0.0025)	-VARPROF 2 (0.0007)	GOPCASH (0.0012) -VARPROF 1 (0.0211) -VARPROF 2 (0.0003) -VARPROF 5 (0.0180)	-VARPROF 4 (0.0007)
R^2	0.0806	0.2929	0.7437	0.5689
Adjusted R^2	0.0722	0.2721	0.6867	0.5381
Total D.O.F.	110	35	22	15
F-test Model Prob. Level	0.003	0.001	0.000	0.001
TIME PERIOD	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	GROWPROF (0.0039) GOPCASH (0.0137) -DBTRDAYS (0.0386)	GROWPROF (0.0023) GOPCASH (0.0040) -DBTRDAYS (0.0268)	GROWPROF (0.0110) GOPCASH (0.0205) -DBTRDAYS (0.0009)	GROWPROF (0.0025) GOPCASH (0.0211) -DBTRDAYS (0.0005)
R^2	0.1862	0.4864	0.7270	0.8443
Adjusted R^2	0.1622	0.4436	0.6861	0.8083
Total D.O.F.	105	39	23	16
F-test Model Prob. Level	0.000	0.000	0.000	0.000
TIME PERIOD	1988 TO 1992			
PORTFOLIO SIZE	1	3	5	7
Significant Independent Variables (Prob Level)	PROFIT 1 (0.0000) -VARPROF 1 (0.0043)	PROFIT 1 (0.0077) -VARPROF 1 (0.0030) GROWPRF% (0.0093)	PROFIT 1 (0.0063) -VARPROF 1 (0.0015)	GROWASST (0.0109) -VARPROF 1 (0.0020)
R^2	0.2714	0.4943	0.5361	0.6677
Adjusted R^2	0.2592	0.4522	0.4940	0.6234
Total D.O.F.	121	39	24	17
F-test Model Prob. Level	0.000	0.000	0.000	0.000

TABLE 13
Correlations between forecast and actual share returns

PERIOD FORECAST	1983 TO 1987			
PERIOD OF MODEL BUILT	1978 TO 1982			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	0.14361	0.27855	**0.56924**	0.32594
Significance Prob. (S)	0.1161	0.0860	0.0046	0.2179
PERIOD FORECAST	1988 TO 1992			
PERIOD OF MODEL BUILT	1983 TO 1987			
PORTFOLIO SIZE	1	3	5	7
Correlation Coeff. (r)	**0.26150**	**0.42535**	**0.44315**	**0.48378**
Significance Prob. (S)	0.0041	0.0056	0.0265	0.0419

TABLE 14
Correlations between financial variables and share returns

TIME PERIOD	1978 TO 1992			
PORTFOLIO SIZE	1	3	5	7
FINANCIAL VARIABLE	LEVERAGE: Financial Leverage			
Correlation Coeff. (r)	-0.09556	**-0.18415**	-0.20356	-0.22554
Significance Prob. (S)	0.0689	0.0459	0.0863	0.1153
FINANCIAL VARIABLE	MRP: Product of Market Beta & Return on Market Portfolio			
Correlation Coeff. (r)	0.09600	0.17555	0.22015	**0.27411**
Significance Prob. (S)	0.0802	0.0562	0.0631	0.0492

Furthermore, the result suggested that of all the financial variables, only a firm's financial leverage added significant

asset pricing information to that contained in the return on the market over the total period under review. Retief *et al.* (1986) contended that financial leverage was the only firm-specific parameter for which the effects could not be diversified away in a portfolio of shares, since the portfolio would always assume the weighted average value of the gearing of its constituent firms. They suggested that the emergence of leverage as a primary determinant of risk in an asset-pricing context was evidence of the separation theorem (Sharpe, 1964) at work.

CONCLUSIONS

The primary objective of this research was to explore the linkages between financial variables and systematic risk as embodied in estimated beta coefficients. It was found that highly significant models could be produced over individual 5-year periods, which in general followed the theoretical propositions offered in the literature. Unfortunately, these models were not stationary over consecutive time periods, which prevented meaningful predictive modelling of betas. This result was consistent with the contention of Marston & Harris (1993) that studies based on realised historical returns required extremely long time series to produce meaningful results, and that those over shorter time frames would be highly sensitive to the data for individual subperiods. However, it remained apparent that certain classes of fundamental financial data were strongly related to both beta and return, offering some useful insights to company management and investors.

In particular, beta risk estimates were strongly positively associated with measures of firm growth and profitability, supporting the notion of a 'strategic risk' element (Stewart 1991) existing for rapidly growing and/or highly profitable firms. Measures of short-term managerial performance such as liquidity ratios and stock turnover were negatively correlated to beta, in agreement with intuitive propositions as well as previous empirical work documented in the literature. Dividend yield was negatively related to unlevered beta risk estimates, in agreement with Gurney (1982) but in contradiction to the classical dividend irrelevance proposition of Miller & Modigliani (1961). However, it was suggested that this was an information effect due to the co-movement of dividends with earnings, and the correlations became insignificant with levered betas. Although firm size was positively correlated with beta, this was contrary to the findings of previous empirical research, and was attributed to the downward bias of thin trading (Dimson, 1979) which affected the typically thinly-traded shares of smaller firms on the JSE. Several measures of variability of profit ratios as well as of cashflow were strongly positively correlated to beta, in agreement with past research and logical expectations, given that beta estimates seek to encapsulate investment risk due to variability of returns.

Lastly, it was found that both unlevered betas and levered market betas were significantly correlated to the same classes of financial variables, except for financial leverage which was only significant against levered betas. This was as expected, and supported the theoretical contention that beta could be viewed as a composite of financial risk due to gearing , and the residual business risk inherent in the firm. This also gave some support to the validity of Hamada's theoretical deleveraging formula in stripping out financial risk while leaving the business risk component largely intact. The strong correlations between financial leverage and market betas also corroborated the earlier work of Retief *et al.* (1984) on South African stocks, although their contention that this was the only significant explanatory variable was refuted by the results of this study.

An important result in nearly all analyses was the marked improvement in correlations and regression models for portfolios of shares. This offered strong support for the contention that portfolio formation eliminated much measurement error in the various parameters through averaging. In the context of microeconomic modelling of systematic risk, this has been described as an emulation of the benefits of diversification understood in classical portfolio theory (Retief *et al.*, 1986).

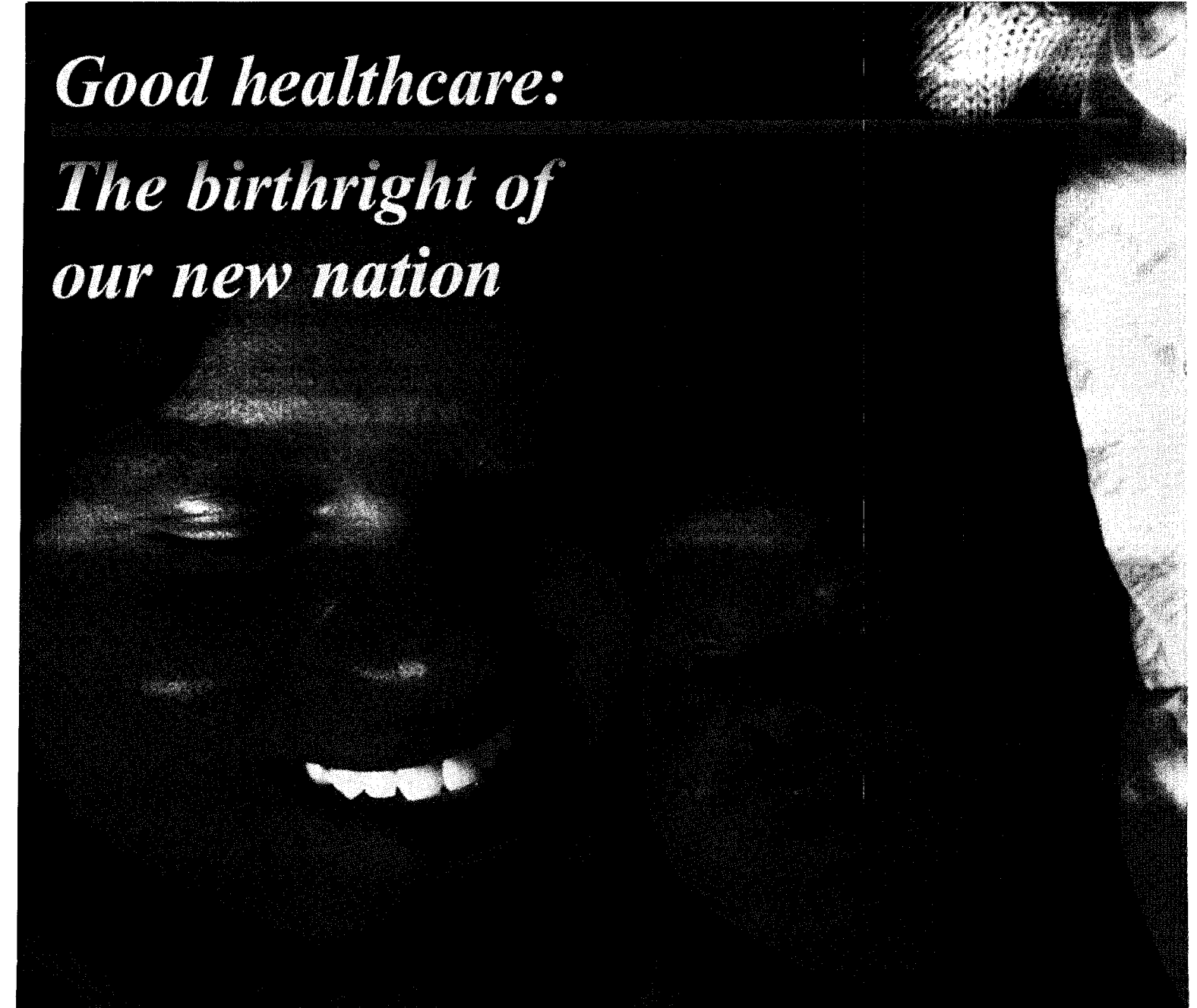
A further notable result was the significance of several of the cashflow-based variables in all analyses, supporting the contention that these measures contained risk and asset-pricing information superior to that in ordinary accrual accounting variables. This was in agreement with Rayburn (1986), Ismail & Kim (1989) and Stewart (1991). However, the cashflow beta measure was not significant in any of the analyses. It is suggested that this may have been due in part to errors in the approximation used for cashflow calculations.

Throughout the analysis, neither of the operating leverage variables were significant, nor were the capital intensity and 'market power' measures. The latter variable was defined as the ratio of market value to book value of the firm, and its lack of significance in the study was in direct contradiction to the surprising and controversial result produced by Fama & French (1992) who found that this ratio was the major determinant of returns over the long term.

APPENDIX 1
Variable names and definitions

VAR. NAME	DESCRIPTION	DEFINITION
LEVERAGE	Financial Leverage	$\frac{Total\ Assets - Equity}{Total\ Assets}$
OPLEV1	Operating Leverage 1	$\frac{Fixed\ Assets\ excluding\ investments}{Total\ Assets - Current\ Liabilities}$
OPLEV 2	Operating Leverage 2	$\frac{\triangle EBIT}{EBIT} \times \frac{Sales}{\triangle Sales}$
GROWTO	Y/Y Turnover Growth	$Turnover_t - Turnover_{t-1}$
GROWTO%	Y/Y % Turnover Growth	$\frac{Turnover_t - Turnover_{t-1}}{Profit_{t-1}}$
GROWFRO F	Y/Y Profit Growth	$Profit_t - Profit_{t-1}$
GROWPRF %	Y/Y % Profit Growth	$\frac{Profit_t - Profit_{t-1}}{Turnover_{t-1}}$
GROWASS T	Y/Y Asset Growth	$Tot.\ Assets_t - Tot.\ Assets_{t-1}$
GROWAST %	Y/Y % Asset Growth	$\frac{Tot.\ Assets_t - Tot.\ Assets_{t-1}}{TTot.\ Assets_{t-1}}$
GTOTCASH	Tot. Cashflow Growth	$Tot.\ Cashflow_t - Tot.\ Cashflow_{t-1}$
GOPCASH	Op. Cashflow Growth	$Op.\ Cashflow_t - Op.\ Cashflow_{t-1}$

Good healthcare: The birthright of our new nation



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Appendix 1 continued

VAR. NAME	DESCRIPTION	DEFINITION
SIZE	Firm Size	*Total Assets*
DIV1	Dividend Yield 1	*Total Dividends Paid* / *Average Ordinary Shareholders Interest*
DIV 2	Dividend Yield 2	*Total Dividends Paid* / *Average Real Ordinary Shareholders Int.*
MKTPOWR	Market-to-Book Ratio	*Average share price x shares in issue* / *Total Assets less accumulated depreciation*
CAPINT	Capital Intensity	*Fixed Assets excluding Investments* / *Total Assets*
PROFIT 1	Profitability Ratio 1	*Operating Profit* / *Average Operating Assets*
PROFIT 2	Profitability Ratio 2	*Profit before inv.income, int. & tax* / *Ave. total assets excl. total investments*
PROFIT 3	Profitability Ratio 3	*Operating Profit* / *Turnover*
PROFIT 4	Profitability Ratio 4	*Profit before inv. income, int. & tax* / *Turnover*
PROFIT 5	Profitability Ratio 5	*Op. Profit before depr,inv.income, int & tax* / *Ave. Total Assets excl. Total Investments*
PROFIT 6	Profitability Ratio 6	*Profit before interest and tax* / *Turnover*
VARPROF1	Variability in Profit Ratio 1	$SD(PROFIT\ 1_{t-4} : PROFIT\ 1_t)$
VARPROF 2	Variability in Profit Ratio 2	$SD(PROFIT\ 2_{t-4} : PROFIT\ 2_t)$
VARPROF 3	Variability in Profit Ratio 3	$SD(PROFIT\ 3_{t-4} : PROFIT\ 3_t)$
VARPROF 4	Variability in Profit Ratio 4	$SD(PROFIT\ 4_{t-4} : PROFIT\ 4_t)$
VARPROF 5	Variability in Profit Ratio 5	$SD(PROFIT5_{t-4} : PROFIT\ 5_t)$
VARPROF 6	Variability in Profit Ratio 6	$SD(PROFIT6_{t-4} : PROFIT\ 6_t)$
VAROPCF	Variability in Operating Cashflow	$SD(Op.Cashflow_{t-4} : Op.Cashflow_t$
VARTOTCF	Variability in Total Cashflow	$SD(Tot.\ Cashflow_{t-4} : Tot.\ Cashflow_t)$
DBTRDAYS	Debtors' Collection Period	*Average total debtors x 12* / *Turnover*
STOCKTO	Turnover Rate of Stock	*Average total Stock x 12* / *Turnover*
PLNTNEW	Plant Newness	*Fixed Assets – Accum. Depreciation* / *Fixed Assets*
PLNTLIFE	Useful Plant Life	*Fixed Assets excl. land, buildings* / *Accumulated Depreciation*
LIQUID	Current Ratio Liquidity	*Current Assets* / *Current Liabilities*
OPCBETA 1	Operating Cashflow Beta	$\frac{Cov(Op.Cashflow_i, Op.Cashflow_{Market})}{\sigma^2(Op.Cashflow_{Market})}$

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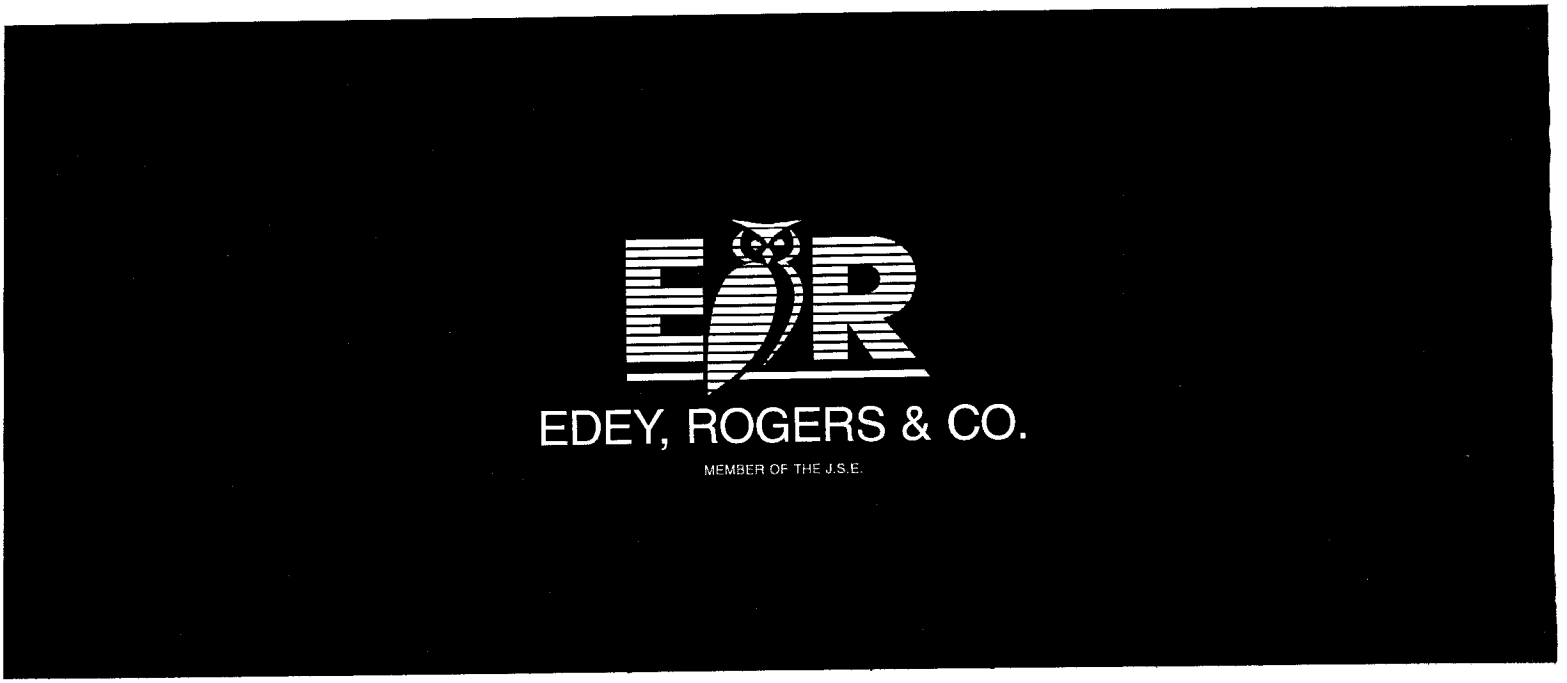

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The supply and demand effect of block transactions on share prices

ABSTRACT

The effect of supply and demand on the pricing of shares was investigated by analysing block transactions on the JSE. A sample of 291 block transactions was selected from the period 1 June 1993 to 1 June 1994 from the Financial and Industrial sectors and analysed using an event time methodology. The study compares the reaction of share prices of large block transactions with the expected price, as predicted using the market model. The analysis period covered twenty days before and twenty days after the block transaction.

The data was subdivided into buyer induced trades and seller induced trades, the distinction being made on the sign of the market model residual (positive – buyer induced trade, negative – seller induced trade). The results show that there is a statistically significant increase/decrease in the share price for buyer/seller induced trades. A relationship between the size of the block trade and the absolute value of the price change was also found. Price reversals immediately after both buyer and seller induced trades were noted.

Support was found for the price pressure hypothesis and the information hypothesis; no support for the substitution hypothesis was found. The results also support the weak and semi-strong forms of the Efficient Markets Hypothesis. Evidence was found to indicate that share prices are affected by supply and demand.

KEYWORDS

price pressure
information
substitution
supply and demand
efficient market

1. INTRODUCTION

Recently the value of shares traded on the Johannesburg Stock Exchange (JSE) has almost doubled as a result of a dramatic increase in foreign investment on the JSE (Payne (1994)). The conventional economic model of supply and demand would suggest that this increased demand for scrip would translate into higher prices. However, modern financial theory contradicts this view, and argues that share prices are not influenced by supply and demand, but by future expected cash-flows. Stewart (1991, p40) states the "prices in the stock market, like all other prices, are set at the margin by the smartest money in the game." He states that "lead steers" set the prices at the margin, based on future expected returns, with supply and demand having no effect. This paper explores this issue by examining the price reaction to large block transactions on the JSE. It addresses the following questions: has the increased demand for shares increased share prices, or is the demand curve for shares flat and are share prices therefore set on future expected returns or have future expected returns changed, and hence prices, as a result of new information?

2. LITERATURE REVIEW

Scholes (1972) conducted a series of empirical tests to determine the validity of various hypotheses relating to the pricing of shares. The three hypotheses examined, and the main issues underlying each, are listed below.

In essence, the price pressure hypothesis states that for large trades the price of the stock must fall to induce investors to buy the additional shares, the larger the trade the larger the price decline. This implies that the demand curve for shares has a downward slope.

The substitution hypothesis maintains that the market values assets such that the expected rates of return on assets of similar risk are equal, and if one defines the market for a security in a broad context, the investor has a wide choice of similar assets. This implies that the demand curve for an individual share is horizontal and prices are set on expected future returns. The inducement to sell large quantities of stock is zero unless the expected returns decrease or the price offered for the block is higher than that determined by the market.

The information hypothesis suggests that the seller of large blocks of shares has more valuable information than the seller of a small block of shares. Thus, when a large block of shares is sold there will be a permanent fall in the share price, which is not necessarily the case with smaller sales.

Scholes (1972) analysed secondary distributions on the NYSE from July 1961 to December 1965. He rejected the price pressure hypothesis and found support for the substitution hypothesis. He found no association between the size of the sale and the value of the information contained in the secondary distribution.

In a similar analysis Kraus & Stoll (1972) set up a series of empirical tests to assess the impact of institutional investors on the efficiency of the stock market. They randomly selected a sample of block trades on the NYSE that occurred during the period 1 July 1968 to 30 September 1969 and proposed the following reasons for price movements in individual securities:

- Information

In a perfectly efficient market, where there are many small buyers, only new information establishes a new price level, which will be maintained until additional information is available.

- Distribution

The expected rate of return must rise temporarily to induce unwilling buyers to buy the stock and induce unwilling sellers to sell their stock.

The data was subdivided into buyer induced block trades and seller induced block trades. This was done by comparing the stock price prior to the trade and the specific transaction price, if there was a drop in price it was classified as a seller induced trade and if there was a rise in price it was classified as a buyer induced trade. If there was no change in the price of the security it was excluded from the analysis. Kraus & Stoll (1972) found support for the distribution hypothesis rather than the information hypothesis.

Ball & Finn (1989) conducted a study on the effect of block transactions on share prices on the Sydney Stock Exchange (SSE). They tested the same three hypotheses as Scholes (1972) and recommended two improvements in the research methodology that Kraus & Stoll (1972) had used. Firstly, to determine whether the block transaction was buyer or seller induced they used the market model residual. (Negative market model residual – seller induced, positive market model residual – buyer induced.) Secondly, they used two separate cross-sectional regressions for the price changes before and after the block trade. They argue that since Kraus & Stoll (1972) used the price change from the opening price to the closing price over the day of the block trade and a single regression analysis, the actual block price itself was omitted and thus one can not directly observe the effect of size on price. If however one uses two regressions, one using the price changes up to the actual block price and the second, for the price change subsequent to the actual block price it is possible to directly observe the effect of block size on the share price.

Ball & Finn (1989) concluded that their results were consistent with the substitution hypothesis and rejected the price pressure hypothesis.

Holthausen, Leftwich & Mayers (1987), Choe, McInish & Wood (1991) and Chan & Lakonishok (1993) examined the effect of large block transactions on share prices and found similar results to each other. They observed that there was a *permanent* increase in the share price following a buyer induced block trade, while the observed drop in share price following a seller induced block trade was later reversed. This led them to conclude that there were price pressure effects associated with only the seller induced block trades and information effects associated with both the buyer and seller induced block trades. This asymmetry in the reaction of share prices to block trades has not been observed in all the studies analysing block trades. Holthausen, Leftwich & Mayers (1990), in a study conducted on the NYSE, found that there was a price reversal following both buyer and seller induced block trades. A price reversal occurs when the share price temporarily returns to the preblock transaction price and then "reverses" to the level of the block transaction price.

Aitken & Frino (1994) analysed a sample of block transactions on the Australian Stock Exchange (ASE) and offered an explanation as to why this asymmetric reaction is present on certain exchanges and not on others. They found evidence of the asymmetric reaction on the ASE where the price rise following a buyer induced trade was sustained while the price drop following a seller induced trade was not. They suggest that the actions of specialists account for the fact that reversals are seen following both buyer and seller induced block trades on the certain exchanges and not on others. A specialist is someone who is employed by the exchange to buy or sell particular shares and ensure that there is always a liquid market.

Karpoff (1987) reviewed the empirical and theoretical studies that had analysed the relationship between price changes and trading volume. Two relationships emerged from the literature:

- a positive correlation between volume and the price change.
- a positive correlation between volume and the absolute value of the price change.

There were 19 empirical studies conducted during the period 1964 to 1987 which analysed the relationship between volume and the absolute value of the price change. Eighteen of these studies found support for a positive association. During the period 1963 to 1987 there were 16 empirical studies from which inferences can be made about the association between volume and price change. Twelve of these studies supported a positive correlation. Karpoff (1986) developed an asymmetric cost model based on the work of Jennings, Starks and Fellingham (1981) which he used to show that these two relationships could be mutually consistent. His asymmetric cost model assumed that the cost of going long and short are different.

Karpoff (1987) concluded his review paper by stating that the price-volume relationship is important for event time studies when price changes and volume are determined jointly, since the analysis of the price-volume relationship will add to the interpretation of the results.

Smirlock & Starks (1988) investigated the empirical relationship between absolute stock price changes and trading volume. They found there to be a significant relationship which was stronger in the periods surrounding the earnings announcements. They concluded that the results indicated that the arrival of information to investors was a sequential process.

This study aims to examine Scholes' (1972) three hypotheses using the methodology of Ball and Finn (1989). The JSE provides a new market in which the theories can be examined, and is of special interest as a consequence of the increasing foreign demand for scrip.

3. RESEARCH HYPOTHESES

The substitution hypothesis, the price pressure hypothesis and the information hypothesis were tested in this study. The first hypothesis, based on the substitution hypothesis, was formulated as follows:

- there is no significant change in the share price as a result of a block transaction.

The second hypothesis is based on the price pressure hypothesis:

- the share price will temporarily decline as a result of a seller induced block transaction, followed by a reversal when the volume returns to normal, the larger the block transaction, the larger the fall in price;
- the share price will temporarily increase as a result of a buyer induced block transaction, followed by a reversal when the volume returns to normal, the larger the block transaction, the larger the rise in price.

The third hypothesis is based on the information hypothesis:

- the share price will decline as a result of a seller induced block transaction and remain at this lower level until new information concerning the share is received (permanent decline), the larger the block transaction, the larger the fall in price;
- the share price will increase as a result of a buyer induced block transaction and remain at this higher level until new information concerning the share is received (permanent increase), the larger the block transaction, the larger the rise in price.

A temporary or permanent change in the share price is defined in terms of the analysis period. That is, if the share price increase or decline continues for up to twenty days after the block transaction it is considered permanent.

4. METHODOLOGY

4.1 Population and Sample

Finance Week publishes a list of block transactions with a value of over one million Rand that occur each week. This list includes shares from all of the sectors on the JSE. The description of each block transaction consists of; the date, the quantity of shares traded, the price at which the transaction occured and the Rand value of the transaction. Every block transaction listed in Finance Week during the period from 1 June 1993 to 1 June 1994 was captured and stored in a spreadsheet data base, a total of 1444.

To check the reliability and to ensure that the data from Finance Week was captured correctly the following tests were performed:

- the capture share price was multiplied by the captured volume and the result compared to the capture value;
- the block transaction price was verified by checking that it was less than or equal to the day's high price and greater than or equal to the day's low price as recorded by the JSE computer system; and
- the block transaction volume was verified by checking that it was less than or equal to the total volume traded on that day, as recorded by the JSE computer system.

The data was corrected for share spilts and consolidations where necessary and any shares revealing any discrepancies were excluded from the sample.

The volume and closing price for each share for 20 days before and 20 days after the block transaction was required for the analysis. This data was collected from the Progressive Download Service using the MetaStock software package for stock market analysis.

The methodology used was that of an event study. Bowman (1983) states that the success of any event study depends on the ability to correctly identify the event time and ensure that there are no confounding events. A confounding event in this case would be when two or more block transactions occured during the analysis period. Thus the shares for which there were more than one block transaction during the forty day analysis period were excluded from the sample. This had the effect of considerably reducing the sample size.

The following criteria were also applied to select a sample of block transactions for the analysis:

- only companies whose shares were listed under the Financial and Industrial sectors of the JSE were included;
- only transactions of ordinary shares were considered; and
- shares in which the beta could not be obtained were rejected.

The resulting sample contained 219 block transactions.

4.2 Methods of Analysis

The transactions were divided into two groups, buyer induced trades and seller induced trades. This distinction was made depending on the sign of the market model residual at the time of the block transaction; (negative-seller induced trade, positive-buyer induced trade.)

The event study method (Bowman, 1983) was used to analyse the data. An event time study compares the average reaction of a number of occurrences of a particular event to the average expected reaction to determine if there is a difference. In this analysis the reaction of the share price to a block transaction is compared to the expected share price under normal circumstances.

The expected share prices were modelled using the market model (Bowman, 1983), enabling one to calculate the risk adjusted excess return. The return on share i in period t is given by:

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}$$

where R_{it} = return on share i in period t
R_{mt} = return on market portfolio in period t
α_i and β_i = constants for share i
e_{it} = residual

Thus the residuals may be calculated as follows:

$$e_{it} = R_{it} - \alpha_i - \beta_i R_{mt}$$

The expected residual is zero, thus any value above or below zero is considered an excess return.

The market model required a beta value for each share, this was obtained from the Department of Mathematical Statistics at the University of Cape Town, as estimated against the Financial and Industrial index. The Financial and Industrial index was thus used for the market portfolio term in the model.

The event, Day 0, was defined as the day the block transaction took place. Day -20 to day -1 were the days before the transaction, while day 1 to day 20 were the days after the transaction. Daily closing share prices for twenty days before and twenty days after the block transactions were analysed.

The cumulative average excess return (CAR) for each day was calculated for both buyer and seller induced trades. The CARs before the event were compared with those after the event using a two sample t-test to determine whether or not there was a significant change in the share price after the event.

The Student's t-test was used to determine if there was a significant change in share price as a result of a block transaction and the direction of this change. The t-test was used to compare the means of the cumulative average residuals before and after Day 0. The statistical tests were carried out using a 5% significance level.

To analyse the effect of block size on block price, the following residuals were calculated:

- price change between Day-1 and block price
- price change between block price and Day 1
- price change between Day-3 and block price
- price change between block price and Day 3
- price change between Day-5 and block price
- price change between block price and Day 5.

The ratio of volume traded to the average volume of shares traded for the last forty days was used as a measure of transaction size.

The relationship between the size of the block transaction and the rise or fall in share price before or after the block trade was analysed using regression analysis.

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5. RESULTS

The graphical representation of the average residuals for all transactions are shown in figure 1.

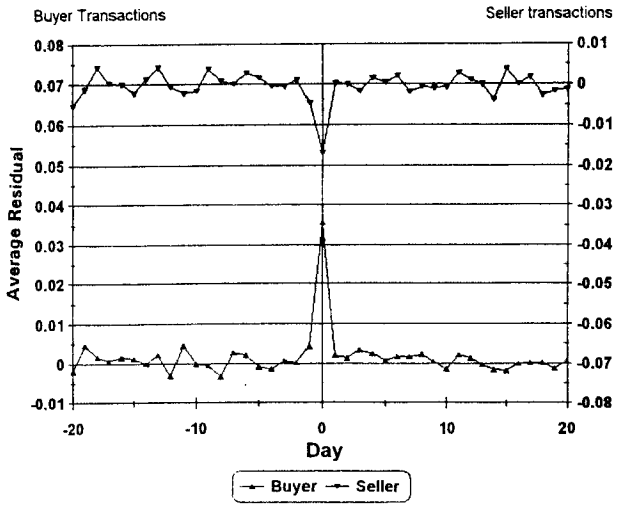

Figure 1 Average residuals for buyer and seller induced block trades in the Industrial and Financial sectors

The analysis of the average residuals for the buyer induced trades shows an increase in share price of 3.5% on the day of the block trade. The analysis for the average residuals for the seller induced trades shows a decrease in share price of 1.7% on the day of the block trade. It is interesting to note that the day before the buyer induced block trade there is an increase in the share price, which may be as a result of insider trading. The opposite effect may be seen for the seller induced trades, where the day before the block trade there was a decrease in share price.

The graphical representation of the cumulative average residuals for the split sample are shown in figure 2.

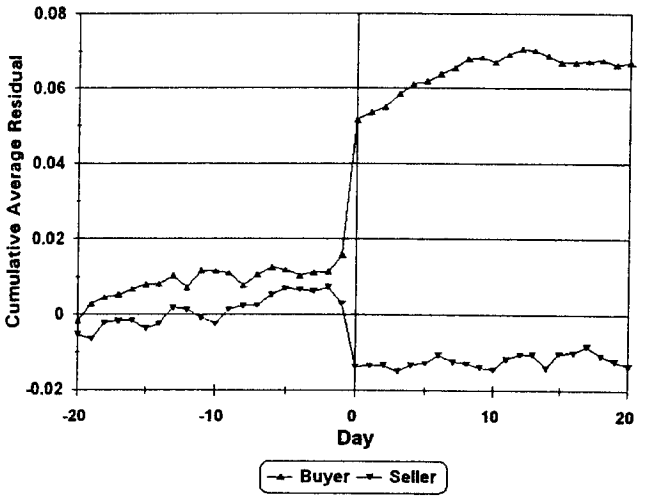

Figure 2 Cumulative average residuals for buyer and seller induced transactions.

Figure 2 shows a slight upward trend in both series before the event. Subsequent to the event the CAR's for seller induced transactions appear to remain constant, but those for buyer induced transactions continue for at least the next ten days.

The results of the t-tests to determine whether or not the price changed significantly after the block transaction, carried out at a significance level of 5%, are shown in Table 1. For the buyer induced trades, $t < -t_{crit}$, thus the null hypothesis is rejected. The mean of the CARs after the block trade is statistically higher than the mean of the CARs prior to the block trade. It can be seen that for the buyer induced block transaction there is a significant increase in share price.

TABLE 1
One tail two sample t-test analysis of buyer and seller induced block trades

Buyer/ Seller	Sample	No of Events	Mean CAR	t Value	t_{crit}
Buyer	DAY-20 to DAY-1	20	0.0090	-40.48	1.687
	DAY 1 to DAY 20	20	0.0651		
Seller	DAY-20 to DAY-1	20	0.0010	12.92	1.706
	DAY 1 to DAY 20	20	-0.0123		

For the seller induced trades, $t < -t_{crit}$, thus the null hypothesis is again rejected. The mean of the CARs after the block trade is statistically lower than the mean of the CARs prior to the block trade and for a seller induced block transaction there is a significant decrease in share price.

To analyse the relationship between the Log (block volume/average volume) and the residuals before and after the block transaction, a number of linear regressions were performed. One of the analyses, for the buyer induced trades, is described and discussed in detail below.

The buyer induced block trade residuals from Day-1 to block price are shown in Figure 3. The independent variable is the Log of the ratio of the block volume to the average volume of the particular share during the analysis period, excluding the block volume. Each trade is represented by a plus symbol. The solid line is a representation of the linear regression line which was fitted to the data.

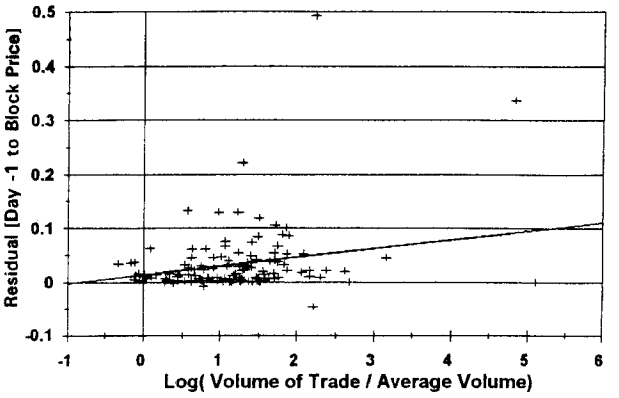

Figure 3 Variation of buyer induced trade residuals (Day-1 to block price) with Log (volume of trade/average volume)

The result of the linear regression analysis is shown in Table 2, and the relationship can be seen to be significant.

TABLE 2
Regression results: (Day -1 to block price) Vs. Log (block volume/ average volume) for buyer induced trades

n=126	Coefficients	Standard Error	t Statistic	P-value
Intercept	0.01438	0.00849	1.69354	0.09284
x1	0.01610	0.00556	2.89367	0.00449

The t-test analysis of the cumulative average residuals supports either the price pressure hypothesis or the information hypothesis. The distinction between these two hypotheses is made depending upon whether or not the rise in share price for the buyer induced trades and the fall in share price for the seller induced trades is temporary or permanent. The price pressure hypothesis predicts a temporary change in the share price, followed by a reversal, while the information hypothesis predicts a permanent change in the share price. The regression analysis that was performed on the residuals before and after the block trade allows one to accept or reject these hypotheses. A summary of the results from the regression analysis for the buyer induced trades is shown in Table 3.

TABLE 3: Summary of the regression analysis for the buyer induced transactions

Independent variable = Log (block volume/average volume)							
	Residuals from Day* to block price			Residuals from block price to Day*			
	-5*	-3*	-1*	0*	1*	3*	5*
Regression significant?	Yes	Yes	Yes	Yes	No	No	No
x variable significant?	Yes	Yes	Yes	Yes	No	No	No
x coefficient	0.0183	0.0206	0.0161	-0.0166	-0.0024	-0.0038	-0.0023
Adjusted R squared	0.0404	0.0600	0.0557	0.0786	-0.0014	0.0090	0.0017
Average residual	0.0384	0.0387	0.0357	-0.0303	0.0038	0.0084	0.0120

As can be seen in table 3, the regressions were significant at a 5 % level for the residuals on the days before the block trade. Thus it may be concluded that for the buyer induced trades the larger the block transaction the larger the rise in share price.

The relationship between the Log of the ratio of the block volume to the average volume and the residual from the block price to Day 0 (ie: the closing price on the day of the block trade) was also found to be significant at a 5 % level. The negative x coefficient and negative average residual indicates that there is a price reversal in the direction of the price change. This can be seen in figure 4 which shows the average residuals for the following periods;

- Day-1 to block price
- Block price to Day 0 (ie: the closing price on the day of the block trade)
- Day 0 to Day 1.

This reversal shows that the higher than expected price of the block transaction is ignored by the market until the following day and is evidence of price pressure effects. On Day 1 the average residual returns to the same level as just after the block trade and there are no further abnormal residuals after Day 1, the change in share price is now permanent. Thus the market has accepted the information content of the block trade and the information hypothesis may be accepted for the buyer induced trades.

A summary of the results from the regression analysis for the seller induced trades is shown in Table 4. The regression as a whole and the x coefficient were significant for the residuals on Day-1 to the block price. Thus it may be concluded that over this period for the seller induced trades, the larger the block transaction the larger the decline in share price.

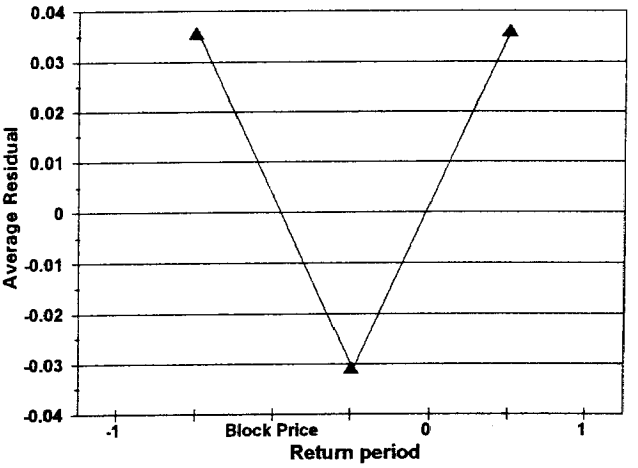

Figure 4 Average residuals for the buyer induced trades

TABLE 4: Summary of the regression analysis for the seller induced transactions

Independent variable = Log (block volume/average volume)							
	Residuals from Day* to block price			Residuals from block price to Day*			
	-5*	-3*	-1*	0*	1*	3*	5*
Regression significant?	No	No	Yes	Yes	No	No	No
x variable significant?	No	No	Yes	Yes	No	No	No
x coefficient	-0.0017	-0.0049	-0.0055	0.0071	-0.0021	-0.0023	-0.0030
Adjusted R squared	-0.0100	-0.0007	0.0350	0.0415	0.0033	-0.0049	-0.0048
Average residual	-0.0209	-0.0203	-0.0168	0.0140	-0.0010	-0.0008	0.0012

The relationship between the Log of the ratio of the block volume to the average volume and the residual from the block price to Day 0 was found to be significant at a 5 % level. The positive x coefficient and positive average residual indicates that there is a price reversal in the direction of the price change. This can be seen in figure 5 which shows the average residuals before and after the block trade.

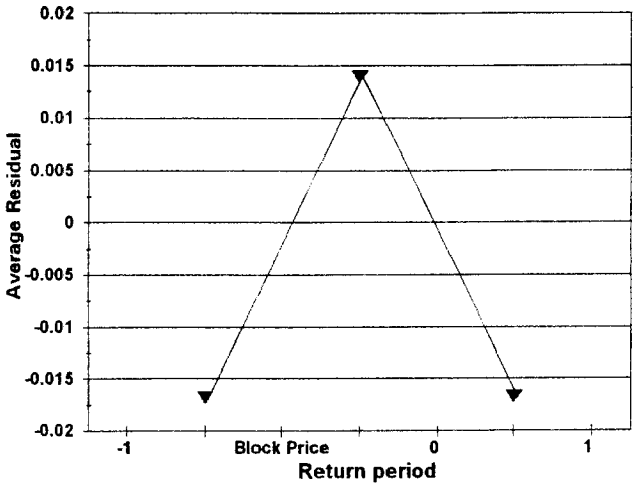

Figure 5 Average residuals for the seller induced trades

This reversal, once again, is evidence of price pressure effects. On Day 1 the average residual returns to the same level as just after the block trade and there are no further abnormal residuals after Day 1, the change in share price is now permanent. Thus the market has accepted the information content of the block trade and the information hypothesis may be accepted for the seller induced trades.

Share price reversals have been found for both the buyer and seller induced block trades, thus there is no evidence of an asymmetric reaction of the share price to a block transaction. This is consistent with the finding of Holthausen *et al.* (1990), but inconsistent with the findings of Holthausen *et al.* (1987), Choe *et al.* (1991), Chan & Lakonishok (1991) and Aitken & Frino (1994). Aitken & Frino (1994) proposed that the activities of specialists on an exchange accounted for the fact that no evidence of an asymmetric reaction of share prices to block trades were found on the NYSE (Holthausen *et al.*, 1991). As there are no specialists on the JSE and no asymmetric reaction of share prices to block transactions was found in this study, the absence of specialists alone, can not account for the asymmetries observed on other exchanges.

Consequently, it can be seen that:

- the rise in price for the buyer induced trades was 4.1 times the drop in price for the seller induced trades;
- the share price continues to rise after the block trade for buyer induced block trades; and
- the share price essentially remains constant at the reduced share price value after the block trade for seller induced block trades.

Karpoff (1985) suggests that costly short sales restrict some investors from acting on their information. In South Africa where selling short is only permitted under certain conditions (The Stock Exchanges Control Act 1985, Section 24), one would initially expect there to be no asymmetries in the cost of buying or selling shares. However if one takes into account the lack of liquidity on the JSE (de Villiers, 1994), and that financial institutions have stated their reluctance to sell shares for fear of not being able to buy them back (Financial Mail, 1992), there are definitely asymmetries in the cost of buying and selling shares. This suggests that the results show that investors are reluctant to act on negative information and it may indicate that certain shares are overpriced. This is not consistent with the original effiecient markets theory but is consistent with subsequent definitions, where the efficiency hypothesis states that the prices reflect information to the point where the marginal benefits of acting on the information do not exceed the marginal costs (Jensen, 1978).

Considering that the information about the block trades reaches the public approximately 5 trading days after it occurs, the fact that the residuals for buyer induced trades continue to rise after the day of the block trade for a period of 10 trading days may indicate market inefficiency, however this trend is not seen for the seller induced trades. Further it would not be possible to make a profit when one takes into account transaction costs, thus this, combined with the findings that the share price reaction to the block trades on the JSE is consistent with the reaction of the share price to block trades on the NYSE, is evidence in support of the Efficient Markets Hypothesis in the weak and semi-strong forms.

6. CONCLUSIONS

The following conclusions may be drawn from this study. There is a permanent rise in the share price, of on average 3.5%, for buyer induced trades as a result of a block transaction, and, the larger the block trade the larger the rise in share price. Similarly, there is a permanent decline in the share price, of on average 1.7%, for seller induced trades as a result of a block transaction, and, the larger the block trade the larger the decline in share price. Price reversals were found following both the buyer and seller induced trades.

Ariff & Chuen Lee (1993), whilst careful to say that they were not questioning the literature on the price-changes-volume relationship, were critical of the methodologies. A series of mispecification tests which they ran indicated that they could not find a suitable model for investigating the price-changes-volume relationship. To this extent it should be noted that support was found for both the price pressure hypothesis and for the information hypothesis, but not for the substitution hypothesis. Furthermore, the results show support for the weak and semi-strong forms of the Efficient Markets Hypothesis.

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Sustainable growth: A cash flow model – Investment Basics XXXIII

1. INTRODUCTION

A company's sustainable growth depends partly on the rate at which it can generate funds available for commitment to the growth target and the return it can expect to earn on these funds. The sources of these funds are retained income, additional borrowed capital (debt) and new equity issues.

A well-known model is that of the Boston Consulting Group's Model (BCG) (Zakon, 1968):

$$SG = [D/E. (R-i).p] + R.p$$

where

SG	=	sustainable growth rate;
D/E	=	debt/equity ratio;
R	=	ROA;
i	=	interest rate (1 – taxation rate); and
p	=	retention ratio.

The above SG is based upon the assumption of additional debt but no additional equity issues.

Firer (1995) gives a brief discussion of a variety of SG models that exist in the literature.

The purpose of this note is to present a model for SG where the emphasis initially is on cash from operating activities (CFO) as the only source without relying on additional debt and/or new equity issues.

2. SUSTAINABLE GROWTH RATE BASED UPON A CASH FLOW MODEL

Whereas the BCG model assumes no new equity it does assume additional debt. Another approach could be to calculate SG where no use is made of either additional debt or new equity issues. Such an approach could therefore perhaps depend on cash flow from operating activities as the only source of cash. In this regard cash from operating activities (CFO) will be defined as:

CFO = EBIT + non cash items – interest – taxation – △NCC:WC – dividends

where

EBIT = earnings before interest and taxation;
△NCC:WC = changes in non-cash components of working capital (i.e. stocks, debtors, creditors);

but EBIT – interest – taxation = PAT (profit after taxation)
∴ CFO = PAT + non-cash items – △NCC:WC – dividends

3. A RELATIVELY SIMPLE EXAMPLE

3.1 INTRODUCTION

In its simplest form assume a company (Trixie) without any fixed assets and/or investments and no borrowed capital. As a result the company does not have depreciation of fixed assets and no interest on borrowed capital.

Assume further that no dividends are proposed and paid and that taxes will be fully paid by year-end.

In the example of Trixie, sales in 1996 will be 1 800 units at a selling price of R4 per unit. The cost price per unit equals R3.

TRIXIE
INCOME STATEMENT FOR THE YEAR TO 31 DECEMBER 1996

Sales	1 800 units at R4	7 200
Cost of sales	1 800 units at R3	5 400
Gross income	1 800 units at R1	1 800
Operating expenses		1 050
Net income before taxation		750
Taxation (40%)		300
Net income after taxation		R 450

BALANCE SHEET AT 31 DECEMBER 1996

Stock	1 350
Debtors	1 200
Cash	50
	R2 600
Share capital	1 000
Retained income	1 150
Creditors	450
	R2 600

The question now arises: at what sales growth rate can Trixie grow in 1997 so that the cash balance on 31 December 1997 will remain at R50? Due to the absence of fixed assets and/or investments, investing activities in 1997 will be zero. Due to the restriction of no borrowed capital (no overdraft and other loans) and no new equity the financing activities in 1997 will also be zero. The only item remaining in the cash flow statement in 1997 will be operating activities. If financing activities equal zero, and investing activities also equal zero, then the operating activities should also be equal to zero, for cash to remain at R50.

As a result CFO = PAT – △NCC:WC = 0
∴ PAT = △NCC:WC

Assume that in 1997 the following will happen:

(a) selling price per unit remains R4;
(b) cost price per unit remains R3;
(c) operating costs/sales will remain at 14,583%
(d) stock period, debtor's period and creditor's period of 1996 will be the same in 1997;
(e) taxation % will be 40% in 1997; and
(f) no dividends will be paid in 1997.

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3.2 CALCULATION OF NET INCOME AFTER TAXATION (PAT)

Let g = sales growth rate from 1996 to 1997. PAT (1997) will be given by $Sales_{96}(1 + g)$ x PAT/sales. Because gross income percentage remains constant (25%) and the ratio operating expenses/sales remains constant (14,583%) and the taxation rate remains constant, PAT/sales will also remain constant, i.e.

$PAT_{96}/sales_{96}$ = 450 x 100/7 200
= 6,25%

PAT_{97} = $Sales_{96}(1 + g)$ x 0,0625
= 7 200 (1 + g) x 0,0625
= 450 (1 + g)

3.3 CALCULATION OF ACTIVITY PERIODS

Both PAT and △NCC:WC will be defined in terms of sales. All activity ratios (stock, debtors and creditors) must therefore be in terms of monthly sales of R600.

S = Stock period = stock/average monthly sales
= 1 350/600
= 2,25 months

D = Debtors' period = debtors/average monthly sales
= 1 200/600
= 2 months

C = Creditors' period = creditors/average monthly sales
= 450/600
= 0,75 months

Working capital cycle (WCC) = S + D – C
= 2,25 + 2 – 0,75
= 3,5 months

3.4 FORMULA FOR △NCC:WC

$$\triangle NCC{:}WC_{97} = \frac{Sales_{97}}{12}(S_{97} + D_{97} - C_{97}) - \frac{Sales_{96}}{12}(S_{96} + D_{96} - C_{96})$$

where

S = stock period = stock/monthly sales
D = debtors' period = debtors/monthly sales
C = creditors' period = creditors/monthly sales

However the sales for 1997 are unknown and must still be determined. Let sales growth rate in 1997 = g.

$$\therefore \triangle NCC{:}WC_{97} = \frac{Sales_{96}(1 + g)}{12}(S_{97} + D_{97} - C_{97}) - \frac{Sales_{96}}{12}(S_{96} + D_{96} - C_{96})$$

However $S_{97} = S_{96}$
$D_{97} = D_{96}$
$C_{97} = C_{96}$

$$\therefore \triangle NCC{:}WC_{97} = \frac{[Sales_{96}(1 + g) - Sales_{96}]}{12}(S_{96} + D_{96} - C_{96})$$

$$= \frac{g\ Sales_{96}}{12}(S_{96} + D_{96} - C_{96})$$

$$= g \cdot \frac{7\,200}{12} \cdot 3,5$$

$$= 2100\ g$$

3.5 CALCULATION OF SUSTAINABLE GROWTH RATE

The growth rate will be obtained when CFO = 0 or when

PAT_{97} = △NCC:WC_{97}

$$\therefore 7\,200(1 + g) \cdot 0,0625 = g \times \frac{7\,200}{12} \cdot 3,5$$

$$\therefore 450(1 + g) = 2\,100\ g$$

$$\therefore g = 0,2727 \text{ or } 27,27\%$$

3.6 INTERPRETATION

The above equation indicates that if CFO = PAT – △NCC:WC then the growth rate in sales will affect both the left hand side of the equation (PAT) as well as the right hand side of the equation (△NCC:WC), i.e.

$$PAT(1 + g) = g\frac{Sales}{12}(WCC)$$

where WCC = S + D – C

$$\therefore g = \frac{PAT}{(\frac{Sales}{12} \cdot WCC - PAT)}$$

where g $$= \frac{450}{7\,200/12 \times 3,5 - 450}$$

$$= \frac{450}{2\,100 - 450}$$

$$= 0,2727$$

The longer the WCC, the lower the g for a given PAT and given sales. On the other hand, growth will be higher for a lower WCC. If e.g. the WCC will be reduced to 2,5 months then

$$g = \frac{450}{7\,200/12 \times 2,5 - 450}$$

$$= 0,4286 \text{ or } 42,86\%$$

In other words a reduction of 1 month in WCC will increase the SG by 15,59% (42,86% – 27,27%).

However, it is not only WCC that is important. The increase in NCC:WC will be determined by the product of

- growth in sales, and
- working capital cycle (WCC).

It is obvious that g will be higher for a high PAT (high margin). Suppose PAT = R550 based upon monthly sales of R600. If WCC = 3,5 months

$$g = \frac{550}{600 \times 3,5 - 550}$$

$$= 0,3548 \text{ or } 35,48\%$$

If PAT increases by R100 or 22,2%, SG will increase by 8,21% (35,48% – 27,27%).

However, for a given margin, SG could be high if WCC is low (e.g. Pick 'n Pay) but lower if WCC is longer (e.g. Edgars). However the margins of Pick 'n Pay and Edgars will not be equal!

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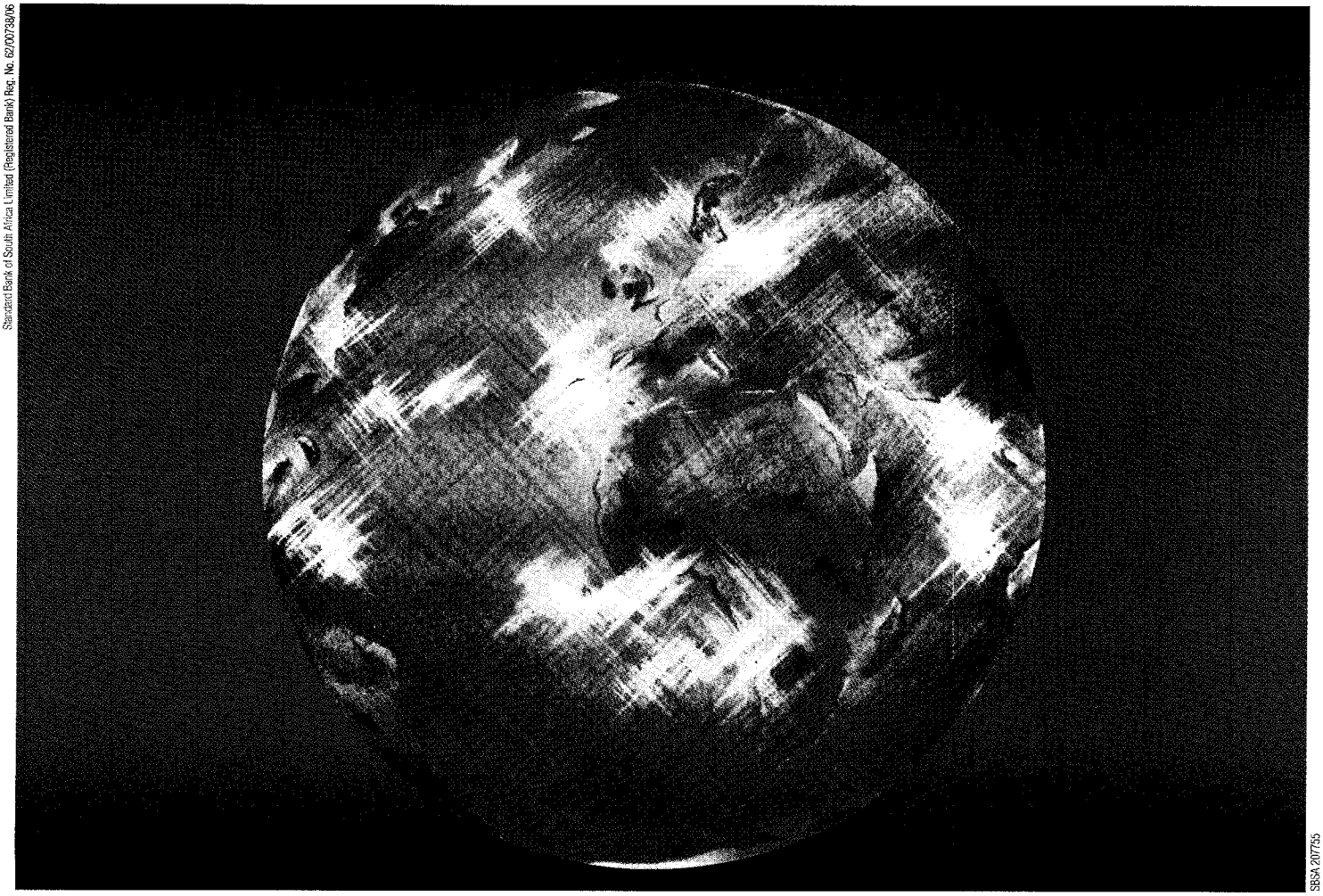

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4. FURTHER APPLICATION OF MODEL

Suppose that the debtors' period of Trixie will increase from 2 months to 3 months in 1997. All the other items will remain the same as in 1996. WCC will change from:

$$WCC_{1996} = 2{,}25 + 2 - 0{,}75 = 3{,}5$$

to $$WCC_{1997} = 2{,}25 + 3 - 0{,}75 = 4{,}5$$

The equation for SG becomes

$$\therefore 450(1 + g) = \frac{7200}{12}(1 + g) \cdot 4{,}5 - \frac{7200}{12} \cdot 3{,}5$$

$$\therefore 450(1 + g) = 2700(1 + g) - 2100$$

$$\therefore g = -0{,}0667 \text{ or } -6{,}7\%$$

5. EXTENSION OF ORIGINAL PROBLEM

The formula for SG was obtained from the general cash flow format, i.e.

Cash from operating activities	–	cash to investing activities	+	cash from financing activities	=	0

Because both investing activities and financing activities = 0, cash from operating activities had to be = 0.

In the original Trixie case no dividends were paid, no investments made, no loans existed and no new equity raised. Suppose now that 25% of PAT was paid as a dividend. What will the new SG be? The retention rate is 0,75 or 75%. The equation for SG becomes:

$$7200(1 + g) \cdot 0{,}0625 \cdot 0{,}75 - g \cdot \frac{7200}{12} \cdot 3{,}5 = 0$$

$$\therefore 450(1 + g) \cdot 0{,}75 - 2100\,g = 0$$

$$\therefore 337{,}5(1 + g) - 2100\,g = 0$$

$$\therefore g = 0{,}1915 \text{ or } 19{,}15\%$$

Suppose now that the original WCC of 3,5 months will increase to 4,5 months in 1997. Suppose further that the dividend retention will be 0,75 in 1997. Suppose further that R300 could be raised by a new equity issue.

The equation for SG becomes

Cash from operating activities	+	cash from financing activities	=	0

$$\therefore 450(1 + g) \cdot 0{,}75 - \left[\frac{7200}{12}(1 + g) \cdot 4{,}5 - \frac{7200}{12} \cdot 3{,}5\right] + 300 = 0$$

$$\therefore 337{,}5(1 + g) - 2700(1 + g) + 2100 + 300 = 0$$

$$\therefore g = 0{,}01587 \text{ or } 1{,}587\%$$

6. SUMMARY

The Trixie example started with no investing activities and no financing activities. To obtain a SG the cash from operating activities (CFO) had to equal zero. However the same cash flow model can be used if the dividend decision is introduced. The model also worked when the debt/equity ratio was changed by introducing new equity.

The model also works when investing activities (new fixed assets and/or investments) will be introduced. However, the model must be adjusted when use is made of new borrowed capital to the extent that interest on the new borrowed capital will affect CFO. In such a case the cash flow model will accommodate the BCG and like models as a special case.

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