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Equities, Bonds, Cash and Inflation: Historical performance in South Africa 1925-1998

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1. Introduction*

An important aspect of research in investments is a study of the past in order to make inferences about the future. In the introduction to their definitive publication on the historical record of the U.S. markets, Ibbotson and Sinquefield (1989) argue that the use of long historical periods enables the researcher to "assess the basic relationships among asset classes, between risk and return, and between nominal and real returns". Despite Nobel laureate Paul Samuelson's famous comment that "we have but one sample of history", and the certainty that history will indeed not be repeated event for event, provided we believe that similar historical event types are likely to repeat themselves in the future, a study of the past will lead us some way along the path of unravelling the future.

It is common cause that South African financial market history commences in 1960. For example, Winston Floquet (Fleming Martin, 1998) has for some years published an annual update of a paper in which he reviews the returns achieved historically in the South African capital markets. The first year of his study is 1960. A similar historical study was published by Smit, Hamman, Gear and Smit (1996) covering the years 1961 - 1993.

Earlier data seem never to have been systematically collected and published. The cavalier treatment often afforded historical data is of great concern. In preparing for this study it was frequently found that valuable information had been discarded once the person who had gathered the data had left an organisation. Consequently estimates of future market performance may be based on a biased historical sample. Only the early part of the 39-year period for which data are freely available was characterised by low inflation. It was only recently that inflation fell to single digit figures. The impact of the Great Depression and the Second World War are not a part of this historical record.

Reaching back into the past may reveal a different story about the South African capital markets. Over 10 years ago Old Mutual commissioned Heather McLeod to research whether or not historical data could be found which would allow a similar starting point to that of Ibbotson and Sinquefield, namely 1926. This paper reports the results of the research, updated to the end of 1998.

The historical performance of the equity, bond and cash markets in South Africa over a period of 74 years from 1925 to 1998 is reported and analysed. The methodology of the South African study follows the principles of the Ibbotson and Sinquefield study but is adapted for local variations in instruments and data. The results of the South African study are fully comparable with those of the USA study. The determination of appropriate data to be used in the local study formed a major part of the research. The long term equity, bond and cash data series described in detail in the paper were spliced together from a variety of sources so as to provide a 74 year historical picture.

2. THE EQUITY DATA

2.1 The JSE-Actuaries Equity Indices

The JSE-Actuaries All Share Index is the definitive index of the South African equity markets. The Price Index is calculated as a market capitalisation weighted arithmetic average of the prices of the components every two minutes during the trading session with an official close being calculated once closing prices become available after the exchange stops trading at 16:00 daily. The official closing prices on the exchange are used for the daily calculation of the Price Index.

The income portion of the All Share Index is the dividend yield. Information on the dividends payable is updated as each company makes them public. The Ibbotson and Sinquefield study uses actual dividends paid rather than a dividend yield. In order to follow the same approach, a massive data collection exercise of the amounts and dates of dividend payments on all Index components over an extended period would have been necessary. The increase in historical accuracy does not appear to be justified given the data problems we report in obtaining the older data.[1]

The convention for performance calculations is to assume that 1/12 of the dividend yield is received each month. The actual incidence of dividends is, however, lumpy with a larger number of companies paying paying dividends in March and September than in other months. A study of the payout patterns of dividends by listed companies revealed the following spread of declaration months[2] :

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2,7%	6,6%	12,5%	7,0%	9,2%	9,4%	4,5%	6,9%	12,3%	8,6%	11,6%	8,8%

These figures indicate that the assumption that dividend payments are spread out equally throughout the year, whilst formally incorrect, is not unreasonable.

2.1.2 Historical Equity Indices

Transactions in gold mining shares dominated the JSE until 1926. Industrial company listings increased substantially in the 1930's and after the Second World War. By 1946 the market capitalisation of financial, industrial and commercial shares exceeded that of mining shares. In 1948 the Bureau for Economic Research published a study by Schumann and Scheurkogel of the University of Stellenbosch entitled "Industrial and Commercial Share Price Indices in South Africa", which reported monthly data from 1910 to 1947 (the BER study). The significance of the study is the use of the market capitalisation weighted technique as used currently for the JSE-Actuaries Equity Indices.

Prior to 1978 the most widely accepted index of the equity markets was the Rand Daily Mail Industrial Index (known as the RDM100). Although it is known that the index was weighted by market capitalisation, no further details of the method of calculation survive. Constituents were changed infrequently by the editors of the paper. There is some confusion as to the starting date of the RDM100 Index. The JSE claims that it began in 1958 and that Sanlam performed calculations covering the period 1949 to 1958. Sanlam have no record of the data and an editor of the RDM in those days believes that the RDM100 was published from before 1950. Data understood to be the RDM100 starting in 1949 were supplied by Old Mutual. More reliable data do not appear to exist for that period and accordingly the series has been used from 1949 to 1959.

The break between the BER study data (which ended in December 1947) and the RDM data from January 1949 was filled from a graph of industrial share prices published by the JSE. The South African Reserve Bank (1993) published a series of capital market
statistics, included in which were annual data for a gold index from 1946, for industrial and commercial shares from 1948 and the equivalent of an ALSI index from 1954. The general direction and magnitude of the data was similar to that reported in this study. However index values in the early years were reported as single significant figures, and this, coupled with the lack of monthly data prior to 1960 and the fact that the index was composed of "a large representative sample", rendered the data only of corroborative value.

The JSE-Actuaries Equity Indices were launched at the start of October 1978. The Actuarial Society and the JSE Index Committee decided to link the new Indices to the Rand Daily Mail (RDM) indices. This was in recognition of the fact that the RDM Indices were also weighted in terms of market capitalisation and because they were then the most widely accepted indicators of these markets. The JSE-Actuaries Equity Indices were constructed by selecting eligible shares from each sector starting with the company with the largest market capitalisation in that sector and then

successively selecting eligible shares until approximately 80% of the market capitalisation of the eligible shares in that sector had been included in the index. The shares making up the index were monitored and updated on a regular basis.

In March 1995 a new and more inclusive method of determining the constituents of the index was established. Effectively all companies are included unless major portions of their operations are outside South Africa, the company is purely or largely a holding company or a major part of the assets of the company consist of shares already in the index (pyramid companies). The latter does not apply to companies in the Investment Trusts, Industrial Holdings, Mining Houses and Mining Holding sectors.

The JSE-Actuaries All Share Index was used so as to cover the full spectrum of equity investment in more recent years. Although data prior to 1960 cover only industrial shares, these are considered to provide a reasonable proxy for equity investment during that period. The equity price index data used in this study are thus effectively made up of two distinct series. The first runs from January 1925 to December 1948 and the second from January 1949 to December 1998. The two price index series could not be linked although the resulting monthly performance series can be linked to allow further calculations. The make-up of the linked price index between 1925 and 1985 is shown in Figure 1.

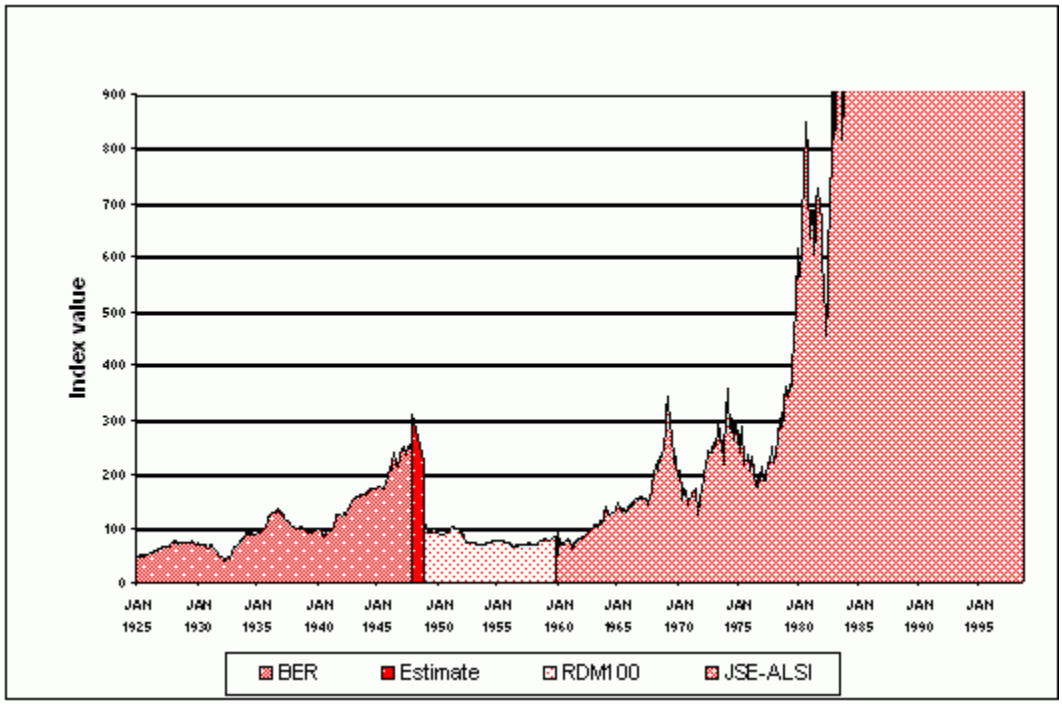


Figure 1: JSE Equity Price Index 1925-1998

The calculation of performance requires both a price index and an income component, usually in the form of a dividend yield. The BER study contained an annual index of dividends from 1925 to 1946 as well as information on the dividend yield at the end of June 1946. Using this information the annual index was converted to an annual dividend yield, giving the results as shown below. The RDM100 was calculated purely as a price index with no dividend information being kept. The income component of equity performance is relatively small and in the absence of any better information, the gap in dividend yield data between 1946 and 1959 was filled by assuming a constant dividend yield of 5% [3] .

From 1960 onwards full information is available in the form of the JSE-Actuaries All Share Index Dividend Yield. The dividend yield time series is shown in Figure 2.

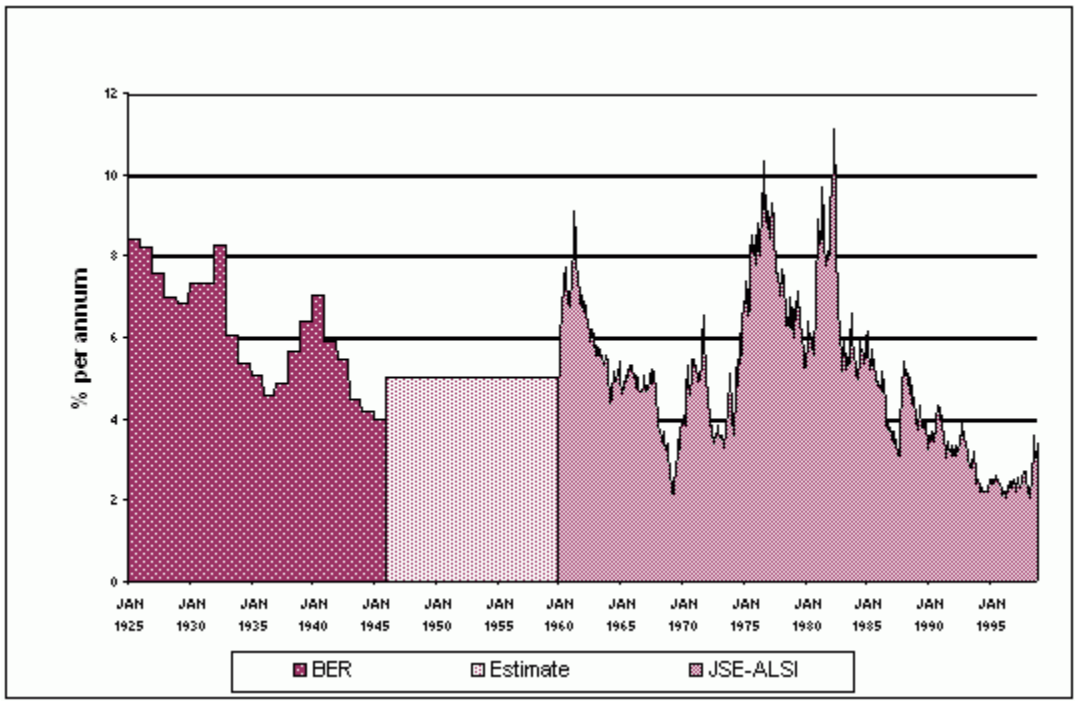


Figure 2: JSE Equity Dividend Yield 1925-1998

1 It is suggested that the JSE and/or the Actuarial Society begin to collect this data on an ongoing basis.

2 The data consisted of all interim and final dividends paid by listed companies between 1974 and 1997 together with the month into which the last day to register fell.

3 This assumption was tested by calculating what effect a change in the dividend yield from 5% to 4% for the 1949 to 1956 period would have on the average return for the full study period. The result was a fall in the arithmetic average return from 15,70% per annum to 15,51% per annum. The effect of this assumption on the results of the study is therefore not considered to be material.

2.2 The Bond Data

2.2.1 The JSE-Actuaries Bond Performance Indices

The JSE-Actuaries All Bond Index provides information for calculating performance on the South African bond markets. The format of the All Bond Index is similar to that of the All Share Index with a capital portion (the price index) and an income portion (the interest yield). The Price Index is a market capitalisation weighted arithmetic average of component bond prices. The component bonds are updated quarterly based on marketability. The weightings are the amounts in issue in private hands. As there was, until 1998, no central data collection for the bond market [4], the closing yield on the JSE Gilt floor was used to calculate the daily index. Since the formation of the Bond Exchange in 1998, all data are centrally collected. The closing yield from this market is now used. The yield is converted to a price following market convention with only the clean price (excluding accrued interest) being used.

The yield-price calculation is date dependent. The month end Price Index is calculated on the last calendar day of the month and is not necessarily the same as that for the last trading day of the month. Interest on bonds accrues smoothly throughout the Figure 2: JSE Equity Dividend Yield 1925-1998

year despite the two payment dates. The simplifying assumption of 1/12 of the Interest Yield being earned each month is thus more appropriate for bonds than was the case for equities. The JSE-Actuaries All Bond Index and its components is available on a monthly basis from January 1986.

2.2.2 Historical Bond Indices

Morgenrood (1987, 1988a,b,c 1989a,b) in a series of papers on the history of the South African markets, traces the issue of bonds and debentures from 1820 onwards. He discusses significant primary borrowings in the local market and offshore by central Government, public utilities and local authorities over a period of some 160 years. In the 1940's and 1950's institutional holdings of Government bonds increased as a result of prescribed asset legislation in the Insurance Act of 1943 and the Pension Funds Act of 1956. Despite repeated attempts to encourage secondary market activity, a formal secondary market did not develop until the end of the 1970's. Prior to 1980 it is thus difficult to determine the constituents of a market bond portfolio and the yields at which to value holdings.

A theoretical one-bond portfolio was used to develop a measure of early historical performance. A single notional 20-year bond was created at the outset with a coupon level appropriate to long bonds at that date. As yields changed, so performance from holding the bond was affected. The coupon level was revised whenever a long dated Government bond was issued, effectively changing the bond in the portfolio. The methodology of the JSE-Actuaries Bond Performance Index was used to chain-link the index when the constituent bond changed. This approach results in a separate Price Index and Interest Yield being obtained. A similar methodology, making use of a notional bond at current coupon levels, was employed in the Ibbotson and Sinquefield (1989) study.

Yield and coupon data for the period 1927 to 1943 were obtained from the BER study (Schumann and Scheurkogel, 1948). Yields for 1925 and 1926 were set after discussions with Dr. Morgenrood (1989). Yield data on long term bonds are available from 1941 onwards on a monthly basis as the JSE-Actuaries Long Bond Yield. Information from Reserve Bank records was used to determine appropriate coupon levels. This period is labelled RBQB in the Bond Price Index and Bond Interest Yield graphs (Figures 3 and 4). Price index and interest yield data were thus calculated on a consistent basis from 1925 to 1979. The initial work from 1941 to 1979 was done in conjunction with Dave Russouw of Old Mutual in 1989.

The period from 1980 to 1985, covering the existence of the JSE-Actuaries Fixed Interest Index, was treated using a different methodology. The coverage of the market through the Fixed Interest Index was superior to that of the single bond portfolio described above but the format of the Index created difficulties. The Index was unweighted and thus although component indices for various regions of the yield curve (0 to 3 years, 3 to 7 years, 7 to 12 years and over 12 years) were available, no official attempt was made to calculate the equivalent of an All Bond Index. In order to do so users were required to choose an arbitrary basis of their own.

For this study the performance on the component indices (0-3 years, 3-7 years, 7-12 years, and 12+ years) was taken from the JSE-Actuaries Bond Index Handbook published in 1988. These sectoral performances were combined using weightings of 15%, 20%, 15% and 50% respectively so as to approximate an All Bond performance between 1980 and 1985. The weightings were determined after considering market capitalisation information on index components as at January 1986. It is not possible to combine the old JSE-Actuaries Fixed Interest Index directly with the new JSE-Actuaries Bond Performance Index (or data produced with that method) as a different definition of income was used. Instead monthly performance can be separately calculated and then linked to allow further calculations.

From 1986 onwards the JSE-Actuaries All Bond Index was used. Bond performance in this study thus consists of long bond performance from 1925 to 1979 with performance on the entire bond market being used from 1980 onwards. The bond price index and interest yields are shown in Figures 3 and 4.

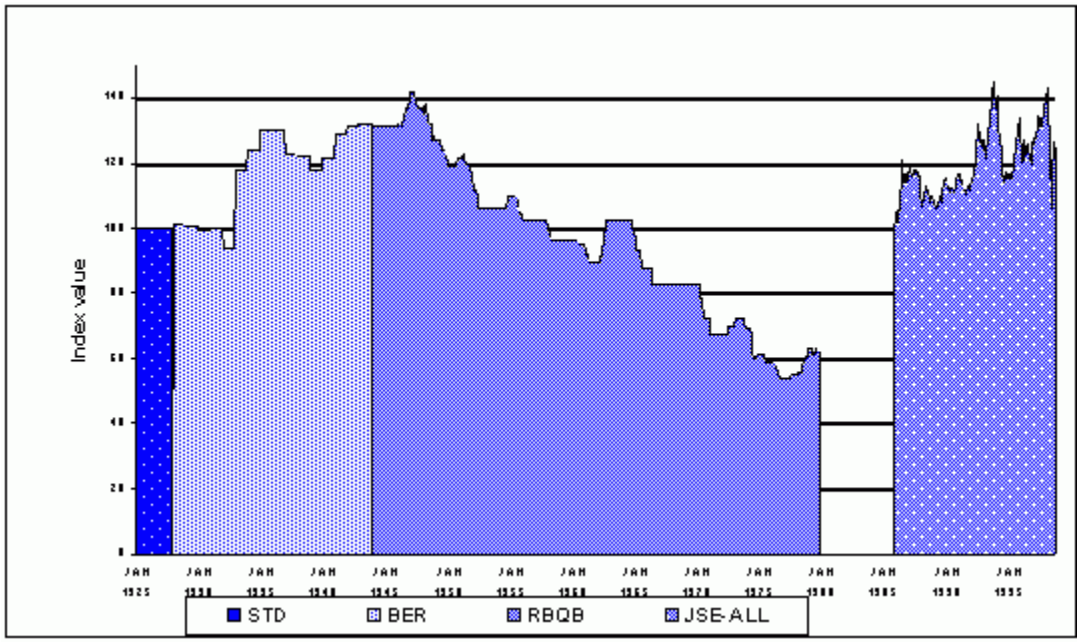


Figure 3: Bond Price Index 1925-1998

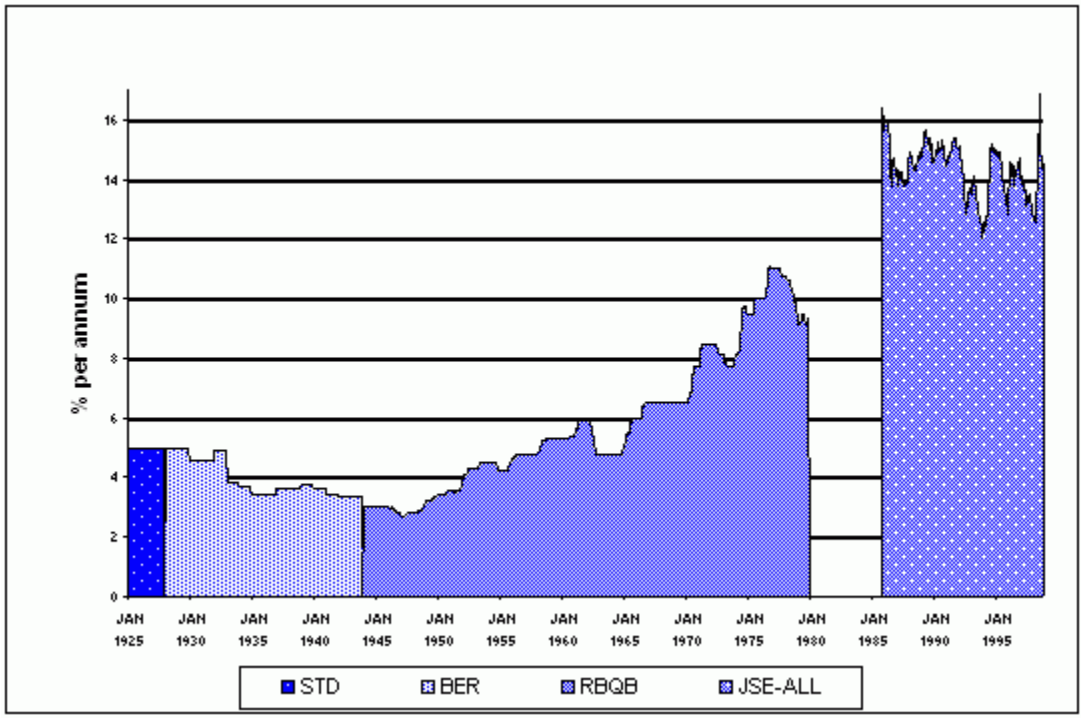


Figure 4: Bond Interest Yield 1925-1998

4 Bonds were traded both on the JSE Gilt floor as well as via screens in the inter-bank market.

2.3 The Cash Data

2.3.1 Determining Appropriate Cash Data

No official index of performance in the money market exists. It was necessary for this study to determine an appropriate money market instrument on which to base a performance index. The most tradable instruments are T-bills, bankers' acceptances, Land Bank bills and promissory notes, prescribed asset bills and negotiable certificates of deposit (NCDs). Studies of performance elsewhere in the world routinely use the 90-day Treasury Bill to determine the performance of cash (For example Ibbotson and Sinquefield, 1989). The T-bill is widely acknowledged as providing the benchmark for "risk-free" returns.

Morgenrood (1987, 1988a, 1988b), in a series of articles on the history of the Treasury Bill in South Africa between 1881 and 1981, concluded that during the first 100 years of its existence the T-bill failed to come into its own as a benchmark for the risk-free rate. The basic cause for this he ascribes to the enduring official reluctance to refrain from intervening in the financial markets. The Banks Act, Act no 23 of 1965 introduced a system of monetary control whereby requirement ratios on various classes of liabilities were set for the holding of liquid assets. T-bills have ranked as liquid assets for banks and building societies since 1965, as prescribed investments for insurers and pension funds, and have always been eligible to be used for Central Bank accommodation. An artificial demand was thus created for these bills. The De Kock Commission of Enquiry (1985) found that "… the South African Treasury Bill market was neither free nor competitive …. and therefore failed to produce realistic, market-related interest rates." In order to determine the most appropriate instrument for the performance index, discussions were held with money market authorities.

A number of points were raised.

a. Distortions certainly did exist in the T-bill rate.

b. BA's have ranked as liquid assets for banks (only partly between 1972 and 1985) and for building societies from 1985. They could not be used by insurers and pension funds to satisfy their prescribed asset requirements. BA's became re-discountable at the Reserve Bank during 1978. The BA rate is thus also subject to some distortion.

c. NCDs have never ranked as liquid assets or as prescribed assets for life offices and pension funds. However fixed deposits ranked as prescribed assets for insurers and pension funds - and NCDs are considered a proxy for fixed deposits. NCDs did rank as prescribed assets for banks and building societies for a brief period during the 1970's. This status did not influence the rates on NCDs as a "shortage" in the supply of prescribed assets has never been experienced in the South African markets.

d. The major distortions in short term interest rates have been caused by the lack of supply of liquid assets from time to time, especially during the 1970's. This resulted in an artificial demand for such assets in order to comply with the liquid asset requirements, resulting in their prices being bid higher. Thus, wide differentials between the rates on liquid assets, such as T-bills, and those on non-liquid assets, such as NCDs, existed on a number of occasions as shown in Figure 5.

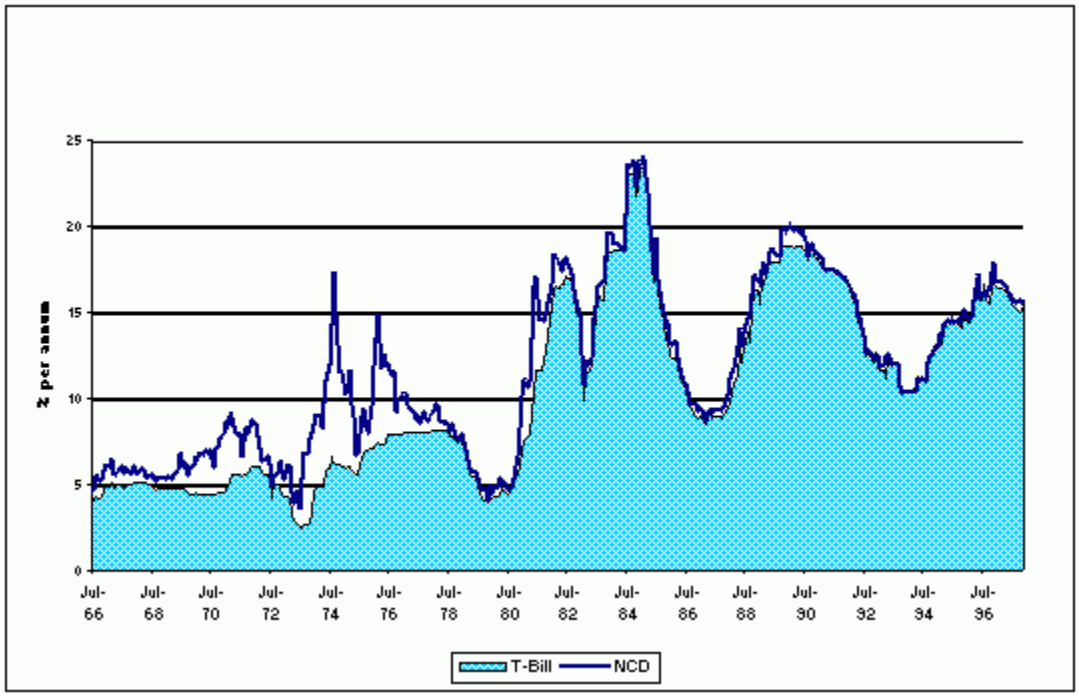


Figure 5: Effective Yields : T-bills and NCDs

Therefore it was decided, in discussion with Dr. Pierre Faure, to use the market for negotiable certificates of deposit as the basis for any money market indices. NCDs are issued for most periods up to one year, whereas other instruments are typically issued for three-month periods only. Trading in NCDs takes place throughout the full maturity spectrum of up to one year, thus providing data on the full money market yield curve. The rates have not been distorted by the various investment requirements applying to banks, building societies, insurers and pension funds and NCD rates can therefore be regarded as representing the true cost of money. Discussions with market participants indicated that during the 1990's, of the instruments for which data are available, NCDs represent between 40 and 50 percent of market capitalisation in the money market.

2.3.2 Historical Cash Data

NCDs were first issued in 1964 and reliable data are available only from August 1966 onwards. Other instruments thus had to be used between 1925 and 1966. Data on three month fixed deposits were provided by Dr Morgenrood of the Standard Bank for the period between 1925 and 1959. The Bureau for Economic Research study published in 1948 corroborated the data made available by Standard Bank (Schumann and Scheurkogel, 1948).

The first BA was probably issued in 1957 following the establishment of UAL as the first local merchant bank. Data on BAs on a monthly basis were available from January 1960 from Dr. Pierre Faure then of Securities Discount House. It was felt that the BA rate could be used from 1960 to July 1966 as the distortions discussed above were not material during that period. Monthly NCDs rates made available by Securities Discount House were used from August 1966 until 1989. Thereafter the rates published by I-Net Bridge were used.

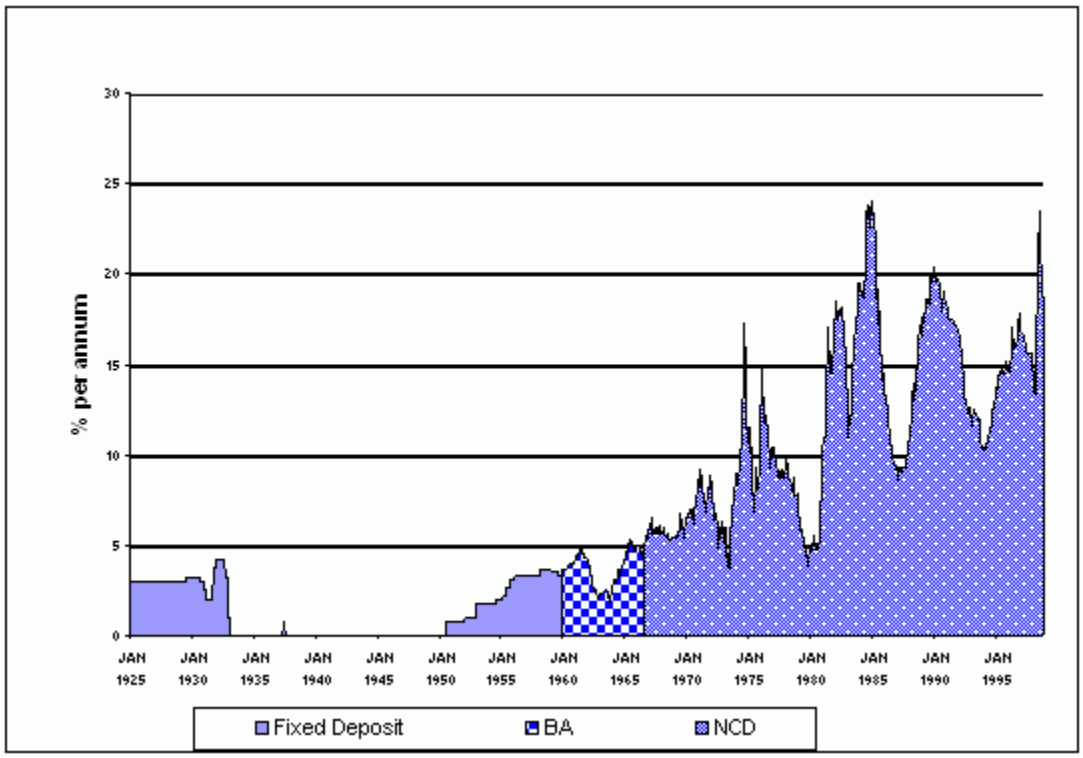


Figure 6: Money Market Yields 1925-1998

Figure 6 shows that three month rates were zero for a substantial period in the 1930's and 1940's. During this time excessive liquidity had built up in the South African market. The table below indicates representative rates for other terms at that time. The continuing use of the three month rate for determining performance during this period of excessive liquidity is considered to be justified. The three month rate represents passive investment in the money market. Investors could of course have improved the return as shown in the following table by taking a view on the course of interest rates.

Date	3 month Deposit	6 month Deposit	12 month Deposit	Overdraft Rate
February 1933	0,00	1,50	3,00	6,25
June 1933	0,00	0,50	2,00	6,00
July 1937	0,50	0,50	3,00	5,50
January 1946	0,00	0,50	1,50	4,50

2.4 The Inflation Data

The Consumer Price Index (CPI), produced by Central Statistical Services, which measures the rate of change of consumer goods prices, is widely used as a measure of inflation in South Africa. Information is collected monthly throughout South Africa on a large basket of goods. The price information, which is updated every five years, is weighted by 30 000 households' buying pattern information. The CPI has been published on a monthly basis since 1910.

Wilkie (1984) noted that the expression "real" may generally be taken to mean returns that are calculated in relation to the consumer price index. Although the adjustment for changes in the general purchasing power of money could be done using some other index as the basis for the calculation, the unqualified use of the term "real returns" implies the use of the consumer price index for the determination of real returns. This is in line with the methodology used for the SBBI study.

3. METHODOLOGY

3.1 The Calculation of Performance

The core of the study is the determination of monthly performance for each asset class. The monthly performance series is used to determine performance on an annual basis as well as over longer holding periods. Inflation-adjusted performance is calculated by removing the effects of inflation from the basic series.

3.1.1 Monthly Equity Performance

The approach used in the calculation of the monthly equity performance is that the index is "purchased" at the start of each month. The index is purchased using the Price Index at the start of the month and sold using the Price Index at the end of the month. It is assumed that dividend income is received half-way through the month and that dividends emerge smoothly over the year. Thus the dividend is calculated using one twelfth of the quoted Dividend Yield. The dividend received is reinvested in the index at the average Price Index for the month. The value of the reinvested dividend at the end of the month is added to the value at month end of the initial investment. This combined value is divided by the amount of the initial investment to obtain performance for the month.

Mathematically,

$PI_{(t)}$ = the Price Index at time (t)

$DY_{(t)}$ = the Dividend Yield at time (t)

$ap_{(t)}$ = the average price index for month (t)

$= [\ PI_{(t-1)} + PI_{(t)}\ ] / 2$

$d_{(t)}$ = the dividend received for month (t)

$= [\ DY_{(t-1)}PI_{(t-1)} + DY_{(t)}PI_{(t)}\ ] / 2400$

$r_{(t)}$ = the monthly performance for month (t)

$$= \frac{PI_{(t)}}{PI_{(t-1)}}\left[1 + \frac{d_{(t)}}{ap_{(t)}}\right] - 1$$

3.1.2 Monthly Bond Performance

The approach used is identical to that for calculating monthly equity performance. In periods where data are available in the form of a Price Index and Interest Yield, the mathematical formulation for equities is used. As interest income rather than dividends are received, the Interest Yield replaces the Dividend Yield in the formulae. In periods where the data are in the format of the discontinued JSE-Actuaries Fixed Interest Index, the mathematical formulation of performance needs to be amended to allow for the different definition of income. In 1989 the JSE-Actuaries Index Subcommittee published monthly performance figures for the Fixed Interest Index using the philosophy outlined above. These monthly performance figures were used directly for the period from January 1980 to December 1985.

3.1.3 Monthly Cash Performance

The approach adopted for measuring the performance of a "cash" portfolio is to assume that the portfolio is made up of three 90 day money market instruments, purchased in successive months. Each month as one of the instruments matures it is replaced by a new three month instrument. The valuation of money market securities in long term portfolios is seldom performed on a sophisticated basis. Active trading of short-dated paper is also unusual. The "portfolio" approach adopted thus mirrors the treatment of money market instruments in the portfolios of long term investors. Each month the portfolio purchases a new three month NCD at the then ruling rate. That rate determines the performance that will be achieved on the instrument over the next three months if the NCD is allowed to run for the full period. Each month the portfolio contains three NCDs of different terms to expiry and the return for any given month is an average of the monthly returns of the three separate NCDs.

Mathematically:

$Y_{(t)}$ = the interest rate on a three month NCD at time (t)

$mv_{(t)}$ = the maturity value of a three month NCD purchased at time (t)

$= 100 + (91/365)\, Y_{(t)}$

$rm_{(t)}$ = the return each month on an NCD held for the full three month period

$[mv_{(t)} / 100]^{1/3} - 1$

$r(t)$ = the monthly performance for month (t)

$[\, rm_{(t-3)} + rm_{(t-2)} + rm_{(t-1)} \,] / 3$:

In the period in which BA data were used, the calculation of performance followed a similar pattern.

Mathematically,

$D_{(t)}$ = the discount rate on a 90-day BA at time (t), with data collected at the end of month (t)

$pv_{(t)}$ = the price of a 90-day BA at time (t)

$= 100 - (91 / 365)\, D_{(t)}$

$rmb_{(t)}$ = the return each month of the three month holding period following the purchase of a single 90-day BA at the end of month (t)

$r_{(t)}$ = the monthly performance for month (t)

$= [\, rmb_{(t-3)} + rmb_{(t-2)} + rmb_{(t-1)} \,] / 3$

3.1.4 Annual Performance

Monthly performance figures for January through December each year are chain-linked together to determine the annual performance.

Mathematically,

$r_{(j,k)}$ = the monthly performance for month (k) of year (j)

$R_{(j)}$ = the annual performance for year (j)

$$= \prod_{k=1}^{12} (1 + r_{(j,k)}) - 1$$

3.1.5 Performance Over Longer Periods

It is often instructive to consider performance over longer periods. As performance can be surprisingly volatile even over long periods, the temptation must be resisted to quote single examples of long term performance. The starting and ending date of the calculations are too easily manipulated to have any confidence in the results. The concept of a rolling holding period return is used to illustrate the level and volatility of performance over long periods. A series of returns over a fixed period (say ten years) is calculated with the ending date moving forward one year at a time. The performance is quoted as a compound annual return. In this study, performance is calculated for holding periods of three, five, ten and twenty years.

Mathematically,

$_{(n)}R_{(j)}$ = the performance over holding period (n) ending in year (j)

$$= \left[\prod_{j=J-n+1}^{J} \prod_{k=1}^{12} (1 + r_{(j,k)}) \right]^{1/n} - 1$$

3.2 The Calculation of Inflation-adjusted Performance

The index of inflation is treated in the same way as the price index of other assets to determine inflation "performance" on a monthly basis. Inflation can be considered as a separate "asset" class in this regard. The monthly performance series for an asset class is combined with the monthly performance series for inflation to obtain a monthly inflation-adjusted series for the asset class. The inflation-adjusted series for each asset class is calculated using geometric subtraction.

Mathematically,

$CPI_{(t)}$ = the Consumer Price Index at time (t)

$I_{(t)}$ = the monthly performance of inflation at time (t)

$= CPI_{(t-1)} / CPI_{(t)} - 1$

$R_{(t)}$ = the monthly performance of the asset class at time (t)

$_{(ia)}r_{(t)}$ = the inflation-adjusted monthly performance of the asset class at time (t)

$= (1 + R_{(t)}) / (1 + I_{(t)}) - 1$

Performance of the inflation-adjusted series over periods longer than one month is calculated as in Sections 3.1.4 and 3.1.5. Wilkie (1984) recommended making adjustments to allow for the lag between the collection of prices and the publication of the index, thus ensuring that inflation is measured over the identical period to asset returns. As the full South African CPI basket is not sampled each month, there is an additional lag in the figures. The refinements of Wilkie's calculations were not felt to be justified in this study.

4. Historical Performance

The performance of equity, bonds and cash is analysed over the 74 year period from 1925 to 1998. In Figure 7 the growth of one rand invested in ordinary shares, long-term government bonds, the money market and inflation since 1925 is graphed. Reinvestment of dividends on shares and coupons on bonds is assumed and taxes are ignored. The vertical scale is logarithmic.

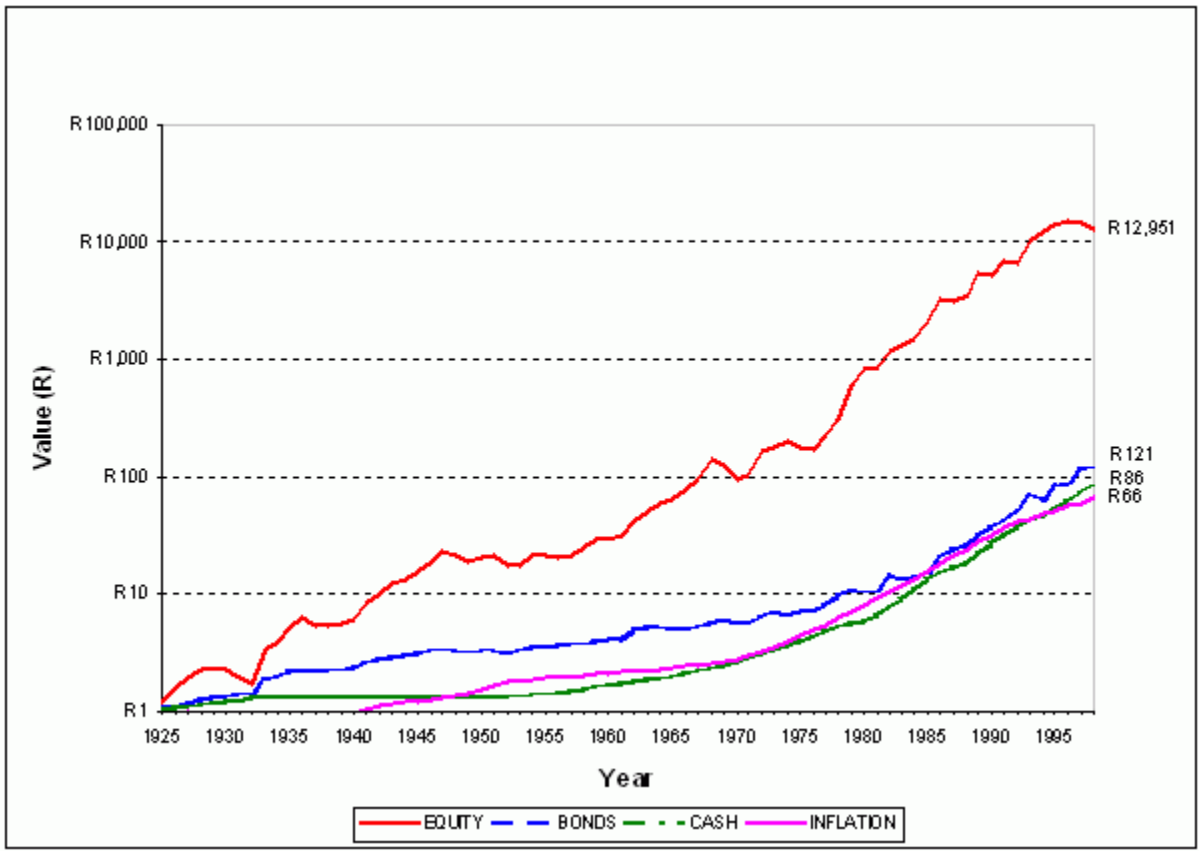
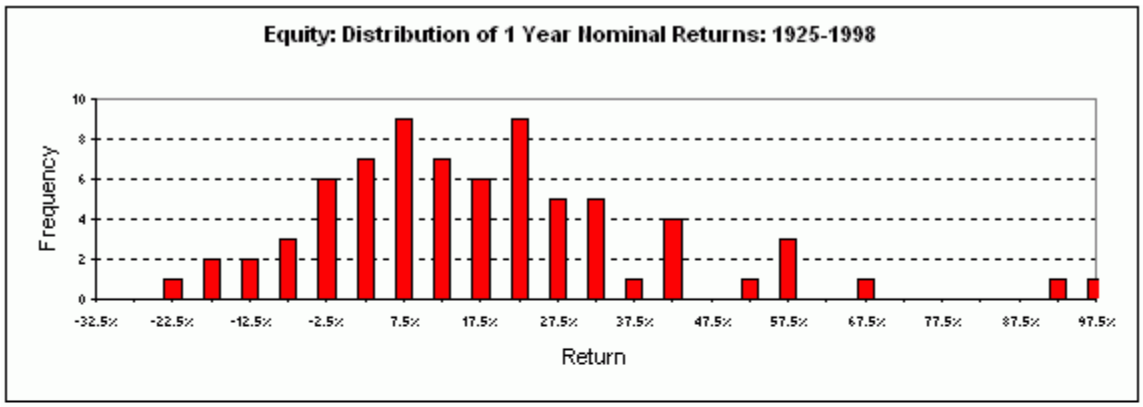
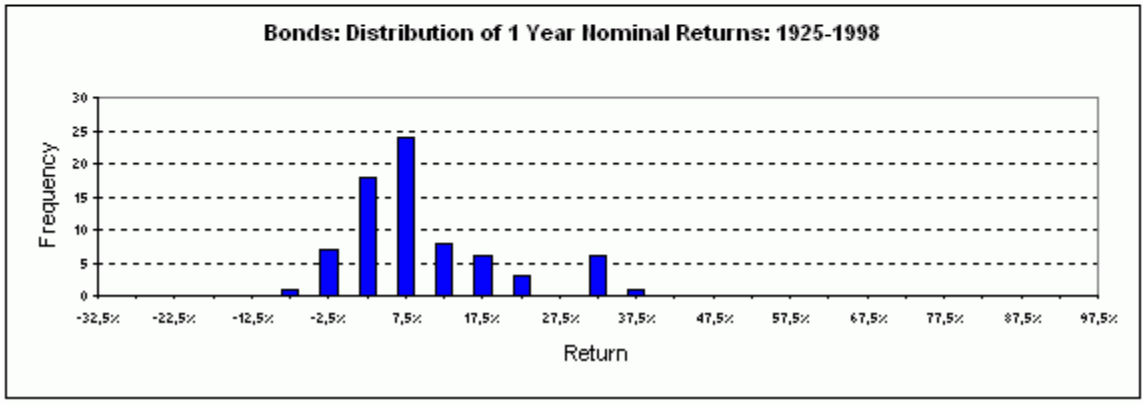


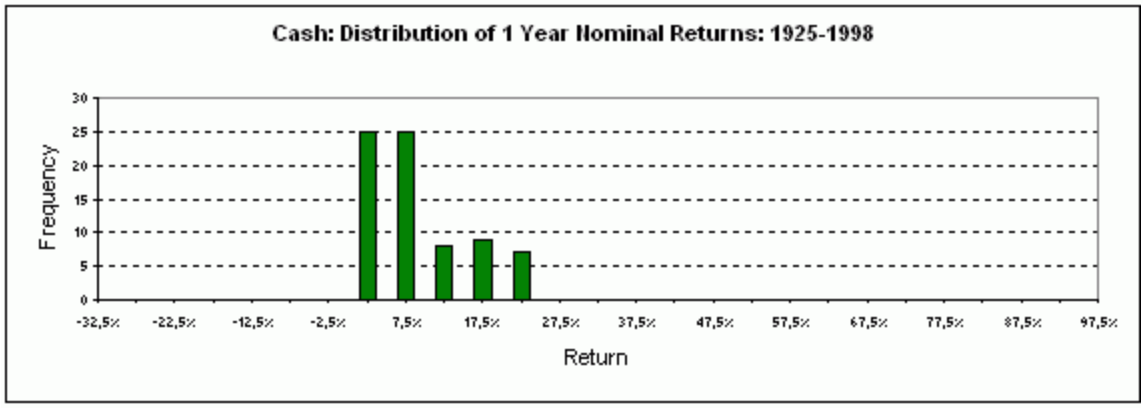
Figure 7: Growth in R1 invested in 1925

Ordinary shares strongly outperformed the other asset classes and inflation over the entire period. A rand (or perhaps ten shillings as it then was) invested in the basket of shares making up the All-Share index in 1925 would have grown to R12 951 at the end of 1998.

As we shall see, this strategy was not without substantial risk. In contrast an investment in long-term Government bonds with a constant 20-year maturity, while exhibiting much less risk, only grew to R121 over the same period, whereas the almost completely riskless strategy of investing only in the short term money market offered a final value of R86. The latter investment closely tracked inflation as R66 was needed to buy the basket of goods that could have been purchased with R1 in January 1925. The impact of inflation on asset returns is discussed in Section 5. For ease of comparison with the equity, bond and cash performance statistics, inflation has been included in the tables in this section.


Equity: Distribution of 1 Year Nominal Returns: 1925-1998
Frequency
Return
-32.5%
-22.5%
-12.5%
-2.5%
7.5%
17.5%
27.5%
37.5%
47.5%
57.5%
67.5%
77.5%
87.5%
97.5%


Bonds: Distribution of 1 Year Nominal Returns: 1925-1998
Frequency
Return
-32,5%
-22,5%
-12,5%
-2,5%
7,5%
17,5%
27,5%
37,5%
47,5%
57,5%
67,5%
77,5%
87,5%
97,5%


Cash: Distribution of 1 Year Nominal Returns: 1925-1998
Frequency
Return
-32,5%
-22,5%
-12,5%
-2,5%
7,5%
17,5%
27,5%
37,5%
47,5%
57,5%
67,5%
77,5%
87,5%
97,5%

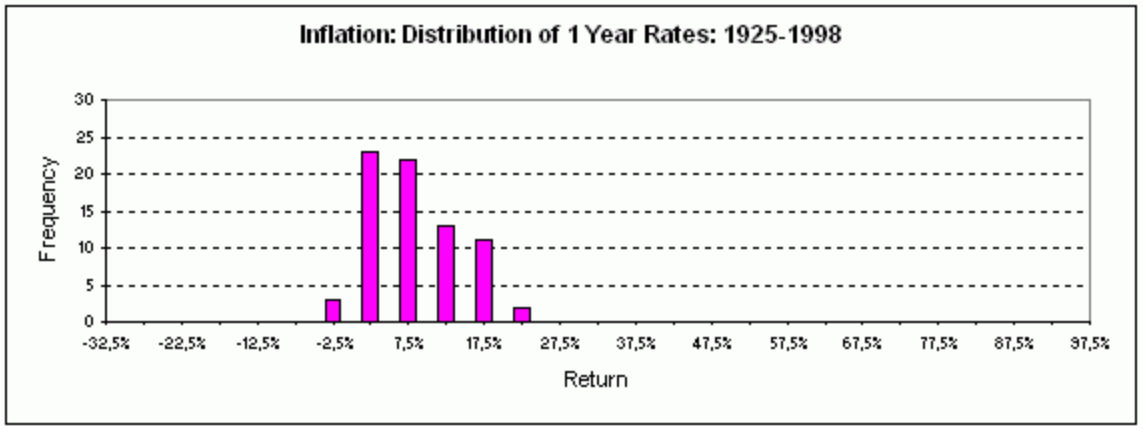
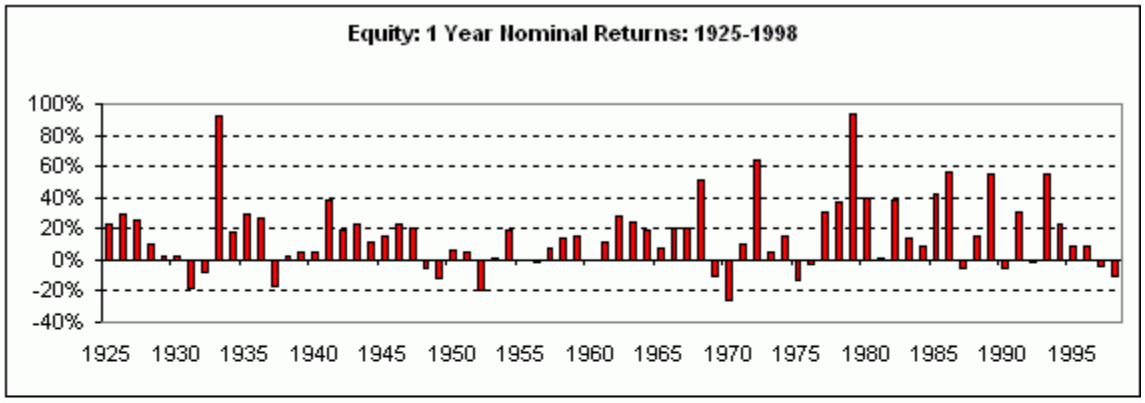
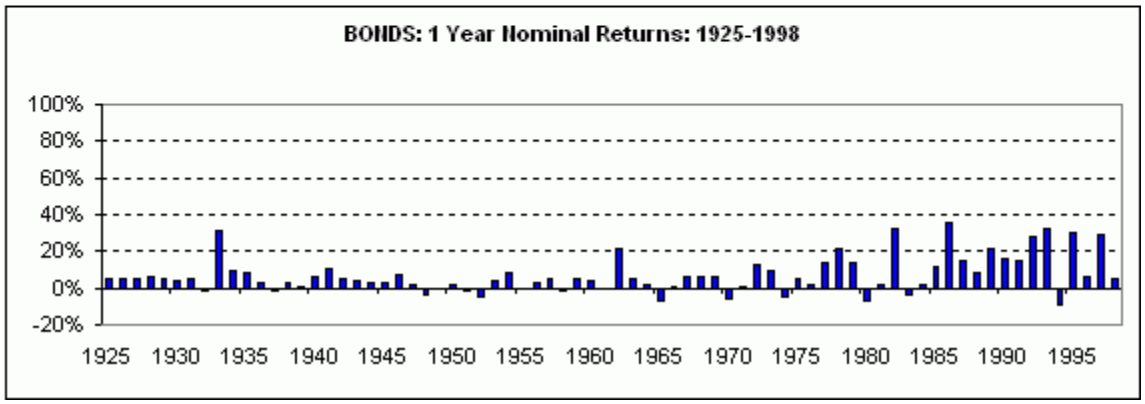

Inflation: Distribution of 1 Year Rates: 1925-1998
Frequency
Return
-32,5%
-22,5%
-12,5%
-2,5%
7,5%
17,5%
27,5%
37,5%
47,5%
57,5%
67,5%
77,5%
87,5%
97,5%

Figure 8: Distributions of One Year Nominal Returns

Figure 8 summarises the behaviour of the three asset classes and of inflation in the format of distributions of annual returns. As expected, equity is shown to have a much wider range of returns than the other assets. Cash has the narrowest distribution with a high incidence of returns between 0 and 5 %. The time series of nominal annual returns on the three asset classes are depicted graphically in Figure 9.





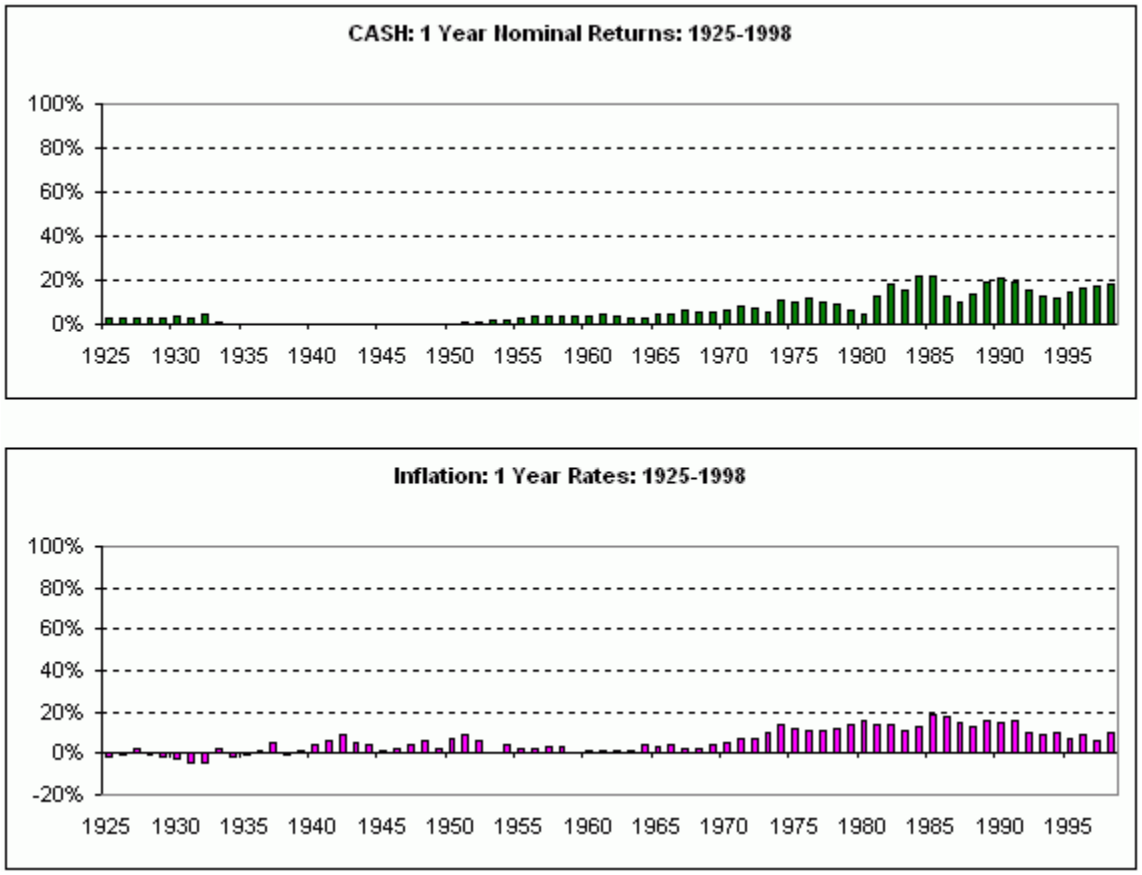


Figure 9: Time Series of Nominal Asset Class Returns

In 16 of the 74 years equities produced a negative annual return. Bonds did so 15 times. However the spread of returns in the bond market covers a much smaller range than those in equities. The deflationary era of the 1920's and 30's is clearly indicated by negative "returns" in 10 of the first 14 years in the inflation data set.

Table 1: Summary Statistics: Nominal Annual Returns 1925 to 1998

	observations	Minimum Value	Maximum Value	Range	Arithmetic Mean	Geometric Mean	Standard Deviation
ANNUAL							
Equity	74	-26.39	93.74	120.13	15.70	13.65	22.94
Bond		-9.05	35.89	44.94	7.13	6.69	10.04
Cash		0.00	21.76	21.76	6.39	6.21	6.47
Inflation		-4.98	18.48	23.46	5.98	5.83	5.68
THREE YEAR							
Equity	72	-10.32	54.92	65.24	14.59	13.85	13.34
Bond		-1.52	24.49	26.02	6.81	6.64	6.21
Cash		0.00	19.64	19.64	6.27	6.10	6.16
Inflation		-3.59	17.08	21.03	6.03	5.89	5.42

FIVE YEAR							
Equity	70	-5.39	38.94	44.33	14.30	13.89	9.77
Bond		-1.56	22.25	23.81	6.65	6.52	5.36
Cash		0.00	17.87	17.87	6.16	6.00	5.95
Inflation		-2.76	15.81	18.58	6.08	5.95	5.32
TEN YEAR							
Equity	65	-0.42	34.13	34.54	14.29	14.06	7.38
Bond		0.88	18.50	17.62	6.33	6.23	4.69
Cash		0.00	17.05	17.05	5.93	5.78	5.74
Inflation		-1.39	14.78	16.17	6.22	6.11	5.04
TWENTY YEAR							
Equity	55	5.90	25.10	19.20	13.72	13.59	5.63
Bond		2.04	14.20	12.16	5.46	5.41	3.43
Cash		0.13	15.01	14.88	5.43	5.32	4.88
Inflation		0.95	13.49	12.54	6.12	6.04	4.12

Returns are shown as % per annum

Table 1 summarises the descriptive statistics from the analysis of performance on equity, bonds, cash and inflation over the full 74-year period. Annual performance figures are shown at the top of the table, followed by performance over rolling periods of three, five, ten and twenty years.

The superior performance of equity over all horizon periods is clearly shown. The higher returns achieved are accompanied by higher risk levels as measured by standard deviation of returns. However over longer periods the range and standard deviation of equity returns approaches that of the other classes. This statistic forms the basis of the view that time diversification works in the favour of long-term equity investors in that over longer horizons risk (as measured by volatility of returns) is reduced. Only in a single 10 year period would an investor in the equity index have obtained a return less than zero (the decade 1948-1957, in which the average annual return was -0,4%) and a bond investor, in any ten year period between 1925 and 1998 always achieved a positive return. The impact of long-term horizons is shown by the fact that, despite the poor performance of the equity market over the past two years (-4,5% in 1997 and -10,1% in 1998) over the twenty years ending December 1998 equity returned a creditable 20,5% average annual return (or nearly 8% in real terms).

Table 2: Serial and Cross-Correlations: 1925 - 1998

	Nominal Returns				Real Returns		
Serial Correlation	Equity	Bonds	Cash	Inflation	Equity	Bonds	Cash
Annual	0,12	0,10	0,93	0,89	0,11	0,05	0,71
3 Year	0,89	-0,31	0,56	0,88	-0,41	0,41	0,50
5 Year	.,85	0,15	0,60	0,96	-0,07	0,37	0,55
10 Year	0,63	-0,45	0,82	0,98	-0,83	-0,30	-0,25

Annual	Equity	Bonds	Cash	Inflation	Equity	Bonds	Cash
Equity	1				1		
Bonds	0,48	1			0,43	1	
Cash	0,08	0,41	1		-0,13	0,36	1
Inflation	0,25	0,29	0,72	1			
Annual	Equity	Bonds	Cash	Inflation	Equity	Bonds	Cash
Equity	1				1		
Bonds	0,32	1			0,39	1	
Cash	0,56	0,47	1		-0,22	0,53	1
Inflation	0,79	0,11	0,72	1			
Annual	Equity	Bonds	Cash	Inflation	Equity	Bonds	Cash
Equity	1				1		
Bonds	0,47	1			0,24	1	
Cash	0,58	0,40	1		0,06	0,69	1
Inflation	0,83	0,40	0,81	1			
Annual	Equity	Bonds	Cash	Inflation	Equity	Bonds	Cash
Equity	1				1		
Bonds	0,49	1			0,28	1	
Cash	0,63	0,42	1		0,10	0,73	1
Inflation	0,86	0,46	0,89	1			

Table 2 shows serial and cross correlations for equity, bonds, cash and inflation over the 74-year period. In addition to annual data, three, five and 10 year non-overlapping returns are used. Low serial correlation coefficients of 0,12 for equity and 0,10 for bond annual returns are reported, whereas the coefficient for cash was 0,93. Cross correlations are shown for annual, three, five and ten year returns. The relationship between cash and inflation is, as expected, strong over all time periods. The cross-correlations between the equity and bond asset classes is not affected by the length of the horizon period. It is arguable that the correlations used in forecasting asset performance are frequently based on more recent historical periods to take account of changing conditions.

The year-on-year equity and bond serial correlations show a negative trend over he past two decades. This pattern of increasing volatility in recent times can be observed in Figure 9. A progressive "uncoupling" of the equity and bond markets can be seen in the trend in cross correlation coefficients between these markets. In the earliest historical period this coefficient was 0,88, but by the last decade of the study it had fallen to 0,14

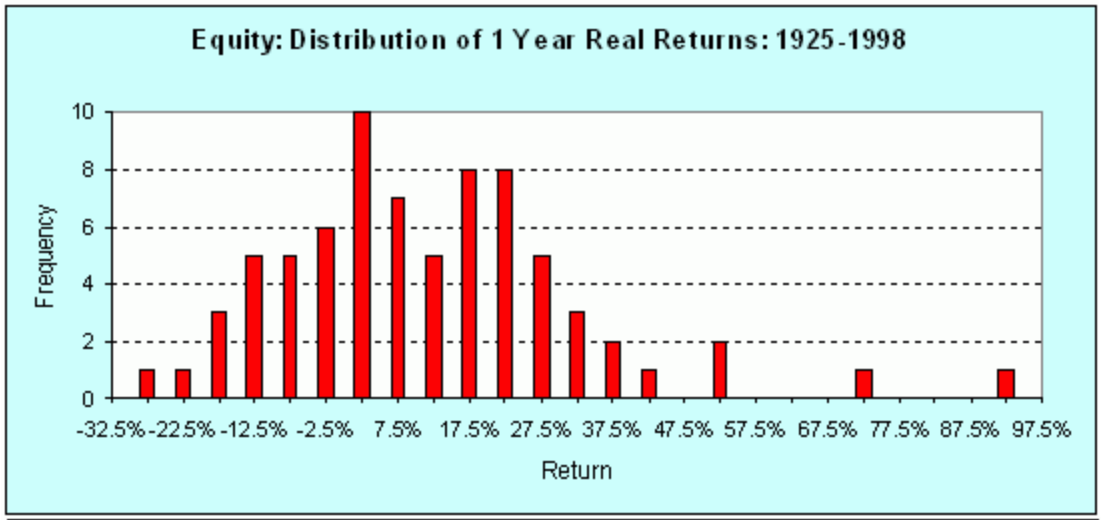
5. Inflation-Adjusted Historical Performance

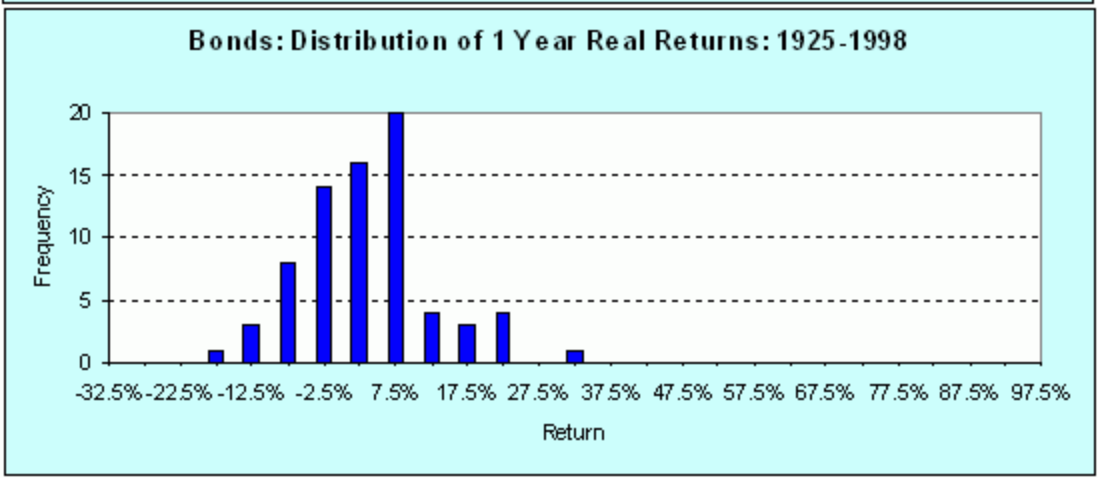
Inflation is treated in the same way as the asset classes in order to produce "performance" graphs and statistics. To facilitate comparisons, the descriptive statistics are shown in Table 1 together with those of equity, bonds and cash.

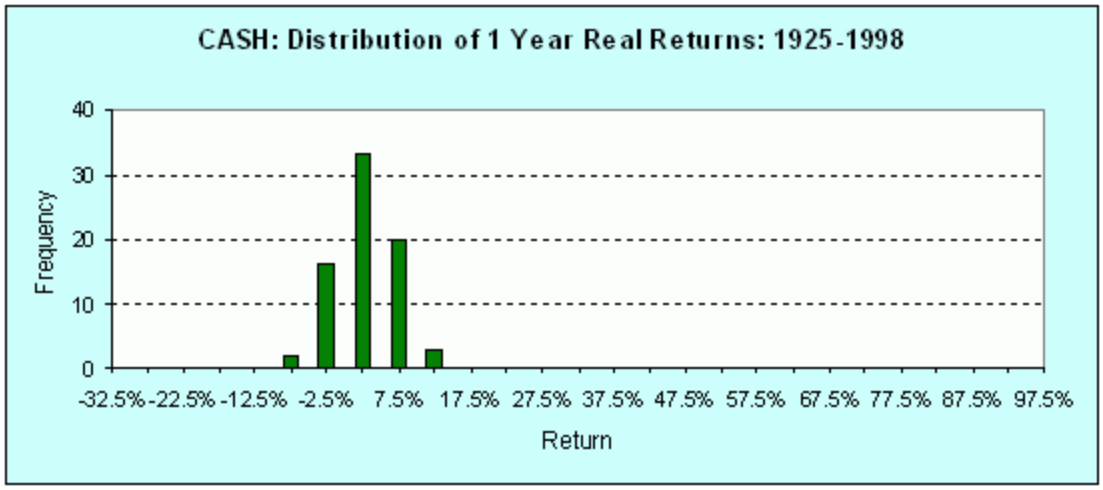
Serial correlation of the inflation series and the cross correlation to other assets are shown in Table 2. The "performance" of inflation is treated graphically in Figures 8 and 9.

Many studies of asset class returns in South Africa have been carried out using data from 1960 onwards (for example Fleming Martin, 1998). As can be seen from the graph of annual performance of inflation (Figure 9), most of the time spanned by these studies covered a period in which inflation was continually increasing, only the last few years showing a slowing in the rate of increase of inflation. By working on data from 1925 onwards it has been possible to include periods when inflation was decreasing and stable as well as a period of deflation.

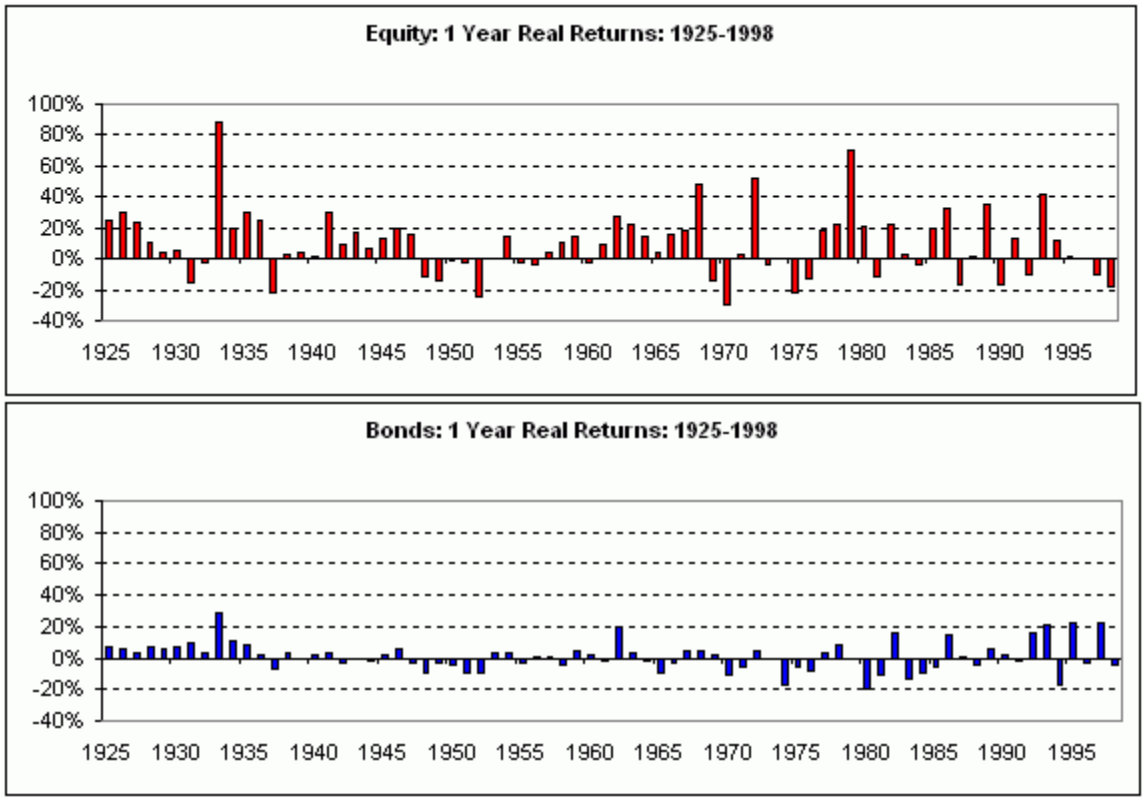
In Table 3 the descriptive statistics from the analysis of inflation-adjusted performance on equity, bonds and cash over the full 74-year period are summarised. The negative arithmetic and geometric means over longer periods highlight the poor performance of bonds and cash in real terms. The inflation-adjusted distributions of equity, bonds and cash and their year by year annual inflation-adjusted performances are shown in Figures 10 and 11.







Figures 10: Distributions of One Year Real Returns



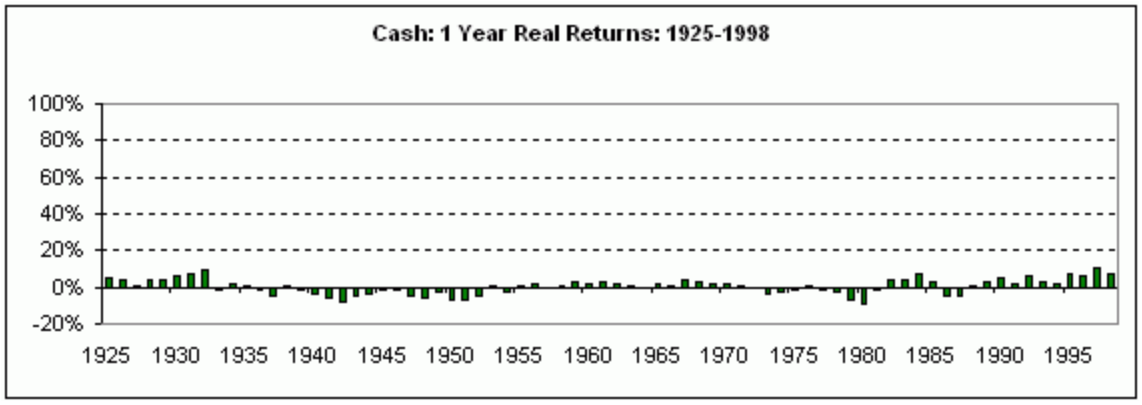


Figure 11: Time Series of Asset Class Real Returns

In Table 2 serial and cross correlations for inflation-adjusted equity, bonds and cash returns, over the full period of 74 years are reported. The serial correlation of annual equity returns is little changed from that calculated from nominal returns. However the correlations for 3, 5 and 10 year non-overlapping periods are negative, whereas for the nominal data they were strongly positive. The equity-bond cross correlations are lower for annual, 5 and 10-year data. The equity-cash results are uniformly lower for the real data set. However the bond-cash correlations are lower across all time horizons for the real set of returns.

Table 3: Summary Statistics: Nominal Real Returns 1925 - 1998

	Observations	Minimum Value	Maximim Value	Range	Arithmetic Mean	Geometric Mean	Standard Deviation
ANNUAL							
Equity	74	-29,86	88,02	117,88	9,21	7,39	20,77
Bond		-19,39	28,29	47,68	1,23	0,82	9,26
Cash		-9,31	10,65	19,96	0,45	0,36	4,27
THREE YEAR							
Equity	72	-14,93	43,00	57,92	8,14	7,51	11,84
Bond		-10,47	15,60	26,06	0,85	0,70	5,60
Cash		-6,24	8,23	14,47	0,25	0,19	3,62
FIVE YEAR							
Equity	70	-10,89	28,94	39,83	7,79	7,50	8,09
Bond		-8,09	11,91	20,00	0,64	0,54	4,66
Cash		-5,46	6,62	12,09	0,10	0,05	3,15
TEN YEAR							
Equity	65	-4,51	17,58	22,09	762,84	7,50	5,33

Bond		-5,28	8,77	14,04	0,19	0,12	3,75
Cash		-4,64	5,25	9,89	-0,27	-0,31	2,50
TWENTY YEAR							
Equity	55	1,83	12,81	10,98	7,15	7,12	2,67
Bond		-3,94	4,57	8,51	-0,58	-0,60	2,05
Cash		-3,43	2,13	5,57	-0,66	-0,67	1,45

Returns are shown as % per annum

6. Conclusions

Although inflation data are available from 1910, as are equity price indices, equity dividends, bond yields and cash data could not be reliably obtained for dates prior to 1925. This dictated the starting point in the present study of the long-term time series of asset class returns in the South African capital markets.

When using an historical time series as the basis upon which capital market forecasts are made, it is desirable to have a period long enough to include all types of events. To quote Ibbotson and Sinquefield (1989):

Such events include war and peace, growth and decline, inflation and deflation, and less dramatic events that likewise affect asset returns.

We study the past to make inferences about the future. Although the actual events of the period will not be repeated, the event-types will probably recur. Some say that the past tells us little because one period or another is "unusual". This logic is suspect : all periods are unusual. If historical event-types (not specific events) tend to repeat themselves, a study of long run capital market returns may reveal a great deal about the future.

Forecasts based on historical data are frequently used in asset allocation work. This study is intended as background for use in the asset modelling process of long-term funds. As such there has been a greater concentration on longer periods, using horizons of up to ten and twenty years to assess the difference in performance of asset classes. It is hoped that the statistical properties of the historical time series data presented here will provide a framework within which to assess the assumptions used in the asset modelling process. The results of the study can be used to illustrate the events of the past and to remind portfolio managers and fiduciaries that the asset relationships of the most recent past may not hold in the future.

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