

# 102 Years of South African financial market history

## 1. INTRODUCTION

An important aspect of research in investments is a study of the past. In order to answer questions dealing with the expected returns and risks from equity, bond and bill markets, to establish yardsticks for judging the worth of new projects and to understand what returns investors in shares and bonds may require, a comprehensive long-term historical record of capital market returns is an invaluable base upon which such judgements can be made.

Up until the end of the last millennium, it was common cause that South African financial market history commenced in 1960, as no earlier data was systematically collected and published. In 1999 Firer and McLeod published a paper in which the historical performance of the equity, bond and cash markets in South Africa over a period of 74 years from 1925 to 1998 was reported and analysed. The methodology followed the principles of the landmark US study of Ibbotson and Sinquefeld (1989) but was adapted for local variations in instruments and data.

In 2002 Dimson, Marsh and Staunton published "Triumph of the Optimists: 101 Years of Global Investment Returns". In it they traced the history of capital markets in individual countries for the twentieth century. They included parts of the Firer and McLeod (1999) data set (hereafter FM), suitably expanded back to 1900, to make South Africa sixteenth and last country with a century of annual returns in Triumph of the Optimists.

In this paper we report the results of a 102 year history of South African capital markets, in which the FM data is combined with the data obtained by Dimson, Marsh and Staunton (hereafter DMS). The rest of the paper is organised as follows. Section 2 contains a discussion of the origins of the FM and DMS data. Section 3 consists of a comparison of the FM and DMS equity series for the period 1925-1959 and suggestions are made as to the composition of an equity index for the years 1900-2001. In section 4 we report the summary statistics for the 102-year history of the South African capital markets. The paper ends with some brief concluding remarks.

## 2. SOURCES OF HISTORICAL DATA

The FM equity index was constructed from the following sources:

- January 1925-December 1947  
The BER study: Industrial & Commercial Share Price Indices in SA
- January 1948-December 1948  
Interpolated from a JSE graph of industrial share prices
- January 1949-December 1959  
The RDM 100 Industrial Index
- January 1960 to date  
The JSE-Actuaries Equity Indices

Firer and McLeod (1999) noted that "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. However their index was composed solely of indices based on the industrial sector of the market from 1925 through 1959. Arguably this index inadequately represents the returns from the Johannesburg Stock Exchange (JSE) as a whole, certainly for the period 1925 through 1946, and to a lesser extent from 1947 until the establishment of the JSE-Actuaries Equity Indices in 1960.

As part of a project to map the history of world capital markets during the last century, DMS constructed an equity index<sup>1</sup> for the JSE for the period 1900-1924. They also wanted to re-calculate the FM index so as better to represent the returns from a broader based basket of equities on the JSE for the period 1925-49 than that used by Firer and McLeod (1999).

Dimson et al. (2002) created a market capitalization weighted index of the thirty to fifty largest mining and financial shares for the years 1900-59. Their objective was to capture 60 percent of the market with this index. They created an industrial index for the period 1900-1925 and a mining and financial index for the period 1900-59. Using decade start weights of 100, 95, 90, 85, 80 and 75 percent, they blended their mining and financial index initially with their industrial index and then, after 1947, with the FM index. DMS were unable to collect monthly data, and so their index is annual only, whereas the FM data is monthly.

Thus the following time series are now available for equities on the JSE:

- Annual, 1900-1959, blended mining, financial and industrial – the DMS series

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<sup>1</sup>Research was done mainly in London and to a much lesser extent in South Africa (where data availability was extremely limited).

- Monthly, 1925-1959, industrial only – the FM series
- Monthly 1960 to date, market capitalisation weighted – the JSE Actuaries Indices.

In the next section we compare the two equity time series.

### 3. A 102-YEAR EQUITY TIME SERIES

The nominal annual returns for the period 1900-24 from the DMS series are shown in Table 1, together with their mean and standard deviation. There is no equivalent series in the FM study, which only commenced in 1925.

**Table 1 : South African capital market returns 1900-24 (percent p.a.)**

Year	Inflation	Equity	Bonds	Bills
1900	4,1	20,0	20,4	4,1
1901	9,2	28,5	2,8	3,5
1902	2,4	6,7	2,8	3,0
1903	-8,2	-14,7	1,0	3,5
1904	-5,1	16,1	4,9	2,9
1905	-6,8	-25,1	1,9	2,2
1906	-7,2	6,4	4,0	3,0
1907	-1,6	-12,8	2,0	3,8
1908	-1,6	39,0	6,5	2,3
1909	4,8	36,4	3,4	2,2
1910	15,4	-0,6	3,0	3,1
1911	4,0	-11,6	5,0	2,9
1912	2,6	9,4	3,0	3,1
1913	1,3	-4,6	2,0	3,5
1914	1,2	-11,2	4,1	3,2
1915	4,9	12,3	-10,7	3,8
1916	5,8	18,9	-1,1	5,3
1917	9,9	6,9	3,9	5,1
1918	7,0	13,8	9,6	3,7
1919	10,3	46,9	2,6	4,0
1920	47,5	-29,6	-0,6	6,5
1921	-17,2	-7,3	13,4	5,3
1922	-13,9	46,6	6,4	2,6
1923	-4,0	6,9	2,9	2,7
1924	0,0	18,7	5,9	3,4
Mean	2,6	8,6	4,0	3,6
Std dev	12,1	20,8	5,4	1,1

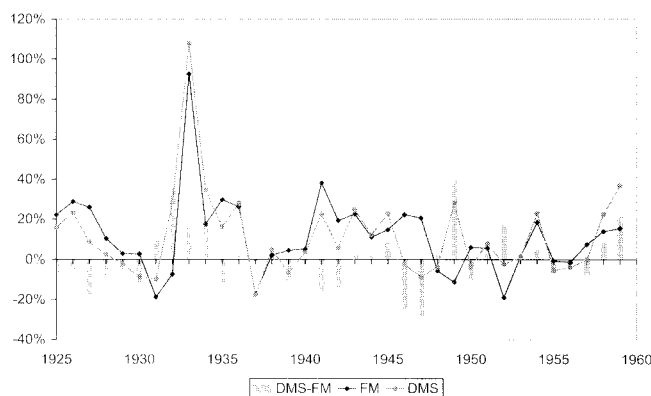
Included in the table are the annual returns from bonds, bills and the inflation rate.

In Table 2 and Figure 1 the time series of annual equity returns for the period 1925-1959 for the DMS and FM studies are compared. The table includes the relative wealth paths for an investment of one rand. Recall that the FM series is composed of annualised monthly total returns of an industrial company time series, whereas

the DMS series is an annual total return based on the blending in differing proportions over time, of a mining, financial and an industrial index. For the period 1925-49, DMS constructed their own industrial index, but used the FM index from 1950-59.

**Table 2 : FM and DMS equity time series returns (in percent) and wealth paths: 1925-1959**

	FM	DMS	Difference	FM wealth	DMS wealth
1924				R1,0	R1,0
1925	22,3	16,0	-6,3	1,2	1,2
1926	28,8	23,2	-5,6	1,6	1,4
1927	26,0	8,6	-17,4	2,0	1,6
1928	10,3	2,5	-7,9	2,2	1,6
1929	2,9	-2,4	-5,3	2,3	1,6
1930	2,6	-8,7	-11,4	2,3	1,4
1931	-18,7	-9,8	8,9	1,9	1,3
1932	-7,4	28,2	35,6	1,7	1,6
1933	92,5	107,7	15,2	3,4	3,4
1934	17,6	34,9	17,3	3,9	4,6
1935	29,8	16,2	-13,6	5,1	5,3
1936	26,3	28,1	1,7	6,5	6,8
1937	-17,3	-17,8	-0,4	5,3	5,6
1938	2,1	4,7	2,6	5,5	5,9
1939	4,5	-6,6	-11,0	5,7	5,5
1940	5,1	3,4	-1,7	6,0	5,7
1941	38,1	22,6	-15,5	8,3	7,0
1942	19,4	5,7	-13,7	9,9	7,4
1943	22,6	24,7	2,0	12,1	9,2
1944	11,2	12,4	1,2	13,5	10,3
1945	14,7	22,7	8,0	15,4	12,7
1946	22,3	-2,5	-24,9	18,9	12,3
1947	20,6	-8,7	-29,3	22,8	11,3
1948	-5,7	-3,7	2,0	21,5	10,8
1949	-11,3	28,1	39,4	19,1	13,9
1950	6,0	-3,6	-9,6	20,2	13,4
1951	5,6	8,0	2,4	21,3	14,5
1952	-19,1	-2,4	16,6	17,3	14,1
1953	1,4	1,1	-0,4	17,5	14,3
1954	18,6	23,0	4,5	20,8	17,6
1955	-0,7	-5,5	-4,8	20,6	16,6
1956	-1,3	-3,9	-2,6	20,3	15,9
1957	7,4	-0,1	-7,5	21,9	15,9
1958	14,1	22,4	8,3	24,9	19,5
1959	15,4	36,8	21,3	28,8	26,6
Arithmetic mean	11,6	11,6	Geometric mean	10,1	9,8
Standard deviation	20,0	22,1			



**Figure 1: DMS and FM equity series return differences 1925-59**

Visual inspection suggests substantial differences between the two time series. For example in 1949 the returns differed by over 39 percent. However the mean returns were almost identical, differing only in the second decimal place. As expected for a series containing resource shares, the DMS returns had a larger standard deviation. Despite this, the DMS series displayed a slightly lower geometric mean return over the 35 year period (9.8 percent against the FM's 10.1 percent).

The correlation coefficient between the two sets of returns was 0.76. In order to test the sensitivity of this coefficient to the years where returns differed widely between the two series, the correlation coefficient was recalculated after successively omitting each of the five years where the difference between the returns was greatest. As can be seen in Table 3, this led to a rapid improvement in the series' correlation.

**Table 3 : The impact of the years with greatest differences in returns on correlation between the two equity series for the period 1925-59**

Cumulatively excluding year(s)	Correlation coefficient
None	0,76
-1949	0,81
-1932	0,86
-1947	0,88
-1946	0,90
-1959	0,91

As a further test of the consequences of choosing one of the DMS or FM return series for inclusion in an index to represent the South African equity market over the past millennium, two returns' series were constructed. Both used the same data for the periods 1900-24 (DMS) and 1960-2001 (FM). They differed only in the returns for the 1925-59 period as discussed above. For the complete 102-year holding period, the geometric average annual

returns of the DMS based series was 12.2 percent compared to 12.3 percent for the series in which the FM returns were used after 1924.<sup>2</sup> The standard deviation of annual returns of the two series were 23.4 percent and 23.0 percent respectively.

Despite the fact that in individual years, the FM and DMS equity returns are sometimes quite dissimilar, in aggregate, and especially when viewing the summary statistics, there is not a great deal of difference between the two series. It is proposed that, because the DMS data attempts to address the lack of resource representivity in the FM equity index, a combined series consisting of the DMS equity returns from 1900-59 and the FM equity returns from 1960 to the present is a fair representation of the returns that were available to equity investors on the JSE during the past millennium.

#### 4. 102-YEAR HISTORICAL PERFORMANCE

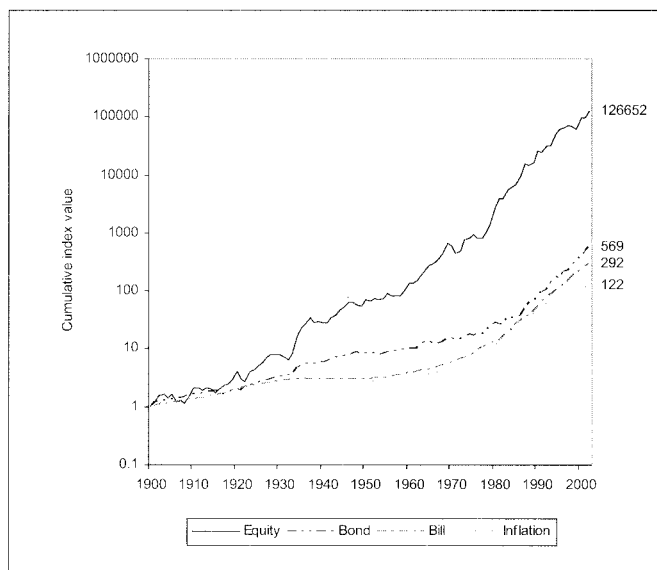
In order to show the historical trade-offs between risk and return in the South African capital markets, we analyse the performance of equity, bonds and bills over the 102 year period from 1900 to 2001. We use the 102-year combined index discussed in section 3 for equities. DMS collected annual data for a bond and a bill<sup>3</sup> index. Their bond index (1900-24) is based on estimated prices for 4 percent government bonds. The pre-1925 short-term interest rates are represented by UK treasury bills (South Africa then being a British Dominion). The 102-year bond and bill returns used in the performance assessment that follows are the DMS returns for the years 1900-24 and the FM returns for 1925-2001.

In Figure 2 the growth of one rand invested in ordinary shares, long-term government bonds, the money market and inflation since 1900 is depicted graphically. Reinvestment of dividends on shares and coupons on bonds is assumed and taxes are ignored. The vertical scale is logarithmic.

Ordinary shares strongly outperformed the other asset classes and inflation over the entire period. A rand invested in the basket of shares making up the equity index in 1900 would have grown to R126,652 at the end of 2001. In contrast an investment in long-term Government bonds, while exhibiting much less risk, only grew to R569 over the same period, whereas the almost completely riskless strategy of investing only in the short term money market offered a final value of R292. R122 was needed to buy the basket of goods that could have been purchased with R1 in January 1900.

<sup>2</sup>Nevertheless this small difference results in a final wealth difference of R10,260.94 or 7.9 percent after 102 years!

<sup>3</sup>Despite the fact that the Firer and McLeod (1999) paper refers to the short-term risk-free investment as cash (since they did not use T-bill returns), the term bill is used here to align with international practice.



**Figure 2: Returns on South African asset classes 1900-2001 in nominal terms**

In Figure 3 the behaviour of the three asset classes and of inflation is summarised in the format of a distribution of annual returns. As expected, equity is shown to have a much wider range of returns than the other assets. Bills have the narrowest distribution with a high incidence of returns between zero and five percent.

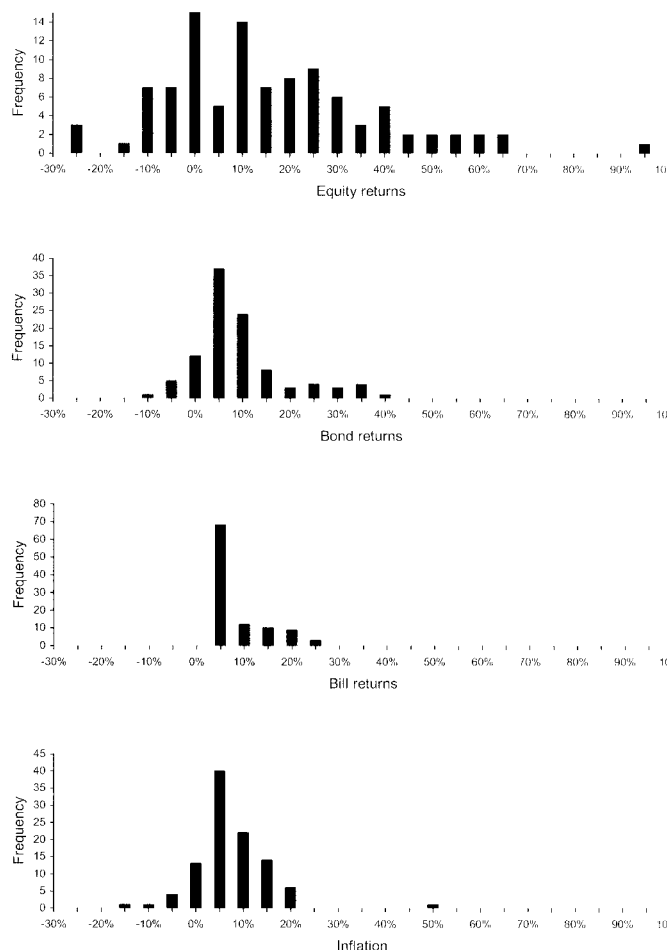
The descriptive statistics for the performance of equity, bonds, bills and inflation over the full 102-year period are to be found in Table 4. Annual performance figures are shown at the top of the table, followed by annualised performance over rolling periods of three, five, ten and twenty years.

The results clearly show the historical supremacy of the equity asset class over all horizon periods. This is achieved at the expense of a higher level of risk as measured by the standard deviation of returns. However over longer periods both the standard deviation and the range of equity returns approaches that of the other classes, suggesting the benefits of so-called time diversification.

The minimum average annual equity return decreases with the length of holding period. No single holding period of length seven or more years showed a negative average return. This is further explored in Table 5. The first panel of the table shows the number of negative holding periods in the data series as a function of the length of the holding period. The second panel shows this number as a proportion of the total number of holding periods.

Conventional academic theory suggests that equities are riskier than bonds which in turn are riskier than bills. On average over time, and as evidenced by the statistics in Table 5, the returns from these asset classes ought to

diminish in the order equities>bonds>bills. In the third panel, we show the number of occasions during which this relationship was breached as a function of the length of the holding period.



**Figure 3: Distributions of one year nominal returns**

Although historically a holding period of 20 years was sufficient, in all but one 20-year period, to generate the out performance of bonds by equities, in 45 percent of the 20-year holding periods, the average returns from bills exceeded those of bonds. This higher reward for lower risk investments may well reflect the problems associated with prescribed asset requirements which were a feature of the South African economy for many years.

Table 6 and Table 7 repeat the results of the preceding two tables, using real rather than nominal returns. Equity returns fall from an average of 9.2 percent to 7.6 percent for a three-year horizon. Thereafter the return does not change much. However the standard deviation of returns falls steadily as the horizon is lengthened. A similar

pattern is observed for bonds and bills, although their returns do decrease monotonically with length of holding period.

Investors with a 20-year horizon would, on average have achieved a positive real return even if they had chosen the "worst" 20-year period of the millennium for equities,

namely the 20 years ended December 1921. On the other hand, for bond and bill investors there were 40 and 36 20-year holding periods respectively in which their returns did not beat inflation! The value of equity investment as a means of achieving positive real returns is confirmed by this analysis.

**Table 4 : Summary statistics: nominal annual returns 1900-2001 (in percent)**

	Observations	Minimum value	Maximum value	Range	Arithmetic mean	Geometric mean	Standard deviation
<b>ANNUAL</b>							
Equity	102	-29,6	107,7	137,2	14,4	12,2	23,4
Bonds		-10,7	35,9	46,6	6,8	6,4	9,5
Bills		0,0	21,8	21,8	5,9	5,7	5,8
Inflation		-17,2	47,5	64,7	5,1	4,8	7,7
<b>THREE YEAR</b>							
Equity	100	-11,4	54,9	66,3	12,8	12,0	13,5
Bonds		-2,8	24,5	27,3	6,4	6,2	6,1
Bills		0,0	19,6	19,6	5,8	5,7	5,6
Inflation		-11,9	20,3	32,2	5,0	4,8	6,0
<b>FIVE YEAR</b>							
Equity	98	-7,2	39,8	47,0	12,4	12,0	9,9
Bond		-1,6	22,3	23,8	6,2	6,1	5,4
Bills		0,0	17,9	17,9	5,8	5,6	5,5
Inflation		-7,7	15,8	23,5	5,0	4,8	5,5
<b>TEN YEAR</b>							
Equity	93	0,7	34,1	33,4	12,6	12,3	7,0
Bonds		0,9	18,5	17,6	6,0	5,9	4,7
Bills		0,0	17,0	17,0	5,6	5,5	5,2
Inflation		-4,3	14,8	19,1	5,1	5,0	4,9
<b>TWENTY YEAR</b>							
Equity	83	2,9	25,1	22,2	12,6	12,5	5,5
Bonds		2,0	16,4	14,4	5,5	5,4	3,5
Bills		0,1	15,8	15,7	5,1	5,0	4,6
Inflation		-2,1	13,5	15,6	4,9	4,8	4,2

Table 8 shows serial- and cross-correlations for equity, bond, bill returns (both nominal and real) and inflation over the 102-year period. In addition to annual data, three, five and ten-year *non-overlapping* returns are used. Low serial correlation coefficients of 0.09 for nominal equity and 0.16 for nominal bond annual returns are reported, whereas the coefficient for bills was 0.93. The 10-year data should be treated with some circumspection as the correlations are based on only ten data points.

For real returns, three and five year non-overlapping holding periods, equity serial correlations are strongly negative, only becoming positively correlated for long holding periods. Bond auto-correlation rises with the length of the holding period but becomes negative for 10 year periods. No pattern can be discerned for the bill auto-correlations.

Cross correlations are shown for annual, three, five and ten-year returns. Long-term bonds and equity are moderately well correlated for both the nominal and the real data series, as are bonds and bills. As expected, cash and equities have almost no correlation when a one year horizon is used. This increases quite strongly with length of horizon period, ending at 0.66 for a 10-year period. In real terms, however, the correlation remains in the low to mid 20 percent range.

The correlation between bills and inflation increases strongly with length of holding period. The relationship between bills and inflation for annual holding periods is not as strong as that reported by Firer and McLeod (1999). However a strong relationship does appear in the longer holding periods.

Table 5: Periods with negative nominal returns

Number of holding periods with negative returns				
Holding period (yrs)	Equity	Bonds	Bills	Inflation
1	33	18	0	19
3	18	10	0	17
5	5	4	0	17
10	0	0	0	15
20	0	0	0	3

Percentage of holding periods with negative returns				
Holding period (yrs)	Equity	Bonds	Bills	Inflation
1	32,4	17,6	0,0	18,6
3	18,0	10,0	0,0	17,0
5	5,1	4,1	0,0	17,3
10	0,0	0,0	0,0	16,1
20	0,0	0,0	0,0	3,6

Number of holding periods in which one asset class underperformed another			
Holding period (yrs)	Equity<Bonds	Equity<Bills	Bonds<Bills
1	39	41	42
3	28	29	43
5	22	22	41
10	9	9	44
20	1	1	45

Finally, in Table 9 we show the resulting risk premia for the South African capital markets. The long-term historical premium as calculated arithmetically is 8.2 percent against bills and 7.1 percent against bonds. This is somewhat lower than the values of 9.6 percent and 8.5 percent that resulted when a start date of 1925 was used (Firer and McLeod, 1999).

## 5. CONCLUSIONS

In this paper we present a new set of indices for the historical returns of South African capital markets covering the period 1900 to 2001. Despite the extreme paucity of detailed recorded data for the early part of the last century, the time series upon which this paper is based provides a fair reflection of the returns (both nominal and real) that were available to investors.

Such history is widely used by firms, financial analysts and investors as a base for their calculations of, among other parameters, the market risk premium. One school of thought suggests that this premium is best estimated from as long a time series as possible. We suggest that the work presented here will provide such practitioners with a solid historical platform upon which to base their estimates.

Table 6: Summary statistics: real annual returns 1900-2001 (in percent)

	Observations	Minimum Value	Maximum Value	Range	Arithmetic Mean	Geometric Mean	Standard Deviation
<b>ANNUAL</b>							
Equity	102	-52,2	102,9	155,1	9,2	7,0	22,6
Bonds		-32,6	37,1	69,6	2,1	1,5	10,6
Bills		-27,8	27,3	55,0	1,1	0,9	6,4
<b>THREE YEAR</b>							
Equity	100	-14,9	55,2	70,2	7,6	6,9	12,7
Bond		-13,7	22,0	35,7	1,5	1,3	6,5
Bill		-12,9	17,5	30,3	1,0	0,8	4,7
<b>FIVE YEAR</b>							
Equity	98	-8,4	40,8	49,2	7,2	6,8	8,9
Bonds		-10,7	15,5	26,2	1,4	1,2	5,4
Bills		-8,9	12,0	20,9	0,8	0,8	3,9
<b>TEN YEAR</b>							
Equity	93	-5,1	18,4	23,5	7,1	7,0	5,4
Bonds		-6,5	10,5	17,1	0,9	0,9	4,2
Bills		-4,6	7,9	12,5	0,5	0,4	2,9
<b>TWENTY YEAR</b>							
Equity	83	0,1	14,6	14,5	7,4	7,3	3,3
Bonds		-3,9	8,1	12,1	0,6	0,6	2,7
Bills		-3,4	4,2	7,7	0,1	0,2	1,8

Table 7: Periods with negative real returns

Number of holding periods with negative real returns			
Holding period (yrs)	Equity	Bonds	Bills
1	40	42	42
3	27	42	42
5	21	44	42
10	7	46	39
20	0	40	36

Percentage of holding periods with negative real returns			
Holding period (yrs)	Equity	Bonds	Bills
1	39,2	41,2	41,2
3	27,0	42,0	42,0
5	21,4	44,9	42,9
10	7,5	49,5	41,9
20	0,0	48,2	43,4

Table 8 : Serial and Cross-Correlations

Serial Correlation	Nominal returns				Real returns		
	Equity	Bonds	Bills	Inflation	Equity	Bonds	Bills
Annual	0,09	0,16	0,93	0,43	0,05	0,08	0,38
3 Year	-0,24	0,58	0,88	0,38	-0,31	0,19	0,07
5 Year	-0,07	0,81	0,90	0,61	-0,35	0,42	0,23
10 Year	0,53	0,82	0,82	0,40	0,04	-0,13	-0,20

Annual	Equity	Bonds	Bills	Inflation	Equity	Bonds	Bills
Equity	1				1		
Bonds	0,43	1			0,46	1	
Bills	0,12	0,45	1		0,21	0,66	1
Inflation	0,07	0,13	0,50	1	-0,25	-0,56	-0,69

3 year	Equity	Bonds	Bills	Inflation	Equity	Bonds	Bills
Equity	1				1		
Bonds	0,48	1			0,50	1	
Bills	0,19	0,70	1		0,20	0,80	1
Inflation	0,26	0,31	0,58	1	-0,25	-0,66	-0,62

5 year	Equity	Bonds	Bills	Inflation	Equity	Bonds	Bills
Equity	1				1		
Bonds	0,48	1			0,44	1	
Bills	0,36	0,83	1		0,24	0,82	1
Inflation	0,33	0,48	0,71	1	-0,18	-0,52	-0,43

10 year	Equity	Bonds	Bills	Inflation	Equity	Bonds	Bills
Equity	1				1		
Bonds	0,60	1			0,43	1	
Bills	0,60	0,87	1		0,22	0,85	1
Inflation	0,67	0,54	0,77	1	-0,14	-0,48	-0,30

**Table 9: South African risk premia, 1900-2001 (in percent)**

	<b>Geometric</b>	<b>Arithmetic</b>	<b>Standard deviation</b>
Equity vs bills	6,1	8,2	22,2
Equity vs bonds	5,4	7,1	19,3
Bonds vs bills	0,7	1,0	7,9

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