

F.T.—ACTUARIES BRITISH GOVERNMENT SECURITIES INDICES, 1978

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1. INTRODUCTION

1.1. In the previous note *F.T.—Actuaries British Government Securities Indices 1977* (*J.I.A.* 106, 357) it was noted that the indices published in the *Financial Times* included new partly paid stocks only when they were fully paid. An alternative series of indices had been constructed, allowing for the calls as and when they occurred. This note, as the previous one, gives details of the alternative series. Reference is also made to the 1976 note *F.T.—Actuaries British Government Securities Indices 1976* (*J.I.A.*, 105, 27).

2. YIELD INDICES

2.1. Appendix B of the 1977 note lists the constituents of the yield indices at 31 December 1977. Changes in the constituents during 1978 are listed in Appendix A of the present note. There were 8 new stocks issued (excluding further tranches of existing stocks); 5 stocks came within one year of maturity; and 4 stocks were moved from one coupon band to another to maintain roughly equal numbers in each band. The grouping of coupons in bands was changed on two occasions.

2.2. At 29 December 1978 there were 18 stocks in the Low Coupon band which then contained coupons from 3%–7½%; 23 in the Mediums (8%–11¼%); and 22 in the Highs (12%–15½%). A complete list of these is given in Appendix B. It will be observed that a slightly more even distribution of stocks among the bands would be achieved if 8% Treasury 2002/06 were moved from the Medium Coupon band to the Lows; but this would leave the longest stock in the Mediums as 10½% Treasury 1999, with a term of just over 20 years, and make the quotation of a 25-year Medium Coupon yield unsatisfactory.

2.3. During the testing period the yields on the irredeemables had been closely related to the yields on long dated stocks. During 1977, however, it became clear that the mathematically neat expression of the irredeemable yield as that derived from the High Coupon curve with an infinite term was unsuitable as an indicator of the real yield on irredeemables—presumably because of foreign buying especially of 3½% War Loan, which has the attractive feature that interest is paid without deduction of tax. From the beginning of 1978, therefore, the quoted irredeemable yield was calculated as the weighted average of yields on the six irredeemable stocks. It is these values that are quoted in the present note.

2.4. Appendix C shows the values of the gross redemption yields, convertible half-yearly, for the ten indices for 31 December 1977 and for the last working day

of each month in 1978, together with the highest and lowest values recorded for each index during the year, all as on the alternative series. The published series differs by very small amounts (0.01% to 0.06%) except for the 5-year indices, which in May and July differed by up to 0.19%, in both directions. It will be noted that the low point for each index occurred on 3 January; the high point for most of the indices was reached in November or December, but the 25-year High Coupon index reached a high on 6 June, a little before the issue of 12% Exchequer 2013/17.

2.5. § 3 of the 1976 note discussed the parameters of the yield curves for each of which the formula is:

$$y(t) = A + B \exp(-Ct) + D \exp(-Ft).$$

From January 1978 to the beginning of March the High Coupon value of F was extremely small, while C was around 0.25 to 0.28. This shape implies that a single exponential curve fits the dated stocks, but that the irredeemable stocks do not lie on that curve and the non-zero but small value of F makes the final term equal to D for the practical finite range of t , but equal to zero for t infinite. The values then changed so that both C and F were near 0.05 and they ranged from 0.04 to 0.06 until December, when they diverged again to about 0.12 and 0.02. $(B + D)$ ranged from about -0.051 to $+0.003$, which last value implies a nearly level yield curve—though still slightly upwards sloping. The root mean square deviation ($RMSD$) ranged from 0.16 to 0.26.

The Medium Coupon curve in the first part of the year was dominated by the value of C , around 0.18 to 0.21, with F being very large (and its effect negligible). For a few days in April C and F were about equal at 0.06 and thereafter C became larger, rising to 1.00, with F very small. $(B + D)$ ranged from about -0.657 to -0.012 ; $RMSD$ from about 0.28 to 0.43.

The Low Coupon values of C and F were about equal throughout the year and ranged from 0.13 to 0.23; $(B + D)$ ranged from -0.063 to -0.035 ; $RMSD$ ranged from about 0.50 to 0.79.

3. PORTFOLIO INDICES

3.1. Appendix E of the 1977 note listed the constituents of the portfolio indices at 30 December 1977. Changes in the constituents during 1978 are listed in Appendix D of the present note. There were 2 calls paid on one stock partly paid at the beginning of the year; 3 new fully paid stocks were issued (including one A stock), and 6 new partly paid stocks on which 10 further calls took place; 1 new tranche was amalgamated with the basic issue; 3 stocks neared redemption; and 7 stocks moved between sectors as the time for redemption shortened.

3.2. At 31 December 1978 there were then 27 stocks in the 'up to 5 years' sector; 17 stocks in the '5 to 15' sector; 26 stocks in the 'over 15' sector (including one partly paid); and 6 stocks in the irredeemable sector; making a total of 76 stocks. These are listed in Appendix E.

3.3. In §§ 5.1 to 5.6 of the 1976 note it was shown how one could use the published values of the indices and the 'xd adj' figure to calculate cumulative rates of return on the sectors for the year on two different assumptions about when dividends are reinvested and at two different tax rates. The values of the index at the end of each month and the cumulative interest received for 1978 to the end of each month, for each sector, are shown in Appendix F.

3.4. The cumulative rates of return for 1978, expressed as percentages, were for the alternative series:

	First Assumption*		Second Assumption†	
	Gross	Net of tax at 37½%	Gross	Net of tax at 37½%
Up to 5 years	+2.43%	-0.82%	+2.39%	-0.83%
5 to 15 years	-2.67%	-6.10%	-2.72%	-6.12%
Over 15 years	-3.27%	-7.49%	-3.27%	-7.47%
Irredeemables	-7.25%	-11.04%	-7.15%	-10.97%
All stocks	-1.09%	-4.83%	-1.11%	-4.83%

* First Assumption: Interest is reinvested at the end of the month during which it has gone 'ex div'.

† Second Assumption: Interest is held as a credit until the end of the month following that in which it has gone 'ex div'.

It can be seen that the first assumption gives results very similar to those given under the second assumption.

If the same calculations are carried out using the published series, the results are the same for 'up to 5 years' and 'irredeemables', but are higher for the other sectors: by 0.06% for '5 to 15', 0.63% gross, 0.59% net for 'over 15' and 0.36% gross, 0.34% net for all stocks.

APPENDIX A

YIELD INDICES: CHANGES IN CONSTITUENTS DURING 1978

Numbers in parentheses indicate the number of stocks in the low, medium and high coupon bands, respectively, other than irredeemables, after each change: at 30 December 1977 they were (19: 21:20)—3%–6¾%: 7¼%–10½%: 11½%–15½%.

12 January	Issue of 10¼% Exchequer 1995 (medium) Transfer from medium to low of 7¾% Treasury 1985/88 and 7¼% Treasury 2012/15 Bands now 3%–7¾%: 8%–10½%: 11½%–15½% (21:20:20)
2 March	Issue of 8¾% Exchequer 1983 (medium) (21:21:20)
9 March	One year from maturity of 11½% Treasury 1979 (low) (21:21:19)
27 April	Issue of 12% Exchequer 1998 (21:21:20)
15 June	Issue of 12% Exchequer 2013/17 (high) (21:21:21)
16 June	Issue of 10% Exchequer 1983 (medium) (21:22:21)
2 August	Issue of 12% Exchequer 1999/2002 (high) (21:22:22)
17 September	One year from maturity of 3% Treasury 1979 (low) (20:22:22)
26 September	One year from maturity of 4¼% British Electric 1974/79 (low) (19:22:22)
1 November	One year from maturity of 10½% Treasury 1979 (medium) (19:21:22)
15 November	One year from maturity of 3½% British Electric 1976/79 (low) (18:21:22)
23 November	Issue of: 12¼% Exchequer 1985 (high) and 12½% Treasury 2003/05 (high) Transfer from high to medium of 11¼% Treasury 1981 and 11¾% Treasury 1991 Bands now 3%–7¾%: 8%–11¾%: 12%–15½% (18:23:22)

APPENDIX B

YIELD INDICES: STOCKS AT 29 DECEMBER 1978

Low Coupons (3%-7½%)

(18 Stocks)
3% Exchequer 1981
3% Treasury 1982
3% Exchequer 1983
3% British Transport 1978/88
3% British Gas 1990/95
3½% Treasury 1977/80
3½% Treasury 1979/81
3½% Funding 1999/2004
5% Treasury 1986/89
5½% Funding 1978/80
5½% Funding 1982/84
5½% Treasury 2008/12
5¾% Funding 1987/91
6% Funding 1993
6½% Funding 1985/87
6¾% Treasury 1995/98
7¾% Treasury 1985/88
7¾% Treasury 2012/15

Medium Coupons (8%-11¼%)

(23 Stocks)
8% Treasury 2002/06
8¼% Treasury 1981
8¼% Treasury 1982
8½% Treasury 1987/90
8½% Treasury 1980/82
8½% Treasury 1984/86
8¾% Exchequer 1983
8¾% Treasury 1997
9% Treasury 1994
9% Treasury 1992/96
9¼% Exchequer 1982
9¼% Treasury 1983
9½% Treasury 1980
9½% Exchequer 1981
9½% Treasury 1999
9¾% Treasury 1981
10% Exchequer 1983
10% Treasury 1992

Medium Coupons (*Continued*)

10¼% Exchequer 1995
10½% Treasury 1997
10½% Treasury 1999
11½% Treasury 1981
11¾% Treasury 1991

High Coupons (12%-15½%)

(22 Stocks)
12% Treasury 1983
12% Treasury 1995
12% Exchequer 1998
12% Exchequer 1999/2002
12% Exchequer 2013/17
12¼% Exchequer 1985
12¼% Exchequer 1992
12½% Treasury 1993
12½% Exchequer 1994
12½% Treasury 2003/05
12¾% Exchequer 1981
12¾% Treasury 1992
12¾% Treasury 1995
13% Exchequer 1980
13% Treasury 1990
13¼% Exchequer 1996
13¼% Treasury 1997
13¾% Treasury 1993
14% Treasury 1982
14½% Treasury 1994
15¼% Treasury 1996
15½% Treasury 1998

Irredeemables

(6 Stocks)

2½% Treasury
2½% Consols
3% Treasury
3½% War Loan
3½% Conversion
4% Consols

APPENDIX C

	YIELD INDICES: GROSS REDEMPTION YIELD (CONVERTIBLE HALF-YEARLY) PER CENT												
	Low Coupons			Medium Coupons			High Coupons			Irredeemables			
	5 yrs.	15 yrs.	25 yrs.	5 yrs.	15 yrs.	25 yrs.	5 yrs.	15 yrs.	25 yrs.	5 yrs.	15 yrs.	25 yrs.	Irredeemables
30 December 1977	7.13	9.17	9.81	9.35	10.27	10.44	9.75	11.23	11.35	9.87			
31 January 1978	7.61	9.80	10.38	9.96	10.80	10.93	10.61	11.72	11.75	10.25			
28 February	7.84	10.14	10.60	9.92	11.16	11.32	10.57	12.08	12.17	10.36			
31 March	7.91	10.24	10.77	10.03	11.29	11.49	10.37	12.09	12.35	10.58			
28 April	8.43	10.84	11.36	10.61	12.11	12.29	10.95	12.67	12.95	11.07			
31 May	8.75	11.04	11.65	11.25	12.24	12.43	11.53	12.76	13.12	11.59			
30 June	8.94	11.06	11.79	11.69	12.28	12.33	11.77	12.76	12.93	11.97			
31 July	8.66	10.89	11.62	11.25	12.08	12.19	11.46	12.58	12.84	11.62			
31 August	8.87	10.96	11.68	11.77	12.16	12.16	11.73	12.67	12.84	11.67			
29 September	8.92	11.07	11.74	11.95	12.23	12.23	11.93	12.78	12.93	11.68			
31 October	9.13	11.22	11.88	12.30	12.36	12.36	12.33	12.94	13.05	11.86			
30 November	9.61	11.47	12.02	12.62	12.70	12.70	12.60	13.24	13.28	12.04			
29 December	9.64	11.39	12.01	12.74	12.76	12.76	12.78	13.30	13.31	11.93			
1978 High	9.75	11.54	12.15	12.74	12.76	12.76	12.85	13.30	13.37	12.15			
(on)	20/12	24/11	10/11	29/12	29/12	29/12	9/11	29/12	5/6	13/11			
1978 Low	7.05	9.12	9.74	9.30	10.19	10.35	9.67	11.13	11.26	9.80			
(on)	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1	3/1			

APPENDIX D

PORTFOLIO INDICES: CHANGES IN CONSTITUENTS DURING 1978

9 January	Call of £40 on 10½% Treasury 1999 (+£320·0m to 'over 15')
12 January	New issue of 10¼% Exchequer 1995 (£30 paid) (+£240·0m to 'over 15')
6 February	Call of £40 on 10½% Treasury 1999 (+£320·0m to 'over 15')
21 February	Shortening of 3% Exchequer 1983 (£498·0m from '5 to 15' to 'up to 5')
23 February	Redemption of 9% Treasury 1978 (−£1497·3m from 'up to 5')
27 February	Call of £65 on 10¼% Exchequer 1995 (+£520·0m to 'over 15')
2 March	New issue of 8¾% Exchequer 1983 (+£772·2m to 'up to 5')
17 March	Shortening of 12% Treasury 1983 (£655·7m from '5 to 15' to 'up to 5')
27 April	New issue of 12% Exchequer 1998 (£30 paid) (+£240·0m to 'over 15')
15 May	Call of £35 on 12% Exchequer 1998 (+£280·0m to 'over 15')
18 May	New issue of 9¼% Exchequer A 1982 (+£758·2m to 'up to 5')
7 June	Call of £31 on 12% Exchequer 1998 (+£248·0m to 'over 15')
15 June	New issue of 12% Exchequer 2013/17 (£15 paid) (+£150·0m to 'over 15')
16 June	Redemption of 10½% Treasury 1978 (−£496·4m from 'up to 5')
	New issue of 10% Exchequer 1983 (£15 paid) (+£135·0m to '5 to 15')
27 June	Call of £30 on 12% Exchequer 2013/17 (+£300·0m to 'over 15')
7 July	Call of £30 on 10% Exchequer 1983 (+£270·0m to '5 to 15')
14 July	Shortening of 12¼% Treasury 1993 (£1094·5 m from 'over 5' to '5 to 15')
	Call of £51 on 12% Exchequer 2013/17 (+£510·0m to 'over 15')
18 July	Shortening of 9¼% Treasury 1983 (£731·2m from '5 to 15' to 'up to 5')
28 July	Call of £50 on 10% Exchequer 1983 (+£450·0m to '5 to 15')
2 August	New issue of 12% Exchequer 1999/02 (£15 paid) (+£120·0m to 'over 15')
16 August	Amalgamation of 9¼% Exchequer A 1982 with main stock
22 August	Call of £40 on 12% Exchequer 1999/02 (+£320·0m to 'over 15')
25 August	Redemption of 5% Exchequer 1976/78 (−£396·9m from 'up to 5')
15 September	Shortening of 6% Funding 1993 (£373·5m from 'over 15' to '5 to 15')
18 September	Call of £41 on 12% Exchequer 1999/02 (+£328·0m to 'over 15')

Appendix D (*Continued*)

23 November	New issues of 12 $\frac{1}{4}$ % Exchequer 1985 (+£680.75m to '5 to 15') and 12 $\frac{1}{2}$ % Treasury 2003/05 (£15 paid) (+£120.0m to 'over 15')
	Shortening of 13 $\frac{3}{4}$ % Treasury 1993 (£1282.8m from 'over 15' to '5 to 15')
8 December	Call of £30 on 12 $\frac{1}{2}$ % Treasury 2003/05 (+£240.0m to 'over 15')
12 December	Shortening of 10% Exchequer 1983 (£813.6m from '5 to 15' to 'up to 5')

APPENDIX E
PORTFOLIO INDICES:

STOCKS AS AT 29 DECEMBER 1978

Up to 5 years (27 stocks)	Market Value £m
11½% Treasury 1979	1,242.7
3% Treasury 1979	623.6
4½% British Electric 1974/79	267.1
10½% Treasury 1979	1,209.4
3½% British Electric 1976/79	240.5
9% Treasury 1980	999.8
9½% Treasury 1980	1,083.1
3½% Treasury 1977/80	248.4
5½% Funding 1978/80	379.8
13% Exchequer 1980	819.8
11½% Treasury 1981	590.0
3½% Treasury 1979/81	436.9
9¾% Treasury 1981	777.9
8½% Exchequer 1981	830.0
9½% Exchequer 1981	740.1
3% Exchequer 1981	519.6
12¾% Exchequer 1981	610.6
8½% Treasury 1980/82	775.0
3% Treasury 1982	338.4
14% Treasury 1982	647.0
8½% Treasury 1982	703.5
9½% Exchequer 1982	1,476.4
8¾% Exchequer 1983	702.4
3% Exchequer 1983	483.6
12% Treasury 1983	608.4
9½% Treasury 1983	699.8
10% Exchequer 1983	812.4
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Sector Total	18,866.2
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5 to 15 years (17 stocks)	Market Value £m
5½% Funding 1982/84	408.2
12¼% Exchequer 1985	680.7
8½% Treasury 1984/86	504.7
6½% Funding 1985/87	428.6
7¾% Treasury 1985/88	386.9
3% British Transport 1978/88	660.2
5% Treasury 1986/89	392.6

Appendix E (Continued)

PORTFOLIO INDICES: STOCKS AS AT 29 DECEMBER 1978 (Continued)

13%	Treasury 1990	597.0
8½%	Treasury 1987/90	464.2
11½%	Treasury 1991	734.0
5½%	Funding 1987/91	259.5
12¾%	Treasury 1992	581.2
10%	Treasury 1992	512.2
12¼%	Exchequer 1992	786.0
12½%	Treasury 1993	1,047.7
6%	Funding 1993	369.7
13¾%	Treasury 1993	1,296.9

Sector Total	10,110.6
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Over 15 years (26 stocks)	Market Value £m
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14½%	Treasury 1994	671.2
12½%	Exchequer 1994	995.0
9%	Treasury 1994	691.9
12%	Treasury 1995	915.0
3%	British Gas 1990/95	95.8
10¼%	Exchequer 1995	650.0
12¾%	Treasury 1995	886.5
9%	Treasury 1992/96	462.7
15¼%	Treasury 1996	1,533.9
13¼%	Exchequer 1996	813.0
3%	Redemption 1986/96	18.0
13¼%	Treasury 1997	1,486.9
10½%	Exchequer 1997	775.1
8¾%	Treasury 1997	599.0
6¾%	Treasury 1995/98	602.5
15½%	Treasury 1998	1,288.4
12%	Exchequer 1998	743.0
9½%	Treasury 1999	458.2
10½%	Treasury 1999	666.0
12%	Exchequer 1999/2002	725.0
3½%	Funding 1999/2004	156.8
12¾%	Treasury 2003/05 (£45 paid)	361.0
8%	Treasury 2002/06	398.2
5½%	Treasury 2008/12	470.3
7¾%	Treasury 2012/15	369.7
12%	Exchequer 2013/17	921.2

Sector Total	17,754.5
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Appendix E (*Continued*)PORTFOLIO INDICES: STOCKS AS AT 29 DECEMBER 1978 (*Continued*)

Irredeemables (6 stocks)	Market Value £m
2½% Consols 1923–	55.8
3½% War Loan 1952–	572.8
4% Consols 1957–	111.8
3½% Conversion 1961	104.9
3% Treasury 1966–	14.0
2½% Treasury 1975–	95.7
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Sector Total	955.0

Total market value of all stocks £47,686.4m

(The figures do not, in some cases, correctly cast due to rounding)

APPENDIX F

PORTFOLIO INDICES: VALUES OF INDEX (P) AND CUMULATIVE INTEREST RECEIVED 1978 TO DATE (C)

	Up to 5 years		5 to 15 years		Over 15 years		Irredeemables		All stocks	
	P	C	P	C	P	C	P	C	P	C
30 December 1977	109.67	0.00	125.45	0.00	134.71	0.00	148.16	0.00	122.49	0.00
31 January 1978	108.25	0.81	121.58	0.96	129.87	1.09	143.88	0.00	119.29	0.93
28 February	108.06	2.10	119.58	1.43	126.41	2.17	142.04	1.45	117.51	1.98
31 March	108.15	2.47	119.48	2.07	125.75	3.24	140.10	1.78	117.26	2.67
28 April	106.41	3.33	116.41	2.07	119.79	4.97	131.11	6.08	113.54	3.78
31 May	105.25	3.63	115.70	2.67	119.99	4.97	126.38	6.08	112.91	4.01
30 June	104.19	4.73	113.17	5.95	119.35	7.00	122.38	7.24	111.72	5.82
31 July	105.65	5.16	114.57	6.99	120.71	8.19	127.04	7.24	113.20	6.65
31 August	104.30	6.70	114.76	6.99	120.40	9.18	126.42	8.69	112.53	7.69
29 September	104.65	7.06	114.43	7.55	119.85	10.19	127.21	9.02	112.43	8.33
31 October	103.55	7.89	114.27	7.55	117.91	12.22	122.30	13.32	111.11	9.52
30 November	103.46	8.19	112.39	8.48	116.69	12.55	121.71	13.32	110.25	9.95
29 December	102.78	9.40	110.90	11.08	115.63	14.49	122.84	14.48	109.28	11.72