Yield curves and representative yields on British government securities

The series of yields published by the Bank of England in the past[1] have included the gross redemption yields[2] on one short-dated, one medium-dated, and one long-dated stock. The choice of single representatives of these maturity groups is open to objection, however, on the following grounds.

a As time passes a stock moves out of the maturity group that it represents and has to be replaced; the new stock has a different life and often a different coupon, and continuity is broken. Even when changes can be avoided, year-to-year comparisons are uncertain, because – other things being equal – the yield on a particular stock usually falls gradually as its life shortens.

b The yield on the selected stock may become temporarily out of line with others within the group represented.

To overcome these disadvantages, the Bank have adopted a new series of representative yields for British government securities; these yields are derived from yield-maturity curves fitted by computer, using a method developed in the Bank and outlined later in this note.

The yield on a stock does not stand in any simple relationship to its life to maturity. Other characteristics of the stock can be equally or more important; and the relative weight of the factors determining the yield will usually change, gradually or suddenly, as the stock's remaining life diminishes and it moves from a maturity group that is attractive to one class of investor into a shorter-dated group more suitable for another class. The redemption yield on a stock with a high coupon – and hence a high running yield – will behave differently during the life of the stock from the yield on one with a low coupon; the presence of special tax features, such as the zones (of differing width) that are free from tax on capital gains, accorded to some stocks under the Finance Act 1965, and any tax concessions to overseas holders, will also have a varying influence on the yield; and the operation of a sinking fund, or periodic redemption by drawings, will cause the yield to behave in a manner peculiar to the stock in question.

The considerable variety of significant characteristics suggests that it is more helpful to show the behaviour of yields on certain selected types of stock than on all stocks at once. The selection could be made from the point of view of some particular class of investor – the life assurance funds, for instance, or the discount houses. Or it could be made from the point of view of H.M. Government as the sole borrower; but even then a number of different choices could be made.

The curves accompanying this note have been fitted to the yields on dated stocks within a certain range of coupon (currently 5% or higher), together with that on one undated stock (see below). The reason for choosing these dated stocks is that their yields are particularly relevant now – and will probably be so for some time to come – to judgments about the appropriate terms for new government issues, to the terms on which tap stocks are sold from time to time by the Issue Department, and thus to the execution of official

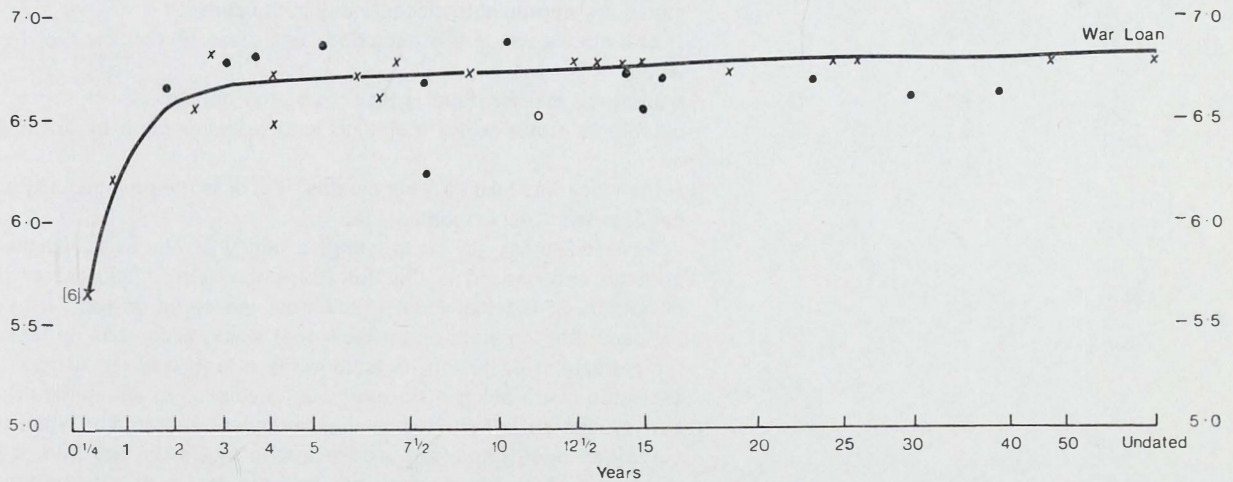1 See Table 25 of the statistical annex to the December 1966 *Bulletin*.
2 The rate of interest which if used to discount future dividends and the sum due at redemption will make their present value equal to the present price of the stock. Tax is ignored throughout.

Chart A

Per cent per annum

Gross redemption yields 30th June 1965

- Stocks excluded (coupons below 4 per cent)
- o Stock rejected by computer
- [ ] Bank rate

War Loan

7·0
6·5
6·0
5·5
5·0

[6]

0 ¼ 1 2 3 4 5 7½ 10 12½ 15 20 25 30 40 50 Undated

Years

Chart B

Per cent per annum

Gross redemption yields at certain dates

[ ] Bank rate

8·0
7·5
7·0
6·5
6·0
5·5

1966 High (31st August)

25th January 1967

1st February 1967

1965 Budget day (6th April)

[7]
[7]
[7]
[6½]

0 ¼ 1 2 3 4 5 7½ 10 12½ 15 20 25 30 40 50 Undated

Years
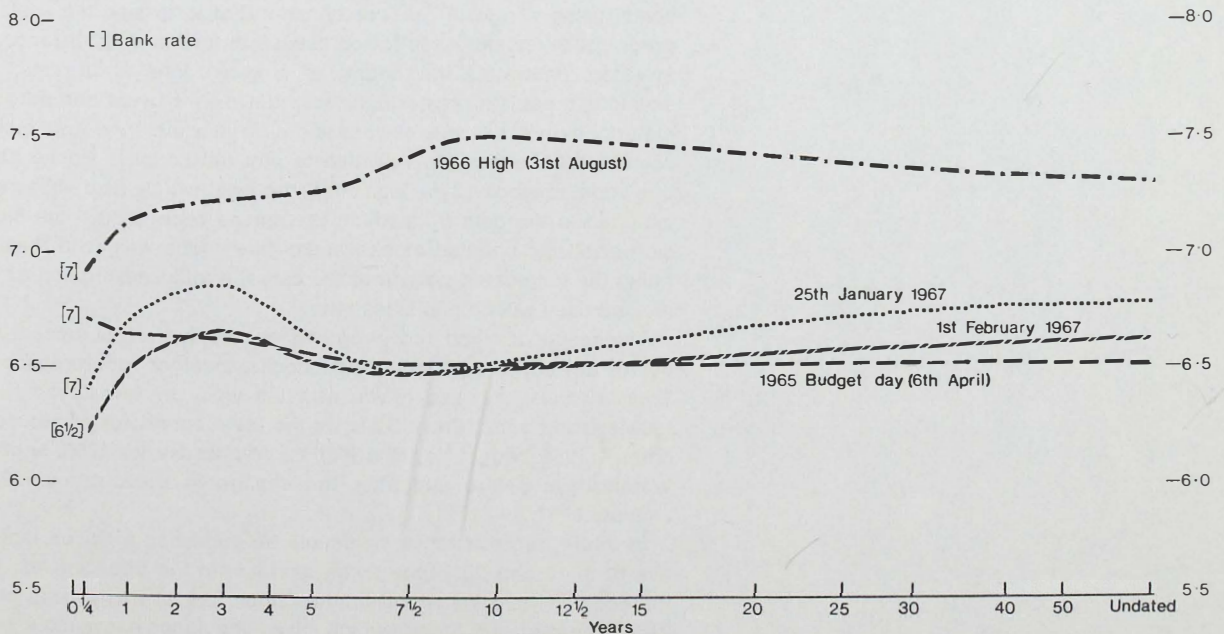
policy on interest rates. But the most suitable selection for this purpose has not always been, and probably will not always remain, the stocks with high coupons; and in time the exclusion of all stocks with coupons below 5% may need to be reconsidered. For the curves fitted for the years 1963 to 1965 stocks with coupons of 4% or more have been included. These selections, even after certain further exclusions listed below, comprise enough stocks to enable the shapes of the curves to be determined with some confidence; and the change in the coupon range at the end of 1965 does not cause any appreciable discontinuity in the series.

The stocks which are excluded regardless of coupon are those where:

a the total market issue is less than £150 million;

b there is provision for a sinking fund or redemption by drawings; or

c the stock has less than six months' life, or is the next maturity and has less than twelve months' life.

As is customary in curve-fitting, a family of curves is examined and the one chosen is that for which the sum of squares of the deviations of the individual yields from the curve is least. It often happens that the yield on an individual stock, which has no reason for permanent exclusion, is temporarily a long way out of line. To avoid the curve being distorted by such stocks, an automatic rejection procedure is included in the computer programme. When the curve has been fitted, any stocks whose yields deviate from it by more than twice the average are rejected and a new curve fitted; however, none of the stocks with a life of under five years is rejected, because there are only a very small number of them and their yields tend to be widely scattered.

An example of a fitted yield curve is shown in Chart A. Three types of stocks are shown – those omitted from the computer calculation because they have a coupon below 4%, one stock that is rejected by the computer because its yield is too far out of line, and those that are used to construct the curve; stocks excluded regardless of coupon for the three special reasons given above are not shown at all. Time to maturity is on a 'discounted present value' scale, using a rate of 5% per annum. That is to say, the scale is progressively compressed to represent the declining significance, in investors' views of the future, of a given interval of time; for example, there is a greater difference between a 1-year and a 2-year maturity than between a 49-year and a 50-year maturity. And such a scale locates a position in which to plot the undated stocks. Only one undated stock ($3\frac{1}{2}$% War Loan, the most widely held) has been included in the data from which the curves were fitted – the inclusion of all the undated stocks would give undue weight to them in fitting the long-dated portion of the curve. A fuller description of the method used will be published later.

The result of using the foregoing criteria is that at present the curves are based on about fifteen stocks, together with three-month Treasury bills; they are drawn with the yield on Treasury bills as their starting point. Chart B shows the fitted curves for some useful dates – 1965 Budget day, the highest Wednesday for 1966, and the Wednesdays before and after the change in Bank rate on 26th January 1967.

In future, representative yields will be published for fixed maturities of 5, 10 and 20 years, taken direct from the fitted curves. For the undated yield the representative stock has for many years been $2\frac{1}{2}$% Consolidated Stock, which gives the longest available con-

Yields on British government stocks

Last working days:	Short-dated (5 years)	Medium-dated (10 years)	Long-dated (20 years)	3½% War Loan
	Calculated redemption yields[a]			Flat yield[a]
	Per cent per annum			
1963 Jan.	4·79	5·23	5·54	5·90
Feb.	5·01	5·43	5·74	6·13
Mar.	5·07	5·45	5·69	5·94
Apr.	5·09	5·29	5·50	5·79
May	4·95	5·17	5·31	5·59
June	4·81	5·08	5·28	5·54
July	4·80	5·06	5·28	5·57
Aug.	4·68	4·96	5·22	5·52
Sept.	4·52	4·90	5·21	5·60
Oct.	4·58	4·97	5·26	5·60
Nov.	4·77	5·21	5·51	5·86
Dec.	4·88	5·24	5·63	5·96
1964 Jan.	4·92	5·27	5·64	6·01
Feb.	5·36	5·45	5·85	6·23
Mar.	5·20	5·46	5·76	6·01
Apr.	5·31	5·49	5·93	6·17
May	5·33	5·55	5·90	6·19
June	5·38	5·64	5·97	6·23
July	5·58	5·76	6·02	6·23
Aug.	5·57	5·75	6·00	6·24
Sept.	5·56	5·77	6·00	6·20
Oct.	5·59	5·84	6·06	6·17
Nov.	6·08	6·07	6·23	6·30
Dec.	6·54	6·38	6·41	6·46
1965 Jan.	6·45	6·35	6·41	6·40
Feb.	6·41	6·36	6·43	6·47
Mar.	6·57	6·52	6·53	6·52
Apr.	6·63	6·60	6·61	6·55
May	6·72	6·69	6·76	6·80
June	6·70	6·73	6·78	6·79
July	6·77	6·79	6·80	6·81
Aug.	6·73	6·68	6·65	6·65
Sept.	6·59	6·47	6·35	6·33
Oct.	6·39	6·43	6·37	6·37
Nov.	6·38	6·41	6·40	6·48
Dec.	6·53[b]	6·59	6·59	6·60

a Gross of tax.
b This becomes 6·47 if stocks with coupons below 5% are excluded. The change does not affect the longer calculated yields.

tinuous run of figures for this purpose. Because the yield curves now being brought into use take 3½% War Loan as the undated stock, it seems best to adopt the same stock as the representative. The yield on 2½% Consols will, however, continue to be included as a monthly series in *Financial Statistics*, published by the Central Statistical Office.

Chart C shows the yields derived from the curves for the last working day in each month since June 1964. The corresponding series, and the yield on 3½% War Loan, are given in the table, back to January 1963, and continued in Table 26 of the annex.

Chart C

Per cent per annum

Calculated gross redemption yields
(last working day of month)

	June	Sept.	Dec.	Mar.	June	Sept.	Dec.	Mar.	June	Sept.	Dec.	Mar.
		1964			1965				1966			1967