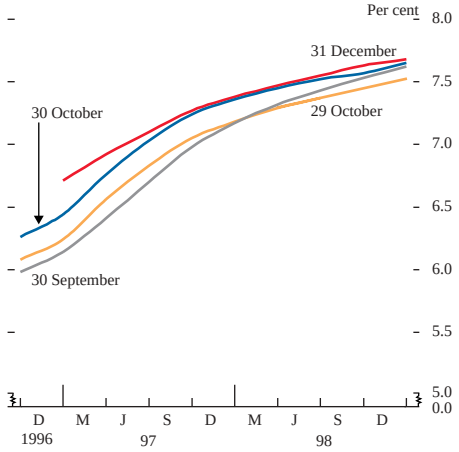
The operation of monetary policy

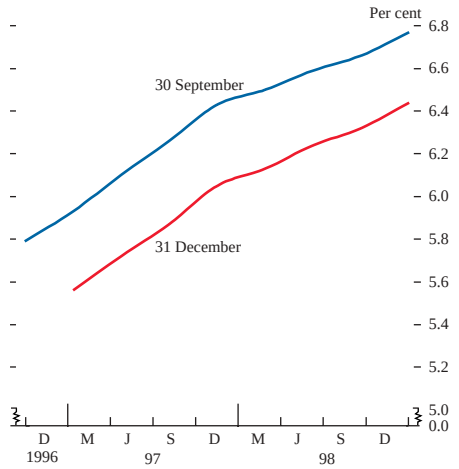
- *Official interest rates were increased once in the period from October to December, by 25 basis points to 6% on 30 October.*
- *Sterling's strong and broadly based appreciation was the most marked development in the foreign exchange market.*
- *The gilt yield curve flattened, and this was reflected in a flattening of the implied forward inflation expectations curve: longer-term inflation expectations fell sharply.*
- *Gilt sales of £6.8 billion were made in this period.*
- *The Bank announced plans for changes in its daily operations in the sterling money markets.*

Chart 1
Short sterling futures rate curves(a)



(a) Three-month Libor rates implied by short sterling futures contracts.

Chart 2
Eurodollar futures(a)



(a) 90-day eurodollar rates implied by futures contracts.

Introduction

In the United Kingdom, official interest rates were raised by 25 basis points to 6% on 30 October, the first tightening of monetary policy since February 1995. Market expectations of the future path of short-term interest rates were revised up immediately after the rise in official rates, and had risen further by the end of the year, influenced by higher-than-expected rises in the retail price indices and by accumulating evidence of the robustness of activity. Sterling rose strongly; by 10.5% in effective terms to finish at 96.1 on the effective exchange rate index (ERI) on 31 December. Over the period as a whole, the gilt yield curve flattened: short-term yields rose while those at longer maturities fell. The yield on ten-year gilts declined by 12 basis points to 7.48%.

In the United States data releases suggested that, after a slowdown in the third quarter, economic growth accelerated in this period, but without causing a deterioration in the immediate outlook for inflation. US official interest rates were unchanged. Financial markets revised down their expectations of the future path of US short-term interest rates, and bond yields fell over the period as a whole.

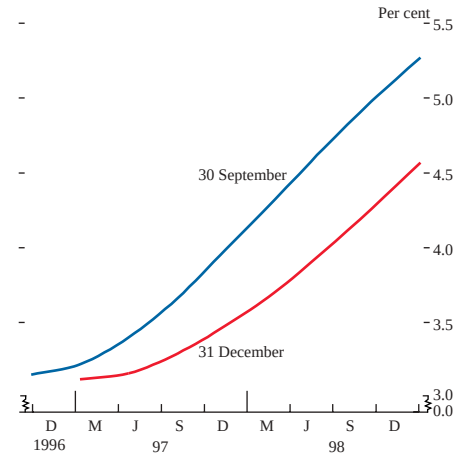
Data and survey releases suggested that the major European economies, while recovering, were growing below trend, and were behind the United States and the United Kingdom in the economic cycle. While there was no change in German official interest rates, within the European Union official rates were reduced in France, Italy, Spain, Portugal, Greece, Sweden and Finland. As the perception gathered pace that German economic growth might fall short of earlier expectations, financial markets revised down their expectations of future German money-market rates, and bond yields fell. The prospects for the timing of implementation of, and the range of participants in, Economic and Monetary Union (EMU) continued to be a major influence in European markets. European government bond yields fell over the period as a whole, with particularly marked falls in Italian, Spanish and Swedish

Table A
Interest rates, gilt yields and exchange rates; selected dates[a]

	Interest rates (per cent per annum)					Gilt yields (b) (per cent per annum)				Exchange rates		
	Sterling interbank rates (c)				Short sterling future (d)	Conventionals			Index-linked			
1996	1 month	3 months	6 months	12 months	3 months	Short	Medium	Long	Long	ERI	$/£	DM/£
30 September	5 55/64	5 7/8	5 61/64	6 13/64	6.14	7.09	7.60	7.99	3.64	87.0	1.5640	2.3854
29 October	5 57/64	5 63/64	6 1/8	6 25/64	6.24	7.07	7.51	7.87	3.59	89.1	1.6108	2.4315
30 October	6 1/16	6 3/16	6 21/64	6 39/64	6.44	7.21	7.55	7.86	3.62	90.2	1.6326	2.4607
31 December	6 5/32	6 29/64	6 21/32	6 15/16	6.71	7.27	7.48	7.62	3.58	96.1	1.7120	2.6373

(a) Close-of-business rates in London.
(b) Gross redemption yield. Representative stocks: short: 7% Treasury 2001; medium: 7½% Treasury 2006; long: 8% Treasury 2015; index-linked—2½% Index-Linked Treasury 2016 (real yield assuming 5% inflation).
(c) Middle-market rates.
(d) Implied future rate: March 1997 contract.

Chart 3
Euromark futures[a]



(a) 90-day euromark rates implied by futures contracts.

Chart 4
Effective exchange rates

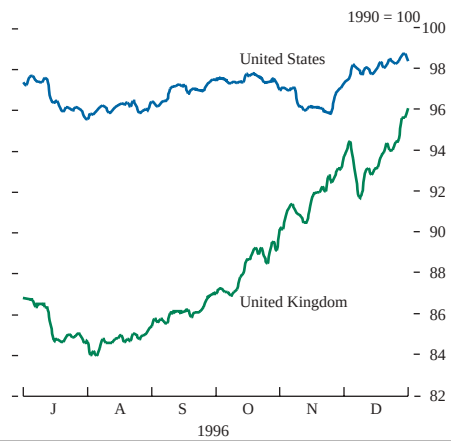


Table B
Sterling exchange rates

1990 = 100

	1992 15 Sept.	1995 29 Nov.	1996 30 Sept.	31 Dec.	Percentage change since 30 Sept.
£/$	1.8875	1.5340	1.5640	1.7120	9.5
£/DM	2.7812	2.2044	2.3854	2.6373	10.6
ERI	99.5	82.2	87.0	96.1	10.5

government bond yields. In part this process of convergence towards German and other 'core' European government bond yields may have reflected financial markets' belief that those countries had become more likely initial participants in EMU. It may also have reflected a perception that economic fundamentals in those countries had improved. The Finnish markka joined the exchange rate mechanism (ERM) and the Italian lira resumed its full participation in the mechanism. The gathering perception that EMU could start on time and with a wider group of participants than had earlier been thought may be a further explanation of the Deutsche Mark's relative weakness against the Ecu and the dollar (see Chart 9).

Foreign exchange markets

The appreciation of sterling was the most significant foreign exchange market development during the fourth quarter. It rose by 10½% in effective terms over the period and it finished 1996 at 96.1 on the ERI. The appreciation was broadly based, with sterling rising against all currencies in the ERI.[1] Sterling reached its highest levels against the US dollar and Deutsche Mark since September 1992 on 31 December at $1.7120 and DM 2.6400 respectively. It had risen by 17% from its all-time low at 82.2 on the ERI, which was reached in November 1995 (see Table B).

It is difficult to account fully for the extent of sterling's appreciation, which began in early August after a sharp fall in both sterling and the US dollar in the second half of July, and which continued steadily in this period. Part of the explanation may be the emerging evidence of the strength of activity in the United Kingdom and the United States, particularly compared to much of continental Europe and Japan, which supported both sterling and the dollar. Actual and expected interest rate differentials moved in sterling's favour, against the US dollar and the main continental European economies. Interest rates implied by three-month eurodollar futures continued a decline which had begun following the Federal Open Markets Committee's (FOMC) decision to leave US official interest rates unchanged at its 24 September meeting. Over the period as a whole the term structure of interest rates implied by eurodollar contracts moved lower by 30–35 basis points as markets revised down their expectations of the path of US monetary policy. The forward rates implied by three-month

(1) See 'Revisions to the calculation of effective exchange rates', February 1995 *Quarterly Bulletin*, pages 43–8, for a discussion of the basket's composition.

Chart 5
Effective exchange rate indices: United Kingdom, United States, Germany and Japan

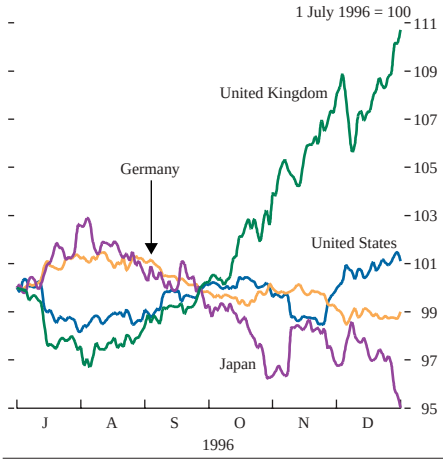
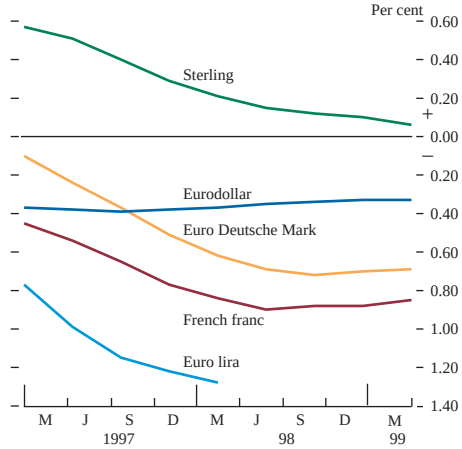


Chart 6
Changes to three-month interest rates implied by futures contracts(a)



(a) 30 September to 31 December.

euromark futures contracts also fell, and the implied term structure flattened: the rate implied by the March 1997 contract declined by 10 basis points, while implied rates from late-1997 onwards were 50–70 basis points lower.

In contrast, actual and expected interest rates rose in the United Kingdom in this period. Implied rates on short sterling futures had begun to rise on contracts out to March 1998 before the increase in UK official interest rates on 30 October. But this official increase came earlier than expected and resulted in a broadly parallel upward shift of the implied term structure of around 20 basis points. The short sterling curve subsequently flattened over the rest of the period, with a further rise of around 25 basis points in the rate implied by the March 1997 contract, but with contracts beyond the end of 1997 little changed. Particular movements in sterling appear to have followed UK inflation and activity data releases, which were in general stronger than the market had expected. During October, for example, sterling rose strongly in particular on publication of the September RPI and third quarter GDP data on 10 and 25 October respectively. Market forecasts of an improving UK net trade position—with the current account deficit projected by the market for 1996 and 1997 being revised down, despite relatively strong economic growth—was another supportive factor for sterling.

The evolution of exchange rates also appeared to have been influenced to some extent by the rise in the oil price which occurred during the fourth quarter. The United Kingdom remains a significant net oil exporter. The June 1997 crude oil futures price rose by 12% in dollar terms in this period; when the futures price peaked at $23.27 on 31 December, the yen had weakened to a 45-month low against the US dollar (Japan being a large oil importer, and the United States an oil producer), and sterling had strengthened to a post-ERM high against the US dollar.

The European background may have also served to support sterling, as financial markets appear to have increased the probability attached to EMU starting on time, and without UK participation, at least in the first wave. Fund managers appear to have increased their exposure both to the currency and to the sterling bond market from a neutral to an overweight position: market anecdote cited as an explanation for this a desire to diversify asset holdings away from the EMU core, or, to a lesser extent, concerns about a potentially 'soft' euro if EMU were to go ahead with a wide group of participating countries. In this respect, yield considerations gave sterling a distinct advantage over the Swiss franc, which has been a beneficiary of such inflows in the past.

Sterling rose sharply around the time of the rise in UK official interest rates. It opened at 89.1 on the ERI on 30 October, and ahead of the announcement it strengthened to 89.8. In the event it rose further during the day closing at 90.2, an increase of 1¼% on the previous day's close. Following the rate rise, sterling continued to appreciate, rising from 90.2 to 91.4 on the ERI, until the publication of the Bank's *Inflation Report* on 6 November. The currency briefly reacted to wire service comments that the *Inflation Report* suggested that the exchange rate appreciation might prove to be only transitory. Sterling's upward momentum was checked, and by 13 November it had fallen back from 91.4 to 90.6 on the ERI. But sterling subsequently recovered following the publication of

Chart 7
Sterling/dollar implied volatility on currency options

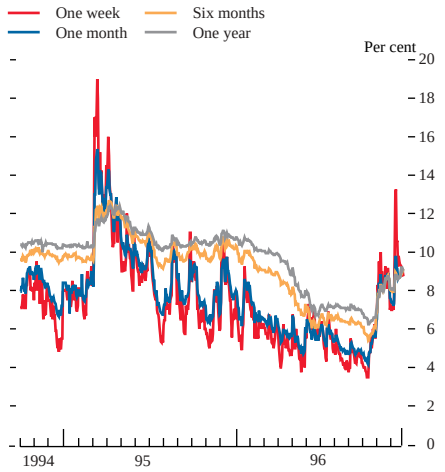


Chart 8
Sterling exchange rates

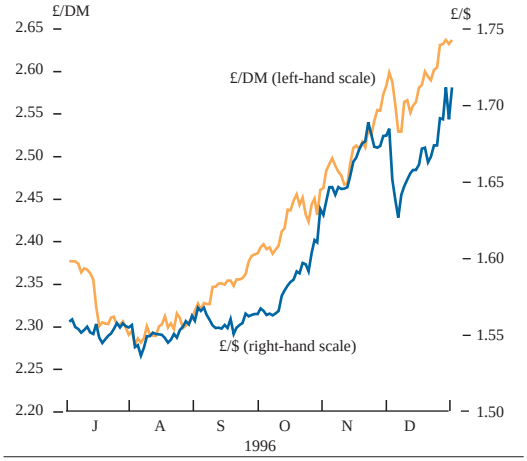
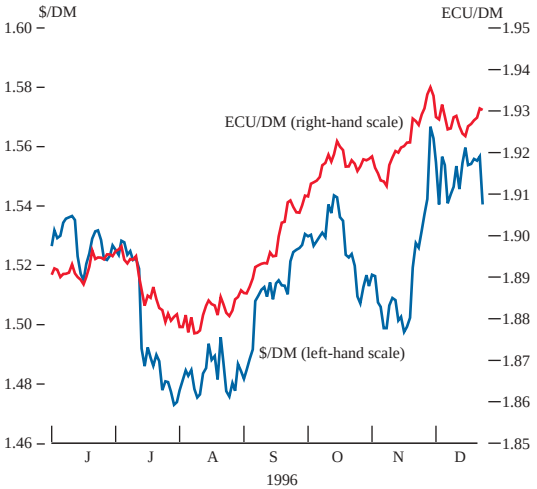


Table C
US dollar exchange rates

	1996 30 Sept.	31 Dec.	Percentage change since 30 Sept.
$/DM	1.5252	1.5405	1.0
$/Yen	111.36	116.05	4.2
$/CHF	1.2535	1.3405	6.9
ERI	97.5	98.4	0.9

Chart 9
Deutsche Mark exchange rates



strong labour market data on 13 November and it rose further the following day buoyed by RPI data which were significantly above market forecasts. Sterling closed at 91.9 on the index on 14 November, an increase of 1.4% in effective terms over two days. The UK Budget was well received by the market and sterling's appreciation continued during the second half of November. It finished November at 94.0 on the ERI and DM 2.5833.

However, exchange rate volatility increased markedly during December, when the market was relatively thin ahead of the year-end. This heightened volatility coincided with comments on 3 December by a Bundesbank Council member, which were interpreted by the markets as suggesting that EMU could boost demand for dollar-denominated assets. The dollar rose sharply in overnight trading and sterling fell through technical support at $1.6660, triggering increased sales. Moreover, its overnight gains to above DM 2.63 (a post-ERM high) were not sustained as it ran into profit-taking. A feature of this episode appears to have been large volumes of technically driven sales of sterling, and it closed at DM 2.5295 on 5 December, a 4% fall in less than 48 hours. Chart 7 shows the volatility in the options market as exchange rate uncertainty, particularly in the short term, increased.

But these chartist-driven selling pressures were short-lived; technical support was apparent at DM 2.5150, and sterling subsequently appreciated against the Deutsche Mark. The decision to leave UK official interest rates unchanged at December's Monetary Meeting had little impact on the exchange rate which continued to appreciate (within its post-October trading up-channel against the Deutsche Mark). It finished the year at DM 2.6373, an increase of 19% and 10½% over the course of 1996 and the fourth quarter respectively.

The spread between expected short-term US and German rates narrowed during the fourth quarter; but the dollar was largely unaffected by this background and it strengthened modestly against the Deutsche Mark, rising from DM 1.5252 to DM 1.5405. Japanese interest rate expectations, which were volatile during the third quarter as expectations that monetary policy would be tightened rose and then unwound, were more stable in this period. The US dollar traded in a range between ¥110.90 and ¥116.60 against the Japanese yen during the period.

The dollar strengthened against core ERM currencies over the fourth quarter, reflecting in part the perception that the agreement on the stability pact, reached at the Dublin Summit on 10 December, had further increased the likelihood of a 'wide' EMU. The dollar and the Ecu both reached their highest levels against the Deutsche Mark towards the end of December. The Finnish markka joined the ERM on 14 October, at a central rate against the Deutsche Mark of FIM 3.04. The Italian lira resumed full participation in the mechanism from 25 November, at a central rate against the Deutsche Mark of Lit 990.004. The Irish pound strengthened with sterling, aided by a modest rise in Irish money-market rates, and it finished the fourth quarter more than 8% above its DM central rate (see Chart 10). The Swiss franc depreciated by 7% in effective terms during the fourth quarter. In part this reflected an easing of monetary policy by the Swiss National Bank, amid continuing signs of weakness in the Swiss economy.

Chart 10
ERM exchange rates: divergence from the Deutsche Mark central rate

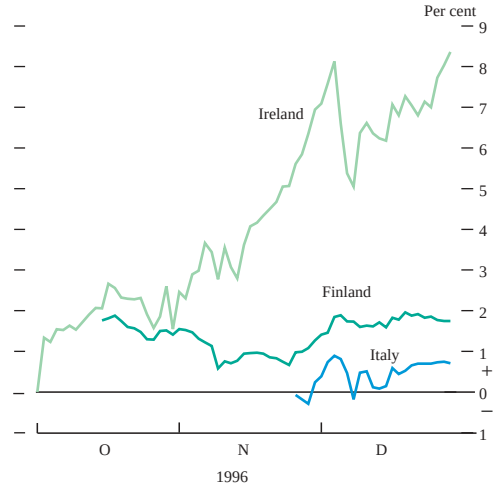
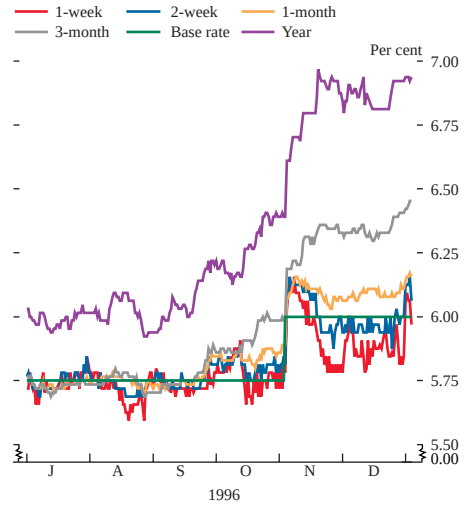


Chart 11
Sterling interbank interest rates(a)



(a) Middle-market rates at 4.30 pm.

Table D
Influences on the cash position of the money market

£ billions; *not seasonally adjusted*
Increase in bankers' balances (+)

	1996/97 Apr.–Sept.	1996/97 Oct.	Nov.	Dec.
CGBR (+)	16.5	-4.1	3.5	1.8
Net official sales of gilts (-) (a)	-19.2	-4.1	4.2	-2.5
National Savings (-)	-3.2	-0.5	-0.4	-0.1
Currency circulation (-)	0.2	-0.1	-1.7	-0.1
Other	1.7	-1.2	-0.9	0.4
Total	**-3.9**	**-10.0**	**4.7**	**-0.5**
Increase (+) in the stock of assistance	1.8	8.0	-6.4	-0.2
Net increase (-) in £ Treasury bills in the market (b)	2.9	1.1	1.6	1.1
Increase in bankers' balances at the Bank	0.8	-0.8	-0.1	0.5

(a) Excluding repurchase transactions with the Bank.
(b) Excluding repurchase transactions with the Bank (market holdings include Treasury bills sold to the Bank in repurchase transactions).

Operations in the money markets

The Bank announced a Minimum Lending Rate of 6% at noon on 30 October, an increase of 25 basis points in official interest rates. From early in the period the money markets had become progressively more bearish about the prospects for interest rates, influenced to a large extent by higher-than-expected retail price inflation, and by continued signs of improving economic activity. Nevertheless, a rise in official rates at the October Monetary Meeting was less than fully discounted, and resulted in a sharp upward movement in the interest rates implied by short sterling futures contracts. The immediate impact of the rate rise on short sterling futures and options, and the information on market expectations that can be derived from this, are discussed in the accompanying box.

After the move in official rates, market expectations of the path of short-term interest rates were revised up further, as the market continued to be strongly influenced by retail price inflation releases and also by accumulating evidence of robust activity. The market's increasingly bearish mood was illustrated by the 'pivoting' of very short-term money-market rates in the last two months of the period. Pivoting is a commonly observed phenomenon when the market attaches a high probability to a change in official interest rates in the near term: in this case, market expectations of a rise in official rates caused market interest rates at one month to rise to a level above the existing level of official interest rates (at which the Bank provides liquidity in its money-market operations), while market interest rates at shorter maturities generally traded below the level of official rates, as ample bill offers were generally made to the Bank in its daily operations.

By the end of the year, the three-month forward rate curve implied by short sterling futures contracts had flattened, with mean expectations of rates implied by the March and June 1997 contracts rather higher than in the immediate aftermath of the rise in official rates, but with less change in contracts beyond the end of 1997. This suggested that the market had brought forward its expectation of the timing of monetary tightening, but not the extent of the tightening. At the end of the period, implied interest rate distributions calculated using options on short sterling futures contracts suggested that the market attached a 75% probability to the March 1997 short sterling contract settling at an implied rate of 6.5% or above, and that a 50% probability was attached to the June 1997 contract settling at an implied rate of 6.75% or above.

Management of the profile of the daily money-market shortages was facilitated by an increased provision of liquidity through the Bank's twice-monthly gilt repo facility. This reduced the amount of liquidity which would otherwise have had to have been supplied in the daily operations, which had been forecast to be large owing both to seasonal influences and the impact on the money market of settlement of the dual gilt auction at the end of October. Demand for liquidity at the first two gilt repo rollovers of the period, on 9 and 23 October, was substantial, partly reflecting the increasing probability which the market attached to a rise in official interest rates at the end of the month; this increasing probability was also expressed in a shift in the balance of the funds applied for towards the longer of the maturities on offer at the rollovers. The Bank

Estimating market expectations of short-term interest rates

The prices of financial assets and derivative securities are a potentially rich source of information for policy-makers and market practitioners. Central banks routinely use bond prices or the prices of interest rate futures to examine implied levels of future interest rates. This enables an evaluation of market participants' views as to the likely course and credibility of monetary policy. Using bond prices or futures prices, however, restricts attention to the market's implied expected future interest rate; that is, the weighted average outcome where the weights are the different probabilities attached to different possible interest rates in the future. But by using option prices it is possible to construct an entire implied probability distribution (or probability density function (PDF)) for future interest rates. These PDFs permit a much richer analysis of the alternative probabilities associated with alternative future levels of interest rates.

Using the information contained within option prices is not new. Market practitioners frequently use estimates of implied volatility 'backed out' from the prices of options using, for example, the Black-Scholes formula.(1) Indeed, this notion of the implied variability of asset prices is so common that within many options markets prices are quoted in terms of implied 'vols'. This conveys how variable the underlying asset price is expected to be over the remaining life of the option. What is relatively new, however, is the use of techniques that recover the probabilities(2) that traders are implicitly attaching to alternative outcomes when pricing options. At the Bank, these implied probability distributions for short-term UK and German interest rates are now used to contribute on a regular basis to our assessment of monetary conditions.(3)

In estimating implied interest rate distributions, the Bank uses the options on the short sterling and euromark futures contracts that are traded at LIFFE. These contracts have a quarterly cycle with expiry dates within March, June, September and December. At any one time four quarterly options contracts are being traded. Since the technique allows the recovery of the probability distribution for interest rates at the expiration of the option contract, it is possible to determine four PDFs at any one time. In January 1997, for example, it was possible to calculate implied PDFs for interest rates at March, June, September and December 1997.

An important use for this technique is in assessing the impact of particular events upon the probabilities the market attaches to various possible future levels of interest rates. How, for example, were the market's perceived probabilities affected by the increase in official interest rates from 5.75% to 6% at the end of October last year? To what extent did the market predict the rise before the event? Using LIFFE short sterling futures prices, we can throw some light on these questions.

Chart A
Implied short sterling forward curve

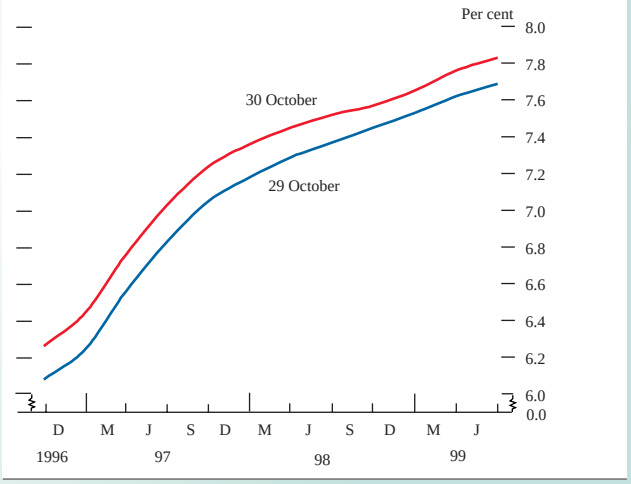


Chart A portrays the implied forward interest rate curve at the close of business on 29 and 30 of October. This curve captures the market's mean path for future three-month interbank interest rates.

Both curves are upwards sloping, suggesting that the market perceived that interest rates were likely to increase over time. Despite this, when official rates were increased at noon on the 30th, a broadly parallel shift in

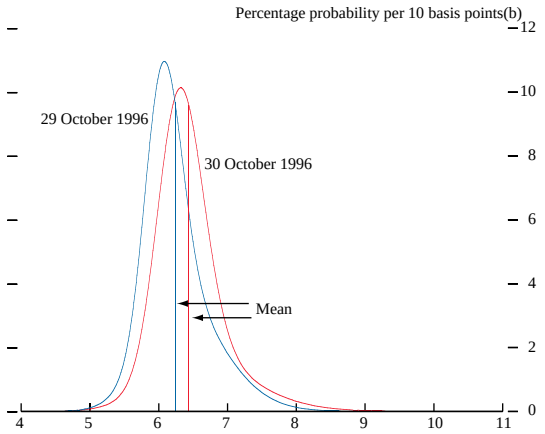
(1) Black, F and Scholes, M, (1973) 'The pricing of options and corporate liabilities', *Journal of Political Economy*, Volume 81.
(2) Technically these techniques permit recovery of a 'risk-neutral' probability density function. To the extent that investors are risk-averse the implied risk neutral distribution may diverge from the 'true' probability distribution perceived by investors.
(3) The details of the estimation procedure the Bank uses to construct these PDFs is set out in an article entitled 'Probability distributions of future asset prices implied by option prices' in the August *Quarterly Bulletin*, 1996, pages 299–311, and in 'Implied risk-neutral density functions from option prices: theory and application', Bank of England *mimeo*, both by Bhupinder Bahra. PDFs were also discussed in a box 'Short-term interest rates in the United Kingdom and Germany: estimating market expectations', in the August 1996 *Inflation Report*.

injected net liquidity of £2.7 billion and £1.0 billion at these two rollovers, which represented 53% and 33% respectively of the liquidity bid for. A further net increase in the liquidity via the facility at the rollover on 6 November took the total amount outstanding to £6.5 billion, which was both the highest amount provided by way of the facility for the year, and since the facility

the implied forward curve of approximately 20 basis points resulted. The implication of this is that the market was surprised by the timing of the authorities' decision to increase rates. This conclusion is also supported by market commentary at the time.

But it would also be useful to know additional information such as whether the probabilities of future changes were also altered by the rate move. In other words, did traders expect that a further rate rise was more likely following the decision to raise rates? Chart B shows the implied PDFs calculated using the option contract expiring in March 1997 based on LIFFE settlement prices for 29 and 30 October. Chart C gives the implied distribution for options expiring in June 1997 calculated on the same dates.

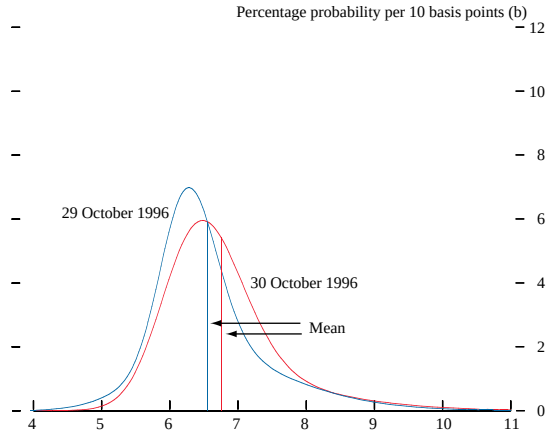
Chart B
Implied distribution for three-month sterling interbank rates at March 1997(a)



(a) At close of business on 29 October and 30 October 1996.
(b) The probability density indicates the likelihood of particular events occurring. Thus the probability density associated with interest rate *x* is approximately equal to the probability of the outcome lying in a corridor 5 basis points either side of *x*. Moreover, the probability of the rate lying between *x*% and *y*% at the terminal date is given by the area under the probability density curve between these two points. The area under the whole curve is always 100%.

Like the mean outcome implied by futures prices, the implied distributions shifted significantly following the change in the base rate. The vertical lines represent the mean of the distribution. This should in theory be equal to the mean interest rate implied by the short sterling futures price underlying the option contract. It is no surprise then that the effect of the base rate change was to shift the means of the distributions to the right by approximately 20 basis points in a manner entirely consistent with the upwards shift in the implied forward curve. The added value of estimating these PDFs though, lies in examining the evolution of the probabilities attached to outcomes either side of the mean.

Chart C
Implied distribution for three-month sterling interbank rates at June 1997(a)



(a) At close of business on 29 October and 30 October 1996.
(b) See footnote (b) to Chart B.

The charts show that the distributions are positively skewed. Intuitively, this means that the market attaches higher probabilities to the interest rate being much higher than the mean for the future date than it does to it being an equivalent amount lower. Another feature is that the distributions are flatter as the time-to-maturity of the options increases. This makes sense since the market is likely to be more uncertain as to the level of future interest rates the further into the future one looks.

For the March 1997 contract the market appears to have changed its assessment between 29 and 30 October by reducing the probabilities associated with rates being less than 6.25% at that date and increasing the probabilities associated with rates being greater than 6.25%, particularly in the range from 6.25% to 7.25%. This suggests that the market perceived an increased chance of further increases in official rates following the rise on 30 October. A similar picture emerges for the June 1997 distribution. In this case the market increased the probabilities it attached to interest rates lying above 6½%, and reduced the probabilities attached to interest rates lying between 5½% and 6½% in particular. An interpretation of this is that, following the October rate rise, the market perceived a higher probability of there being relatively large increases in interest rates by June.

was introduced on a formal basis in January 1994. The Bank also relieved some of the anticipated pressure on the size of the daily money-market shortages by reducing the size of the weekly Treasury bill tender, from £400 million to £200 million, with effect from 11 October, taking the size of the weekly tender to its lowest level for the year.

The Bank of England's operations in the sterling money markets

On 4 December the Bank published proposals for changes in its daily operations in the sterling money markets, through which it implements monetary policy. On 20 December it issued for consultation a draft operational notice for these operations and a draft legal agreement for counterparties. The Bank received helpful comments from a wide range of participants in the sterling markets, many of which are reflected in its definitive plans published on 4 February. The Bank plans to start the new operating arrangements on 3 March.

The Bank's plans take account of the successful development of the gilt repo market,(1) which began operating in January 1996. Gilt repo has developed to the point where it has become, in essence, a modern form of secured money, appropriate to be used in the Bank's daily operations in the money market. In addition, the Bank will broaden the range of counterparties able to participate in its daily operations, and make some technical changes to its late lending arrangements. These developments, though evolutionary in character, nonetheless represent a substantial development of the Bank's operations to take account of the changing market environment. The Bank believes that they will have the effect of enhancing the scope for banks and other sterling market participants to manage their day-to-day liquidity and, more generally, foster the continuing development of efficient and competitive sterling money markets.

Changes to daily open market operations

The Bank will extend its daily open market operations to include gilt repo, as well as continuing operations, as at present, in Treasury bills and eligible local authority and bank bills; in addition, marketable HM Government foreign currency debt may be used. The Bank will invite its counterparties to bid for funds by way of repo of gilts, eligible bills and/or marketable HM Government foreign currency debt, and/or outright sale of eligible bills. The maturity for the Bank's operations in repo will be around two weeks, although there may be minor variations from day to day in order to smooth the future pattern of daily shortages/surpluses; the Bank will be prepared to purchase outright eligible bills with a residual maturity up to the longest-dated repo invited. The Bank will also change the timing of its afternoon operation: in recent years the need for market participants to be active in managing their liquidity right up until market trading ends for the day suggests that the current time of 2.00 pm is earlier than is desirable. Following consultation with the market, the Bank has decided to move its afternoon operation to 2.30 pm.

Counterparties

The Bank will broaden the range of counterparties able to participate in its daily open market operations, to include market participants active in the gilt repo and/or bill markets. The Bank's present main counterparties are the discount houses, all of which are active participants in the bill and/or gilt repo markets. In future, banks (including discount houses), building societies and securities firms who wish to participate in the Bank's daily operations may do so, provided they meet certain functional requirements. These are that they:

- have the technical capability to respond quickly and efficiently to the Bank's operations;
- maintain an active presence in the gilt repo and/or bill markets, thus contributing to the distribution of liquidity around the system;
- participate regularly in the Bank's operations; and
- provide the Bank with useful information on market conditions and developments.

There will be no requirement for the Bank's money-market counterparties to be separately capitalised or specialist entities, and there will be no special supervisory arrangements for counterparties *per se*; prudential oversight of their activities as a whole will remain with their existing supervisor. The Bank will not publish a list of its money-market counterparties. The Bank is also ending its separate capitalisation requirement and the associated specialist supervisory arrangements for the gilt-edged market-makers.(2)

End-of-day arrangements

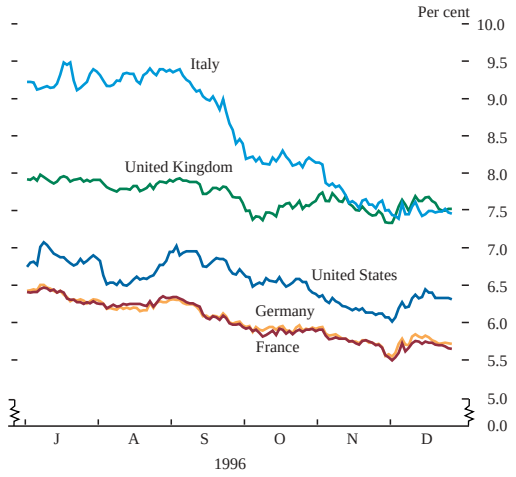
The Bank will make changes to its existing late lending arrangements, through which it is prepared, within limits, to lend secured money at the end of the day to adjust for any late imbalance in the market. Moving the final round of open market operations from 2.00 pm to 2.30 pm should reduce the need for access to late financing from the Bank. Nevertheless, because late imbalances can inevitably arise, there will be a need for some form of late financing for the settlement banks, which provide wholesale payments services to the rest of the market and which need to balance their settlement accounts at the Bank at the end of the day. The Bank will therefore provide a late financing facility for the settlement banks in the form of overnight repo and, for a transitional period, it will continue to provide a similar facility for the discount houses.

Next steps

Discussions have been held with a number of institutions which have expressed an interest in becoming counterparties. There is no presumption that all potential money-market counterparties must be ready to participate by the start date: the Bank will be prepared to take on new counterparties which fulfil the criteria at any time. Institutions which are interested in becoming counterparties should contact the Head of Gilt-Edged & Money Markets Division at the Bank.

(1) The introduction and development of the gilt repo market are described in articles in the May and November 1996 *Quarterly Bulletin*, and in boxes in the August and the current edition of this article.
(2) The removal of the requirement for gilt-edged market-makers to be separately capitalised is discussed in the article, 'The gilt-edged market: developments in 1996', pages 63–74.

Chart 12
Ten-year benchmark yields(a)



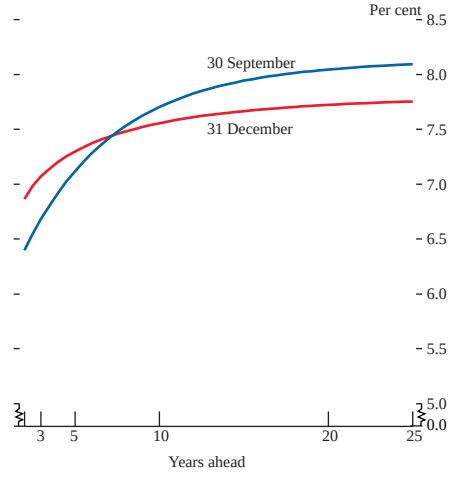
(a) Gross redemption yields on a semi-annual basis.

Table E
Total unhedged return on ten-year government bonds (in sterling terms), 30 September to 31 December 1996

Per cent

	Security component	Currency component	Total return in sterling terms
UK Gilts	2.98	0.0	2.98
US Treasuries	4.38	-8.64	-4.64
German Bunds	3.59	-9.55	-6.30
French OATs	4.04	-9.22	-5.55

Chart 13
Gilt par yield curves



Gilt yields and inflation expectations(1)

Ten-year government bond yields fell in all G7 countries. US Treasuries benefited from the better-than-expected prospects for US inflation, and German bunds from continued evidence of non-inflationary economic growth, and later from a perception that actual growth might be below market expectations. The government bonds of the previously 'high-yielding' EU countries significantly outperformed those of 'core' countries, although the rate of this outperformance slowed towards the end of the period.

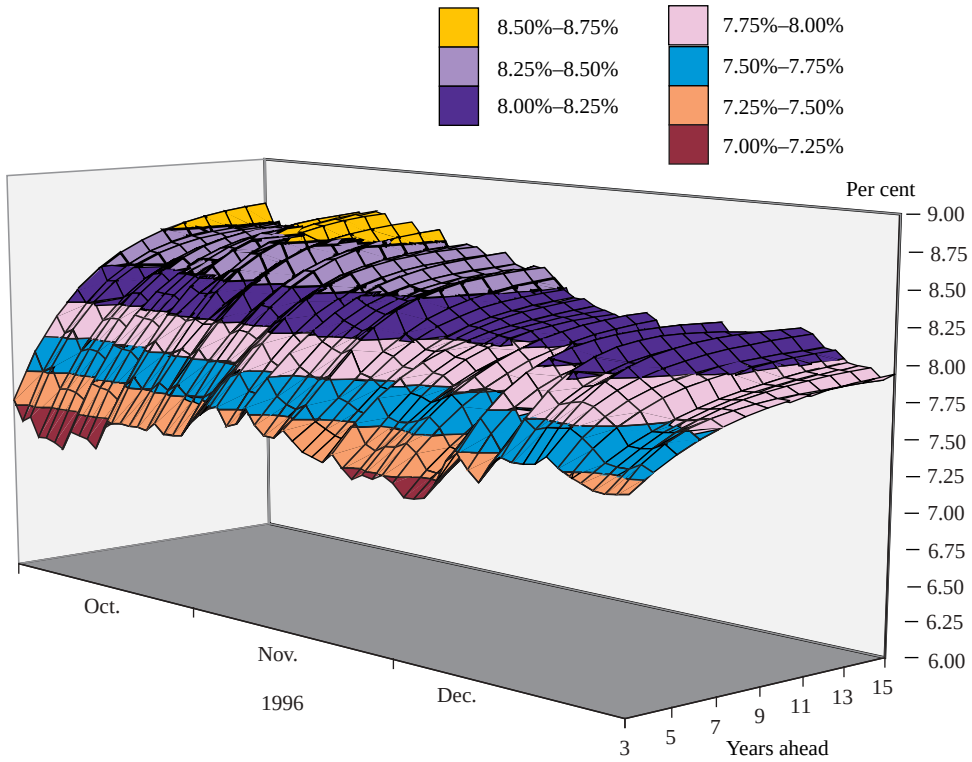
The gilt market underperformed other major government bond markets when performance is measured in terms of changes in yields, although gilt yields did decline at longer maturities over the period. Table E shows that, while ten-year gilts underperformed other major markets in domestic currency terms, one result of sterling's strong and broad-based appreciation was that they outperformed when the performance is measured in terms of total return—that is, taking into account the change in price, plus the reinvestment of any coupon paid on the bond, plus the change in the value of the currency.

Over the period as a whole, the yield curve flattened: short-term yields rose while those at longer maturities fell. The yield on ten-year gilts declined by 12 basis points to 7.48% by the end of December. Gilts participated in the international rally in bond markets in early October which followed the decision by the FOMC to leave US official interest rates unchanged at its September meeting. But sentiment in the gilt market turned in October following the release of domestic inflation and employment data. Following the 25 basis point rise in UK official interest rates on 30 October, yields rose across much of the curve but by rather more at the short end, resulting in a significant flattening of the curve. The gilt market rallied in November and early December, with declining yields on European bonds, the strength of the exchange rate and an unexpectedly large public sector debt repayment in October being supportive factors. The UK Budget, which was presented on 26 November, resulted in very little change in gilt yields. Yields rose slightly towards the end of the period, however, as government bond markets worldwide interpreted remarks by the Chairman of the US Federal Reserve Board as suggesting that asset prices might be overvalued, and, later, to a series of stronger-than-expected US economic data.

While longer-term par yields declined by less in the United Kingdom than in the United States and Germany, UK six-month implied forward rates at five and ten years fell by more than in these countries. Over the period as a whole, UK six-month implied forward rates declined by 43 basis points at five years, and by 76 basis points at ten years. That compares with declines of 30–35 basis points at five and ten years in both the United States and Germany. At the end of the period, the UK six-month implied forward rate at ten years was 7.88%, compared to 7.68% for Germany. Thus, while the market revised up its expectation for the path of UK short-term interest rates in the near future, it implicitly revised down its expectation of the path of short-term interest rates further out. This is consistent with the decline of 12 basis points

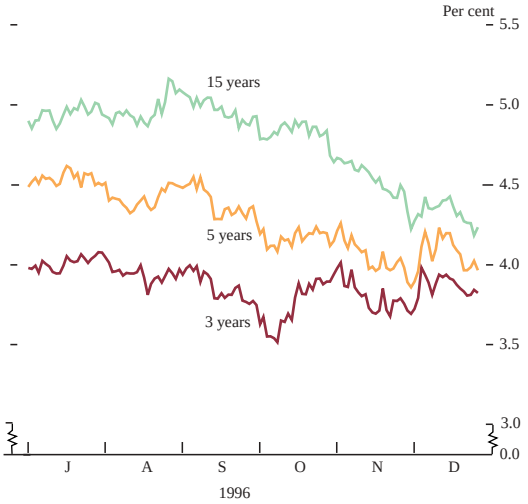
(1) Developments over 1996 as a whole are described in 'The gilt-edged market: developments in 1996', pages 63–74.

Chart 14
UK six-month implied forward rates



This 3D surface illustrates how the implied forward rate curve has evolved day by day. The shading emphasises the level of forward rates at any given point on the surface. The implied forward rates are annualised six-month interest rates derived from the zero-coupon yield curve.

Chart 15
Inflation expectations at 3, 5 and 15 years(a)



(a) Implied annualised inflation in the six-month period beginning 3, 5 and 15 years ahead.

over the period in the ten-year par yields (the ten-year par yield reflects the geometric average of the path of expected short-term interest rates over the next ten years).(1)

The flattening of the yield curve in this period was reflected in a flattening of the implied forward inflation expectations curve. Short and longer-term six-month forward inflation expectations converged towards 4% by the end of the period, with the short-term expectations rising and longer-term expectations falling significantly: three-year expectations rose by 5 basis points to 3.82% by the end of the period, while five-year expectations fell by 40 basis points to 3.97% and 15 year expectations fell by over 70 basis points to 4.17%.

Gilt financing

Gilt sales and financing requirement

Following the Budget, the gilt sales requirement for the 1996/97 fiscal year was revised downwards slightly, from £39.9 billion as at end-September to £38.4 billion. As Table G shows, the main factor behind the lower requirement for gilt sales was the increase in the assumed contribution from sales of National Savings products, reflecting their strong performance. There was also a small reduction in the CGBR forecast for the year.

Gilt sales in the fiscal year to the end of December amounted to £29.1 billion, of which 17.5% was raised through index-linked

(1) The decomposition of ten-year yields and yield differentials are discussed in an article 'Recent yield curve behaviour—an analysis' by Bill Allen on pages 43–8.

Table F
Official transactions in gilt-edged stocks

£ billions: *not seasonally adjusted*

	1996/97 Apr.–Sept.	1996/97 Oct.	Nov.	Dec.
Gross official sales (+) (a)	22.3	4.1	0.2	2.5
Redemptions and net official purchases of stock within a year of maturity (-)	-3.1	0.0	-4.4	0.0
Net official sales (b)	19.2	4.1	-4.2	2.5
of which net purchases by:				
Banks (b)	1.4	0.3	-2.1	0.9
Building societies (b)	0.4	0.5	-0.9	0.2
M4 private sector (b)	12.9	0.3	-2.0	2.5
Overseas sector	3.8	2.9	0.9	-0.9
LAs and PCs (c)	0.8	0.2	0.0	-0.3

(a) Gross official sales of gilt-edged stocks are defined as official sales of stock with over one year to maturity net of official purchases of stock with over one year to maturity apart from transactions under purchase and resale agreements.
(b) Excluding repurchase transactions with the Bank.
(c) Local authorities and public corporations.

Table G
1996/96 financing requirement

£ billions

	Original remit	At end-Sept.	Post-Budget
CGBR forecast	24.1	28.1	27.9
Net change in official reserves	0.0	0.0	0.0
Gilt redemptions	11.5	12.5	12.5
Under/overfund from 1995/96	0.0	2.1	2.2
Financing requirement	**35.6**	**42.7**	**42.6**
Assumed contribution from National Savings	3.0	3.0	4.5
Expected contribution from certificates of tax deposit	0.0	-0.2	-0.3
Gilt sales required	**32.6**	**39.9**	**38.4**

sales and the remainder through conventionals. The maturity distribution of conventional sales reflected the pattern of auctions to end-December, being skewed away from medium-dated stocks (which were auctioned twice in the first nine months of the fiscal year, and accounted for 23% of conventional gilt sales) and towards short and long-dated stocks (which were each auctioned four times, and accounted respectively for 41% and 36% of conventional gilt financing). For the fiscal year as a whole, the government's remit specified that the Bank would aim to distribute conventional gilt sales roughly equally across the three maturity bands; this aim was reflected in the maturity ranges announced at the end of December for auctions in the last quarter of the fiscal year. The schedule included two issues of medium-dated stocks, and one each of short and long-dated.

Auctions

The results of the auctions held in October and December are summarised in Table H. As usual, no auction was held in November on account of the Budget.

October was the second of the 'dual' auctions scheduled for the year, the first having been held in July. The authorities repeated the basic pattern of the successful July auction, auctioning a total of £3.5 billion (less than the maximum £4 billion allowed under the remit), by combining two stocks at near-opposite ends of the maturity spectrum—the 7% Treasury 2001 and the 8% Treasury 2015. This was intended to maximise the potential appeal across different investors, and also had the effect of weighting the amount of issuance towards the shorter-duration, less risky stock. The results of the auctions were encouraging in that both generated very high levels of bidding and tight pricing, as evidenced by the cover and 'tail' statistics. Demand appears to have been stimulated by the perceived attractiveness of gilts relative to other markets at the time; in the run-up to the auction, European government bond prices trended higher while gilts tended to fall, and on the eve of the first auction the ten-year yield spread between gilts and bunds stood at 171 basis points, having dipped below 150 basis points earlier in the month. Perhaps more significant than the cover and tail statistics, however, was the fact that market participants appear

Table H
Gilt issuance

Date	Stock	Amount issued (£ millions)	*Of which, to CRND*	Price at issue (per £100 stock) (a)	Yield at non-competitive allotment price (b)	Yield at issue	Yield when exhausted (c)	Average yield (d)	Cover (e) at auctions	Tail (f) at auctions (basis points on yield)	Date exhausted
Auctions of Conventional stock											
22.10.96	7% Treasury Stock 2001	2,000	*0*	99.53125	7.10	n.a.	n.a.	n.a.	3.57	0	22.10.96
24.10.96	8% Treasury Stock 2015	1,500	*0*	101.34375	7.86	n.a.	n.a.	n.a.	2.66	0	24.10.96
4.12.96	7% Treasury Stock 2002	2,500	*0*	99.40625	7.13	n.a.	n.a.	n.a.	1.70	2	4.12.96
Tap Issues of Conventional Stock (including to CRND) (g)											
28.11.96	7¾% Treasury Stock 2006	100	*0*	101.96875 (h)	n.a.	7.46	7.46	7.46	n.a.	n.a.	28.11.96
Tap Issues of Index-Linked Stock											
15.10.96	2½% Index-linked 2001	150	*0*	185.5625	n.a.	3.10	3.09	3.09	n.a.	n.a.	15.10.96
15.10.96	2½% Index-linked 2013	150	*0*	146.3125	n.a.	3.50	3.50	3.50	n.a.	n.a.	15.10.96

n.a. = not available.

(a) Non-competitive allotment price.
(b) Gross redemption yield per cent based on the weighted average price of successful competitive bids.
(c) Gross redemption yield or real rate of return (assuming 5% inflation) based on the price when the issue ceased to operate as a tap.
(d) Weighted average gross redemption yield or real rate of return (assuming 5% inflation), based on actual price at which issues were made.
(e) Total of bids divided by the amount on offer.
(f) Difference in gross redemption yield between the weighted average of successful competitive bids and the lowest accepted competitive bid.
(g) Various official funds under the management of the Commissioners for the Reduction of the National Debt.
(h) Issued with no minimum price.

to have focused on the second of the two auctions in advance of the first taking place, whereas in July there had been very little pre-auction positioning in the second of the stocks until the day before the auction. This might indicate some increasing confidence on the part of the market in its approach to dual auctions, although at present there is only a small sample on which to judge.

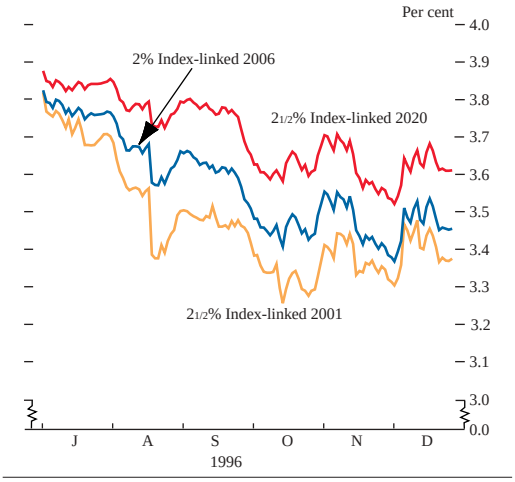
A new short-dated stock was introduced at the December auction, and was intended to provide a new benchmark for the market in the five-year area. The remit had specified that the strippability of new short-dated conventional benchmarks would be decided on a case-by-case basis; in the event, the authorities decided that, having issued largely into non-strippable issues at the short end of the curve in the year to date, the new benchmark should be strippable. The amount to be auctioned, £2.5 billion, was lower than the average in the year to date, reflecting the downwards revision to the gilt sales requirement following the Budget. Although the gilt/bund spread, particularly in the five-year area, was thought by the market to remain at attractive levels, in the event this was not a predictor of strong demand; cover (1.7 times) was below the average for the financial year to date, and the tail (2 basis points) was slightly wider. However, the cover was in line with the long-term average (going back to 1991) for new stocks: historically auctions of new stocks have on average generated slightly lower volumes of bidding, perhaps because fear of the 'loser's curse'—opening up a short position and then failing to cover it in the auction—is likely to be strongest when the auction represents the only available supply of stock. Certainly a number of auction participants were cautious about opening shorts in the light of the stock's expensiveness in the repo market prior to auction—although, as noted in the article on the gilt-edged market in 1996 in this *Bulletin*, there does not as yet appear to be any consistent relationship between the repo behaviour of auction stocks and the auction's outcome. December auctions have historically generated lower cover than the long-term average, perhaps related to caution ahead of year-ends for some market participants. However, the sample of December auctions is very small and it is not therefore possible to draw firm conclusions on this point.

On 30 December the authorities announced the maturity ranges of auctions during January-March 1997, consisting of a new medium stock in the range 2006–2008 inclusive and a short stock in the range 2001–2003 inclusive for the dual auction on 28 and 30 January; a long stock in the range 2021 or after for 26 February; and a medium stock in the range 2006–2008 inclusive for 26 March.

Conventional taps

One conventional stock was tapped in the quarter, with an issue of £100 million of 7¾% 2006 on 28 November. The stock was particularly tight in the repo market at the time, and there had been a large volume of failed deliveries. Being a relatively small amount of stock, the new issue was placed in the 'Shop Window' (ie advertised for sale on the Bank's screen pages), the key difference between this and the usual tap procedures being that no minimum price was assigned to the issue. The issue was exhausted in an initial tender at a 3/32 premium to the middle-market screen price at the time of announcement.

Chart 16
Yields on index-linked government stock



Index-linked gilts

Real yields on index-linked government stock at different maturities had diverged earlier in the year. In the fourth quarter the shape of the real yield curve was little changed, and real yields fell slightly at all maturities. The pace of index-linked sales slowed in this period, following the rapid progress made in the first six months of the financial year towards achieving the annual sales target for indexed gilts (15% of total gilt sales), and also reflecting the reduction in the overall gilt sales requirement after the Budget. Only one package of taps was brought, for a total of £300 million in nominal terms (see Table H for details). The issues were exhausted on the same day. Index-linked sales raised £0.8 billion in total during the quarter, taking sales for the first nine months of the financial year to £5.1 billion, or 88% of the annual target.

Sectoral investment activity

At £2.4 billion, net investment in gilts in this quarter was lower than in the two preceding quarters, reflecting the weight of redemptions. These included £1 billion of 6¾% 1995–98 stock called for early repayment on 1 November. Within sectors, net purchases by the overseas sector were very robust, amounting to more than total net sales during the quarter. This reflected strong net purchasing in October and November, which might in turn have stemmed from a variety of factors, including the general attractiveness of gilts and other sterling assets to overseas buyers (where there was widespread anecdotal evidence of strong interest from outside Europe, in particular Japan), and the pattern of holdings of redeemed stocks (the overseas sector is unlikely to have been significant holders of the stocks, the larger of which was non-FOTRA).

ONS statistics for institutional investment for the quarter July-September now provide further detail on the very heavy net purchases by the domestic non-monetary sector during that period. In a quarter where net investment overall by pension funds and long-term insurers was at very high levels, net investment into gilts by these two sectors remained very strong, at £1.5 billion and £2.8 billion respectively.

Technical developments[1]

The Bank announced on 3 December that it was putting back its target date for the introduction of the upgraded Central Gilts Office (CGO) system to 26 August 1997. The extension to the timetable was agreed partly in order to allow members to concentrate resources on the phased introduction of CREST; and also to allow sufficient time for a stable upgraded CGO system to be available for trialling, to enable CGO members to feel confident of a smooth transition to the new system.

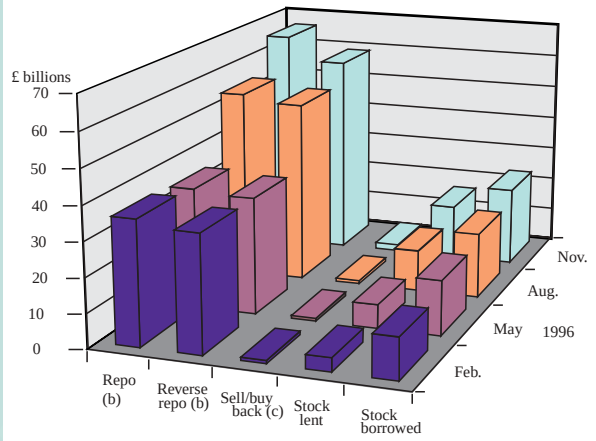
On 4 December the Bank published a consultation paper setting out its proposals on developments to its operations in the sterling money markets (see the accompanying box on page 12). One of the Bank's proposals was that, at the time of the inception of the new operating arrangements, the requirement on its counterparties in both its money-market and gilt-edged operations to be separately

(1) The upgrade to the CGO system and the proposal to end the separate capitalisation requirement for gilt-edged market-makers are described more fully in 'The gilt-edged market: developments in 1996', pages 63–74.

Recent developments in the gilt repo market

The gilt repo market grew nearly 20% in the quarter to end-November, following growth of around 55% in the previous quarter, taking the total amount outstanding to over £65 billion,(1) as measured by data submitted to the Bank on a voluntary basis by market participants. There was also further growth in stock lending, with the reported figure growing by around 25% to about £23 billion outstanding. The combined total of all outstandings of repo-like activity reported to the Bank by around 85 institutions reached nearly £84 billion.

Chart A
Outstanding amounts reported to the Bank(a)



(a) Transactions entered into, but for which the second leg has not yet settled.
(b) Sell/buy back and buy/sell back transactions conducted under an annex to the Gilt Repo Legal Agreement are included under repos and reverse repos respectively.
(c) The reported levels of sell/buy backs and buy/sell backs are very similar.

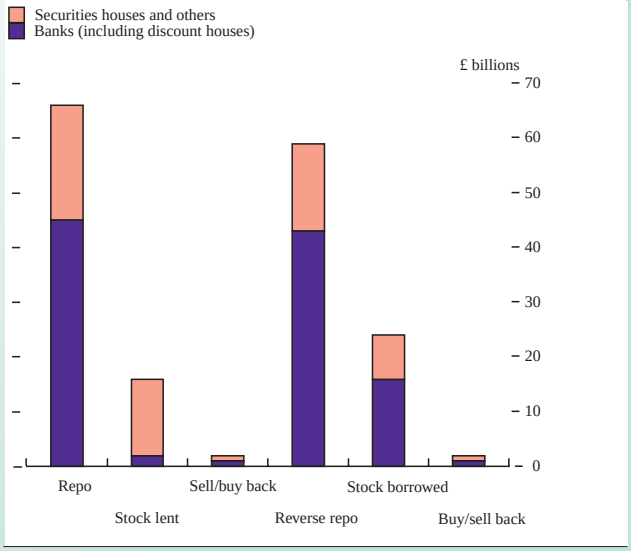
Data on the outstanding amounts of gilt repo reported to the Bank will in future be published in the Bank's new monthly publication, *Bank of England: Monetary and Financial Statistics (Bankstats)*, first issued in January 1997. New data will be available in the April edition, showing data for end-February, and quarterly thereafter, although any revisions to back data will, of course, be included in *Bankstats* in the intervening months. In future, therefore, new data on the size of the gilt repo market will first be available in *Bankstats*.

The November monetary statistics compiled by the Bank reflected the rising trend in the market as a whole. At the end of November 1996, gilt repos reported on banks' and building societies' balance sheets reached £40 billion, up around 21% from August, and reverse repos rose to £43 billion, up nearly 8%. Unlike the data reported to the Bank on a voluntary basis, which are reported gross, the balance sheet data may be reported net of offsetting transactions with the same counterparty where the maturity of the reverse repo is less than or equal to that of the repo, in line with accounting conventions. The December monetary statistics showed a fall in both repo and reverse repo outstandings, to £29 billion and £32 billion respectively. The fall was consistent with market reports of reduced activity in December, and is believed to be partly due to end-of-year balance sheet adjustments made by numerous financial institutions and their banking counterparties, and also due to the decline in trading activity in repos and other instruments over the holiday period.

On 4 December, the Bank published proposals for changing its daily money-market operations, which included broadening the range of instruments to include gilt repos and extending its range of counterparties (see the box on page 12). This led to increased interest in the gilt repo market, with numerous enquiries being made to firms active in gilt repo. However, December is traditionally a quiet period in both bond and money markets, and this interest did not translate into increased activity in the short term. Over the longer term, it is widely expected that the Bank's proposals will contribute to the further growth of the gilt repo market. This is likely to arise both as a result of increased gilt repo activity by direct counterparties to the Bank's daily operations, and as the Bank's counterparties transform the system liquidity provided by the Bank into the maturities desired by the market.

Data to end-November show that banks, including the discount houses, continue to account for the largest share of gilt repo activity and outstandings (see Chart B). The discount houses as a group have a substantial share of banks' repo business. Securities houses' activity has continued to increase, and other types of institution are becoming more actively involved. Provision of data by institutional investors (or their fund managers) remains limited, and continues to be the main reason for the

Chart B
Outstanding amounts by practitioner



(1) The comparable figure for end-August has been revised down from £58 billion to £55 billion, following corrections to previously submitted figures. Figures reported here were correct at the time of going to press.

discrepancy between reported stock lending and borrowing, as institutional investors remain the main lenders of stock into the market.

Table A
Outstanding amounts at end-November 1996 by residual maturity(a)

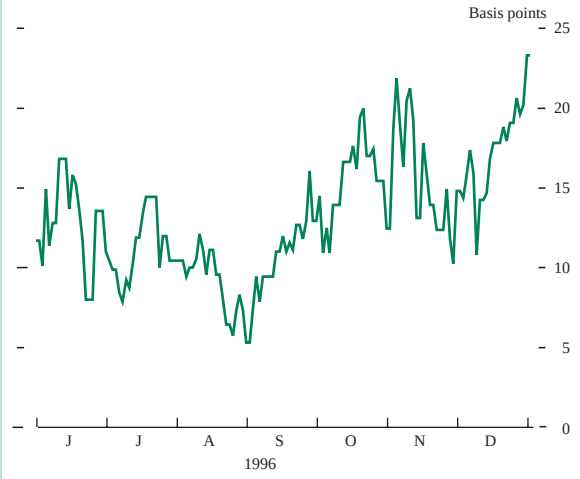
£ billions

	On call and next day	2–8 days	9 days–1 month	1–3 months	3–6 months	Over 6 months	Total
Repo	12	24	14	13	1	1	66
Stock lent	12	2	1	1	0	0	16
Sell/buy back	0	1	1	1	0	0	2
Total out	**25**	**27**	**15**	**14**	**1**	**1**	**84**
Reverse repo	13	20	12	12	2	1	59
Stock borrowed	15	4	3	1	0	0	23
Buy/sell back	0	1	0	0	0	0	2
Total in	**28**	**25**	**15**	**13**	**2**	**2**	**84**

(a) Totals may not sum due to rounding.

The end-November snapshot of the residual maturities of repo trades outstanding showed a marked increase in the value of trades with one to three months' and two to eight days' remaining maturity, while the proportion of nine-day to one-month trades outstanding fell. Reported turnover in repo during the quarter reached nearly £18 billion per day, up from around £15 billion previously. There was an increase in the proportion of turnover in maturities longer than eight days; up from 8% to 11%. The average reported transaction size in repos was around £38 million, and £37 million in reverse repos; although much larger trades are common in repo as a general collateral money-market instrument, the *average* size reflects the inclusion of special repo trades (in scarce stocks), the size of which tends to be much smaller.

Chart C
Three-month interbank rate minus three-month gilt repo general collateral rate(a)

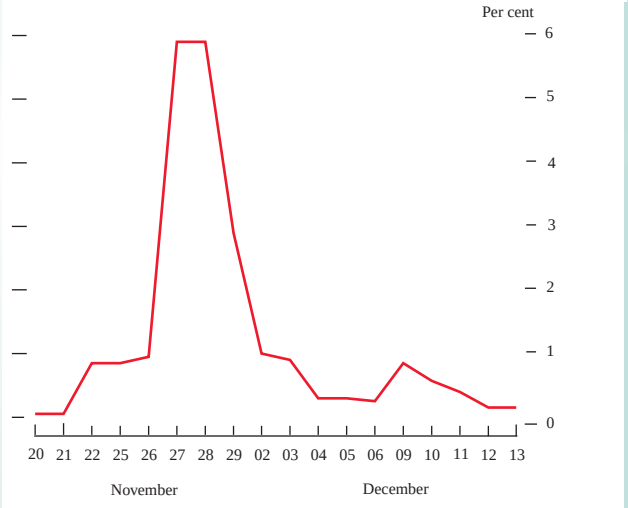


(a) Middle rates collected by the Bank at 10.15 am. Data on GC rates are now available monthly in *Bankstats*.

Three-month general collateral (GC) rates continued to trade at several basis points below the comparable interbank rate in the final months of 1996. This became more pronounced towards the end of December, when demand for year-end liquidity caused interbank (unsecured finance) rates to be bid up, meaning that secured funds could be obtained at a greater discount than usual to unsecured money. The reduced demand for repos (evident in the monetary statistics) may also have tended to depress GC rates.

Several scarce stocks traded special (at a premium to GC) for short periods in the final quarter of 1996. In particular, there was a lot of activity in 7¾% 2006 in late November, when there was an increase in demand for the stock, mainly because investors switched out of a similar maturity stock as it approached its ex-dividend period. Market-makers and others, having sold the stock to meet this demand, then sought to cover their short positions in the repo market. However, a large proportion of the stock was apparently held by investors who do not currently lend or repo their stock, limiting its supply to the market, and causing the special rate to trade at close to 0% and the failure of some trades to be settled. In response to this excess demand, the Bank issued a small amount of stock to help relieve the market's temporary difficulties, selling £100 million of the stock on 28 November.

Chart D
Special rate on 7¾% 2006(a)



(a) Indicative one-week special rate, expressed in basis points below the prevailing one-week general collateral repo rate.

At the start of 1997, there was tightness in 6¾% 2004, and some market participants again reported that there had been cases of counterparties failing to deliver stock in accordance with their contractual obligations. Such failures to deliver remain very unusual in the cash gilt and gilt repo markets. Market participants are advised by the Gilt Repo Code of Best Practice to sub-divide any large trades into smaller sizes, to reduce the risk of non-receipt of a small amount of stock resulting in a failure to deliver onwards a larger volume of stock to a further counterparty. The Code also makes clear that market participants are free to agree to accept partial deliveries of stock.

The May *Quarterly Bulletin* will have a full-length article covering the current size and structure of the gilt repo market, and developments in the market in its first full year.

capitalised and subject to specially tailored supervisory arrangements should cease.

A further conversion offer between two stocks was announced on 29 October. As with the offer made in August, its purpose was to build up the pool of strippable stocks in advance of the strips market starting. The offer involved converting out of 12% Exchequer Stock 2013–17 into the strippable 8% Treasury Stock 2015, with terms being fixed on 12 November and the offer closing on 3 December. As before, the vast majority of holders by value chose to accept the offer, with a take-up rate of 94.3%. Nearly £1.3 billion was added to the strippable stock, while the source stock was reduced to below £100 million, putting it on the list of small illiquid stocks for which the Bank is prepared to offer a price to market-makers to ensure that a bid price is always available for remaining investors. In total the two conversion offers have added nearly £2.8 billion to the pool of strippable stocks.

UK Government ECU issuance

The United Kingdom continued to hold regular monthly tenders of ECU 1 billion Treasury bills during this period, comprising ECU 200 million of one-month, ECU 500 million of three-month and ECU 300 million of six-month bills. The tenders continued to be oversubscribed, with issues being covered by an average of 3.0 times the amount on offer. For 1996 as a whole, average cover was 2.5 times, compared with an average of 2.4 times in 1995. Within this period, bids were accepted at average yields up to 14 basis points below the ECU Libid rate of the appropriate maturity, with bidding particularly strong in the December tender. There are currently ECU 3.5 billion of UK Government Treasury bills outstanding. Secondary market turnover in this period averaged just over ECU 2 billion per month, unchanged from the levels of activity seen earlier in the year.

On 15 October, the Bank reopened the United Kingdom's ECU Treasury Note maturing in 1999 with a further tender for ECU 500 million, raising the amount outstanding with the public of this Note to ECU 2.0 billion. There was strong cover at the auction of over five times the amount on offer, and accepted bids were in a tight range of 4.38%–4.39%. The total of Notes outstanding with the public under the UK ECU Note programme thus rose from ECU 6.0 billion to ECU 6.5 billion.