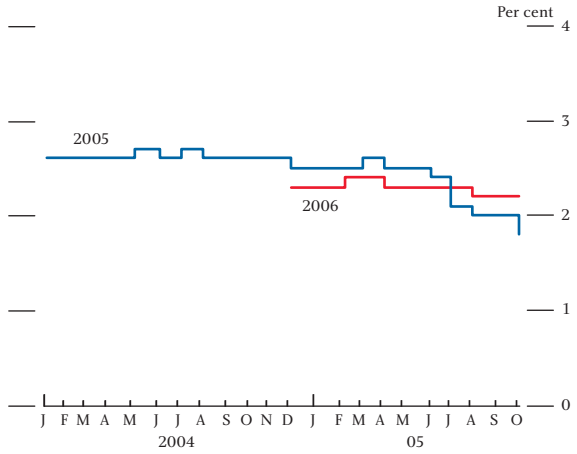
# Markets and operations

*This article reviews developments since the Autumn* Quarterly Bulletin *in sterling markets, UK market structure and in the Bank's official operations.*(1)

- *Short-term nominal sterling interest rates rose, reversing the falls in forward rates observed earlier in the year. This was part of a global upward revision to near-term interest rate expectations.*
- *But long-term nominal and real sterling forward rates declined. Indeed, long real forward rates fell to historically low levels over the period, probably reflecting heightened UK pension fund demand for long-dated bonds.*
- *UK equity indices ended the period higher, although they had fallen sharply in October before rebounding. Alongside robust earnings growth, announcements of takeover activity may have supported share prices over recent months and helped to sustain the upward trend in UK equity prices.*
- *In effective terms, sterling depreciated, largely reflecting a fall in the value of sterling against the US dollar. Nonetheless, comparing movements over a longer window, the sterling ERI remained in a relatively narrow range.*

Economic activity data for the UK economy suggest that real GDP growth fell a little in the third quarter, reflecting erratically weak energy production. Consensus forecasts for GDP growth in 2005 have been revised down further (Chart 1). However, forecasts for 2006 have remained broadly stable, indicating that market economists continued to expect GDP growth to pick up next year. Perhaps consistent with only a temporary weakening in activity, equity prices in the United Kingdom increased over the period (Table A).

**Chart 1**
**Expected real GDP growth for 2005 and 2006**




Source: Consensus Economics.

Short-term sterling market interest rates have risen since the Autumn *Quarterly Bulletin*. By the end of the review period, the sterling futures curve was broadly flat out to the end of 2006, unwinding the downward slope that had emerged earlier in the year. These developments were part of a global upward revision to near-term interest rate expectations. With consumer price inflation having edged higher in a number of countries, market participants seem to have placed increased emphasis on the possible policy response to any signs of second-round effects on inflation of previous oil and commodity price rises.

Long-horizon sterling forward rates fell markedly. Market contacts suggest that this may have reflected increased UK pension fund demand for long-maturity index-linked

(1) This article focuses on sterling markets. The period under review is 2 September (the data cut-off for the previous *Quarterly Bulletin*) to 18 November. The reader is referred to 'Risks in the international system', Chapter 2 of the Bank of England's forthcoming *Financial Stability Review*, for a broader review of international financial markets.

### Table A
### Summary of changes in market prices

| | 2 Sep. | 18 Nov. | *Change* |
|---|---|---|---|
| **Sterling three-month interbank interest rates** (per cent)[a] | | | |
| December 2005 | 4.40 | 4.61 | *21 bp* |
| June 2006 | 4.25 | 4.57 | *32 bp* |
| **Sterling nominal forward rates** (per cent)[b] | | | |
| Three-year | 4.04 | 4.24 | *21 bp* |
| Ten-year | 4.19 | 4.17 | *-3 bp* |
| Twenty-year | 4.10 | 3.92 | *-18 bp* |
| **Equity indices** | | | |
| FTSE 100 | 5327 | 5499 | *3.2%* |
| FTSE All-Share | 2675 | 2765 | *3.4%* |
| **Exchange rates** | | | |
| Sterling effective exchange rate | 101.0 | 98.8 | *-2.1%* |
| $/£ exchange rate | 1.841 | 1.713 | *-6.9%* |
| €/£ exchange rate | 1.468 | 1.464 | *-0.3%* |

Columns may not correspond exactly due to rounding.

Sources: Bank of England and Bloomberg.

(a) Rates implied from prices for short sterling futures contracts.
(b) Instantaneous forward rates, derived from the Bank's government liability curves. Estimates of the UK curve are published daily on the Bank of England's website at www.bankofengland.co.uk/statistics/yieldcurve/index.htm.

bonds. Long-term sterling inflation expectations appear to have remained broadly stable.

## Short-term interest rates

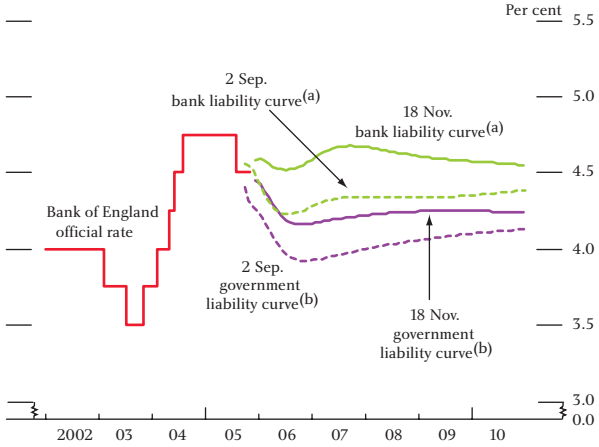
The United Kingdom's Monetary Policy Committee (MPC) maintained its official rate at 4.5% over the review period. Looking ahead, market participants revised upwards their views about the future path of sterling interest rates over the next few years, with short-term forward rates increasing by around 30 basis points.

As a result, by the end of the review period, the profile for sterling interest rates (derived from instruments that settle on Libor) was broadly consistent with market participants expecting no changes in official rates during 2006 (Chart 2).

The spread between this 'bank liability' curve and forward rates implied by general collateral (GC) repo rates and gilt yields (the 'government liability' curve) widened slightly over the period. This change appears to be linked to increased demand for short-dated gilts rather than a more general widening in the spread between secured and unsecured interest rates. As a result, the government liability curve may not currently provide a clear guide to near-term official rate expectations.(1)

In addition to nominal forward rates derived from instruments that settle on Libor, an alternative market-based measure of near-term sterling interest rate expectations can be derived from swaps linked to

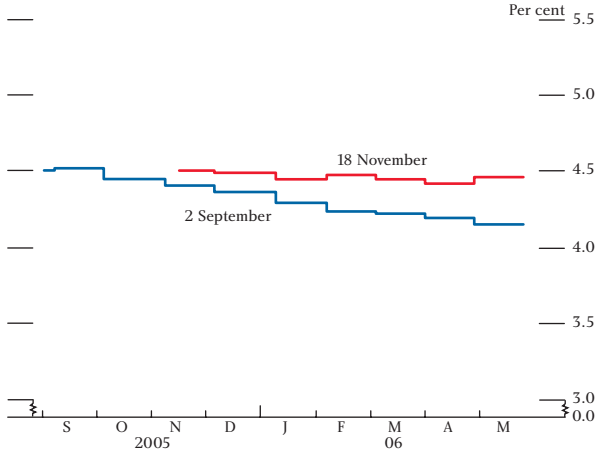
### Chart 2
### Sterling official and forward market interest rates




Sources: Bank of England and Bloomberg.

(a) One-day nominal forward rates implied by a curve fitted to a combination of instruments that settle on Libor.
(b) One-day nominal forward rates implied by GC repo/gilt curve.

### Chart 3
### Forward rates implied by sterling overnight interest rate swaps




Sources: Bank of England and Bloomberg.

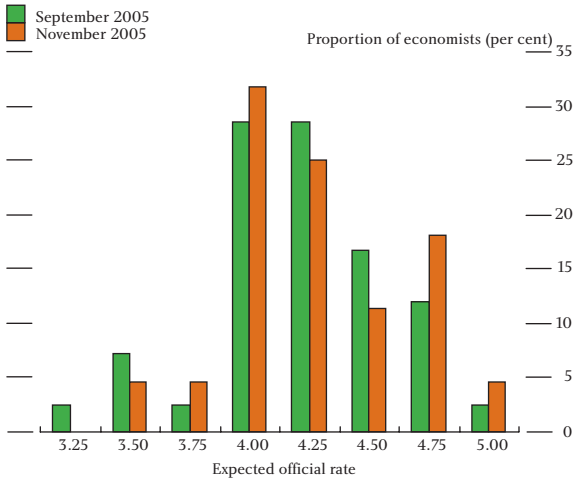
sterling overnight interest rates (SONIA). The box on pages 410–11 describes the derivation of this measure. By the end of the review period, these SONIA-based measures were also broadly consistent with little expectation of a change in official rates over the next six months (Chart 3).

In contrast, according to the survey of UK economists conducted by Reuters in November, the majority of respondents continued to expect rates to fall by the end of 2006, although there had been an increase in the proportion of economists expecting rates to rise in 2006 (Chart 4).

Implied volatility, as derived from options prices, rose somewhat, suggesting that uncertainty surrounding

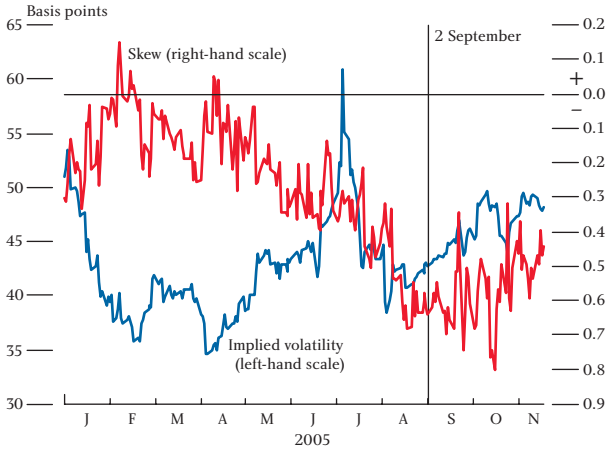
(1) See the box 'Market-based measures of interest rate expectations', on pages 404–05 of the Winter 2004 *Quarterly Bulletin*, for an explanation why short-dated gilt yields may be low relative to GC repo rates.

### Chart 4
### Economists' forecasts for the Bank of England official rate at end-2006




Source: Reuters.

### Chart 5
### Six-month implied volatility and skew from interest rate options



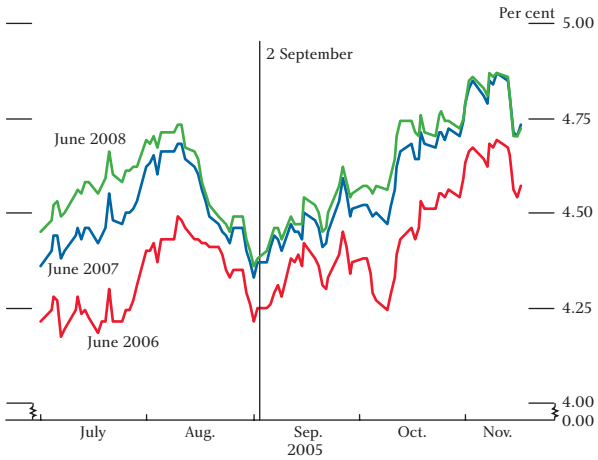

Sources: Bank of England and Euronext.liffe.

market participants' expectations for short-term interest rates increased over the review period (Chart 5). At the same time, the balance of risks to near-term sterling interest rates became a little less negatively skewed, although the risks remained to the downside.

In terms of movements through the period, sterling implied rates generally rose in October, partly in response to comments by a number of members of the MPC. But towards the end of the period, implied rates declined a little following slightly weaker-than-expected data releases and the publication of the November *Inflation Report* (Chart 6).

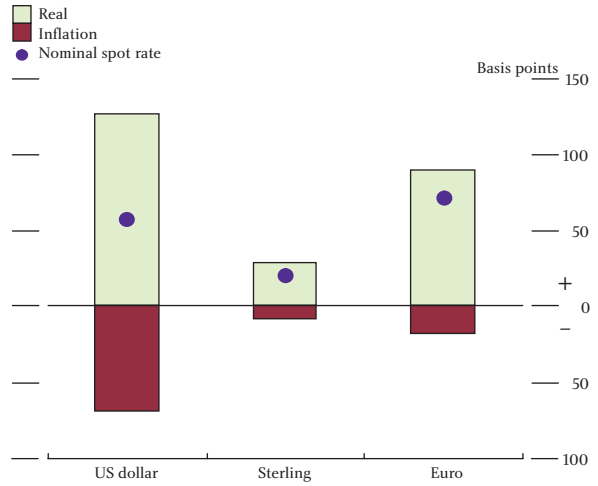
Based on the difference between nominal and index-linked gilt prices, the increase in short-term sterling nominal interest rates over the period largely

### Chart 6
### Implied sterling interest rates from short sterling futures contracts




Source: Euronext.liffe.

### Chart 7
### Changes in three-year spot rates since 2 September 2005(a)




(a) The real component of euro rates is derived by nominal government bond yields less inflation swap rates. Sterling and dollar real rates are derived from the Bank's government liability curves.

reflected an increase in short-term real rates (Chart 7). This rise may be related to global factors. Indeed, there were even larger increases in three-year real rates in the United States and euro area, consistent with expectations of increases in official interest rates in these economies.

## Longer-term interest rates

Further along the yield curve, sterling forward rates fell, with the largest declines occurring at very long horizons (Chart 8). These falls reflected some quite sharp moves in nominal gilt yields towards the end of the period (Chart 9). Indeed, on 16 November, the ten-year nominal forward rate dropped by around 12 basis points, the largest one-day fall since August 2003.

## Interest rate expectations from overnight swap rates

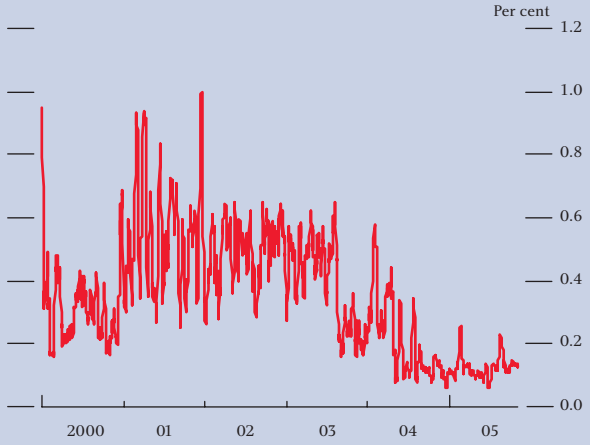
Market expectations of future official sterling interest rates can be inferred from a variety of sterling money market instruments. At short horizons, forward interest can be derived from swaps that settle on the sterling overnight index average (SONIA).(1) A SONIA interest rate swap contract (or Overnight Indexed Swap (OIS)) is an agreement between two counterparties to exchange (swap) fixed interest rate payments for floating interest rate payments. This is based on a pre-determined notional principal linked to the daily SONIA fixings compounded daily over the life of the swap.(2)

SONIA swaps are used to speculate on or hedge against the future level of overnight interest rates. Contracts vary in tenor from one week to two years, although liquidity is greatest at horizons of less than a year. SONIA swap rates should reflect market expectations of future overnight rates. As a result, forward rates derived from OISs indicate expected future interest rates at these short horizons.

Typically in the past, the spread between SONIA and the Bank's official rate has been highly volatile and, at times, fairly wide. But more recently, as has been mentioned in recent *Quarterly Bulletins*, volatility of the overnight rate relative to the policy rate has declined (Chart A). This reflects, at least in part, the interim reforms already introduced as part of the Bank's fundamental review of its official operations in the sterling money market. Indeed, the primary objective of the Bank's money market reforms is to reduce the volatility of overnight market interest rates around the MPC's official rate, so that the money market yield curve is flat until the date of the next MPC interest rate decision.(3)

The Bank envisages that there will be a material further fall in SONIA volatility with the launch of the full money market reforms.(4) Lower volatility should also encourage increased trading in instruments linked to SONIA. Indeed, market contacts report that

**Chart A**
**Mean absolute deviation of SONIA and official interest rate**(a)




(a) Based on a ten-day moving average.

turnover in SONIA swap markets has grown rapidly over the past year or so. Looking forward, therefore, forward rates derived from SONIA swaps should provide a more reliable read on market expectations of future official rates.

### Inferring expectations from SONIA swap rates

One method by which it is possible to back out expectations of future policy from SONIA swap contracts of different maturities is as follows.

**Step One** — Assume that changes in SONIA occur only on MPC decision days.

**Step Two** — Take the one-month swap rate, $OIS_1$. This rate must be equivalent to the interest earned by compounding daily the expected SONIA rate over the next month. If the current official rate ($OR$) holds up until the next meeting, the one-month swap rate can be used to calculate a rate prevailing following the meeting ($FR$). More formally:

$$\left(1+\frac{OIS_1}{36500}*T_1\right)=\left(1+\frac{OR}{36500}\right)^{t_1}\left(1+\frac{FR}{36500}\right)^{T_1-t_1} \quad (1)$$

(1) SONIA is the average interest rate, weighted by volume, of unsecured overnight sterling deposit trades transacted between midnight and 4.15 pm on a given day between members of the Wholesale Money Brokers' Association.
(2) For additional information on interest rate swaps and other instruments used in the sterling money market, see Brooke, M, Cooper, N and Scholtes, C (2000), 'Inferring market interest rate expectations from money market rates', *Bank of England Quarterly Bulletin*, November, pages 392–402.
(3) See the consultative paper published by the Bank of England, *Reforms of the Bank of England's Operations in the Sterling Money Markets*, May 2004.
(4) The article on 'Stabilising short-term interest rates' on pages 462–70 of this *Bulletin* describes how the Bank's new framework should tie short-term interest rates more closely to the Bank's official rate.

where $T_1$ is the number of days to the maturity of the first swap and $t_1$ is the number of days to the next MPC meeting. Rearranging:

$$FR = \left[ \left[ \frac{\left(1 + \frac{OIS_1}{36500} * T_1\right)}{\left(1 + \frac{OR}{36500}\right)^{t_1}} \right]^{\frac{1}{T_1 - t_1}} - 1 \right] * 36500 \qquad \textbf{(2)}$$

So for example, if $OIS_1$ is 4.510, $OR$ is 4.5, $T_1$ is 32 and $t_1$ is 22, using equation **(2)**, $FR$ = 4.5044.

**Step Three** — Following the logic of step two, the two-month OIS ($OIS_2$) can be represented in terms of the base rate and a series of forward interest rates between meetings:

$$\left(1 + \frac{OIS_2}{36500} * T_2\right) = \left(1 + \frac{OR}{36500}\right)^{t_1} \left(1 + \frac{FR_{t_1,t_2}}{36500}\right)^{t_2 - t_1} \left(1 + \frac{FR_{t_2,t_3}}{36500}\right)^{T_2 - t_2} \qquad \textbf{(3)}$$

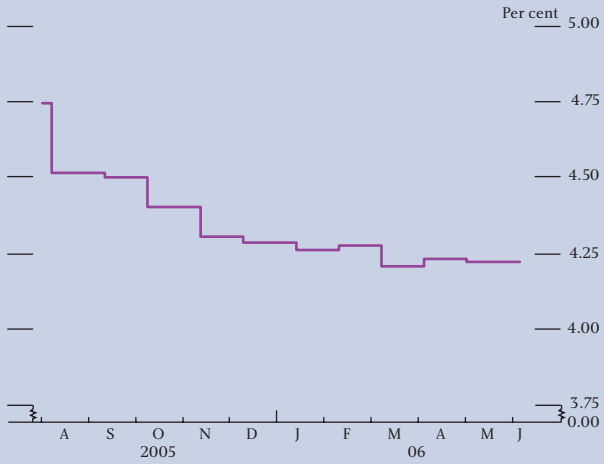
where $T_2$ is the maturity of the second swap, $t_2$ is number of days to the second meeting and $FR_{t_i,t_j}$ is the forward rate applicable between meeting $i$ and $j$.

Given the two-month swap rate, and using the policy rate up until the first meeting and the rate inferred in step two, a prevailing rate following this second MPC meeting can therefore be inferred. Thus in the example, assuming $OIS_2$ = 4.508 and with $FR_{t_1,t_2}$ = 4.5044, $T_2$ = 61 and $t_2$ = 56, then $FR_{t_2,t_3}$ = 4.3649.

**Step Four** — Repeat for twelve monthly OIS contracts.

Compared with other estimated curves, the OIS-inferred curve potentially allows more precise inferences regarding the timing of changes to the policy rate. One important caveat, however, is that risk premia and/or banks' specific hedging requirements may drive OIS rates away from true expectations of future overnight rates.

**Chart B**
**Forward rates implied by SONIA swaps on 29 July 2005**



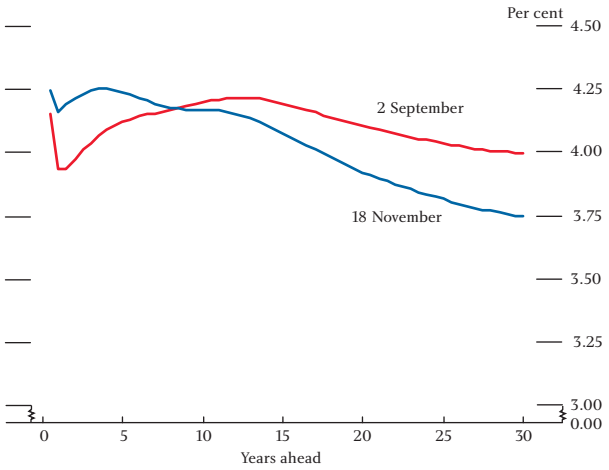

Sources: Bank of England and Bloomberg.

Chart B shows the implied path for rates implied from SONIA swaps on 29 July 2005. It shows that at that time, market interest rates indicated participants were anticipating reductions in the official rate.

Abstracting from risk premia, which are likely to be small at these short horizons, SONIA swap rates on 29 July 2005 suggested a strong expectation of a 25 basis point reduction in the official rate at the August 2005 MPC meeting and further reductions towards the end of the year.

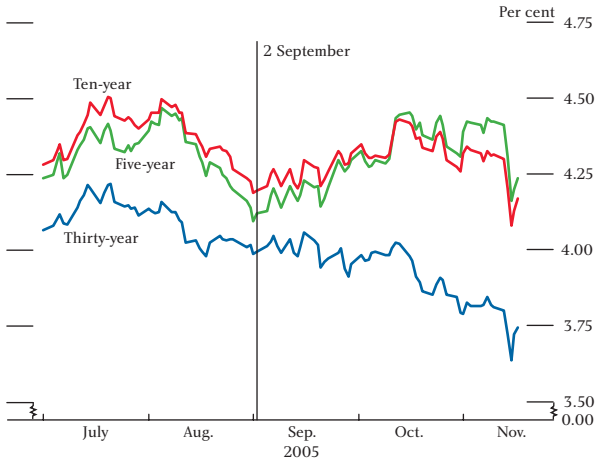
One limitation of using the OIS-based approach to infer market expectations about the timing of interest changes is that readily available data on monthly spaced contracts only extend to one year. But at horizons less than one year, this approach has some other benefits. In particular, for any given future date, derived forward rates can be cross-checked against over-the-counter forward-starting SONIA swap rates, which are now actively traded out of MPC meeting dates. These rates can give a direct read on market expectations of decisions at particular future MPC meetings.

## Chart 8
## Sterling nominal forward rates(a)



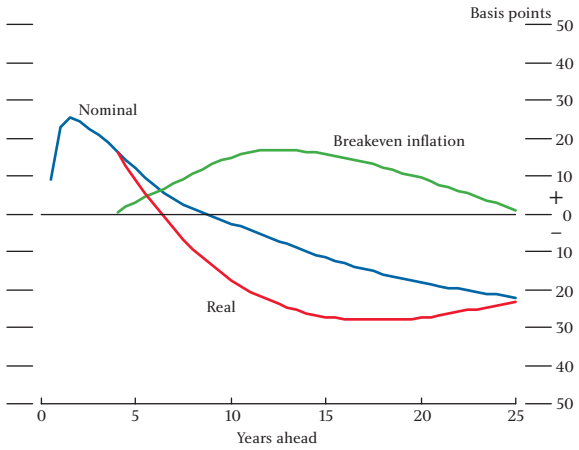

(a) Instantaneous forward rates derived from the Bank's government liability curve.

## Chart 9
## Sterling nominal forward rates since July 2005(a)



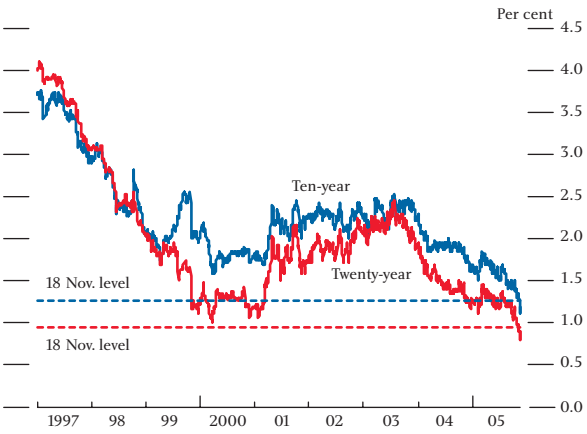

(a) Instantaneous forward rates derived from the Bank's government liability curve.

## Chart 10
## Changes in sterling forward rates(a)




(a) Instantaneous forward rates derived from the Bank's government liability curve.

## Chart 11
## Sterling real forward rates since January 1997 derived from index-linked gilts(a)




(a) Instantaneous forward rates derived from the Bank's government liability curve.

The decline in long-maturity nominal forward rates appears to have been linked to a number of factors. Purchases of long-maturity gilts by UK pension funds may have had a particularly significant effect. In addition, the fall towards the end of the period may have reflected a reaction to the November *Inflation Report*, as well as some unwinding of speculative positions involving buying euro-denominated government bonds and selling gilts ('long-bund, short-gilt' positions).

Decomposing the changes in longer nominal forward rates into their real and inflation components indicates that while breakeven inflation forward rates increased slightly at all maturities, market-based real forward rates fell at maturities beyond six years (Chart 10).

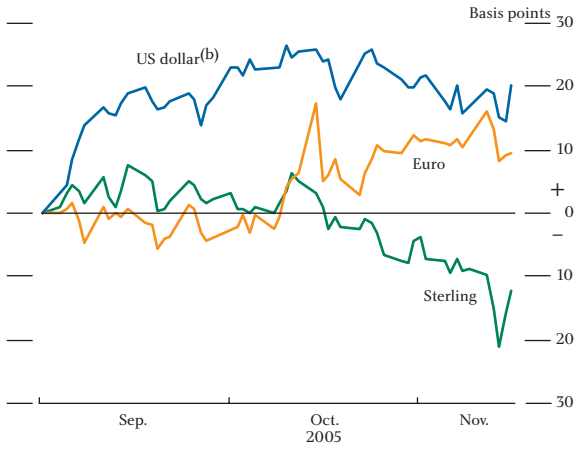
The recent fall in real sterling forward rates has continued the general downward trend in real rates over the past two years (Chart 11). Indeed, during November, long real forward rates reached the lowest levels since the UK government began to issue index-linked gilts in 1981.

The precise level of sterling real forward rates implied by index-linked gilts should be interpreted with care. Real interest rates inferred from these financial market instruments will not necessarily coincide with the 'true' underlying real rates of interest that households and firms face and that affect their economic decisions. In particular, the inflation-adjusted returns from index-linked gilts may be understated because the referenced measure of inflation is based on the RPI and is constructed as an *arithmetic* average of price changes in the basket of goods and services. Such a measure will give a large weight to prices of goods and services that have risen most rapidly, even though consumers may to

some extent have substituted away from these items towards cheaper alternatives. In contrast, the CPI measure, being a *geometric* average of individual price changes, will tend to give a relatively lower weight to such items. This 'formula effect' is estimated to add about half a percentage point a year to RPI-based measures of inflation.(1)

Generally speaking, the declines in sterling real forward rates over the past few years have coincided with the decline in international long-term real forward rates.(2) But during the current review period, real forward rates in other major currencies have risen, suggesting that the recent decline in sterling real rates reflected some sterling-specific factors (Chart 12).

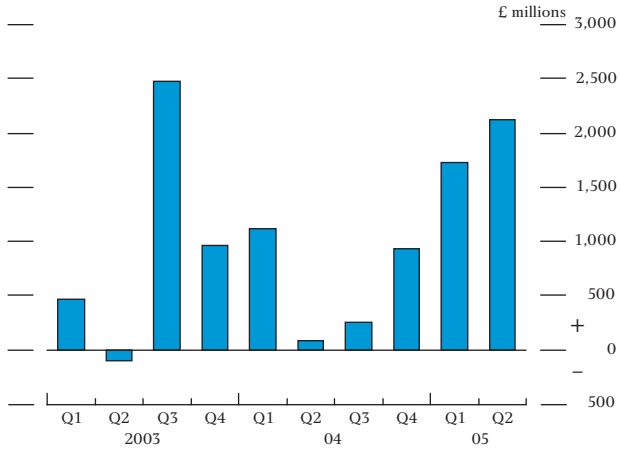
**Chart 12**
**Cumulative changes in international ten-year real forward rates since 2 September**(a)




(a) The sterling and dollar instantaneous real forward rates are derived from the Bank's government liability curve. Euro instantaneous real forward rates are calculated as nominal government bond yields less inflation swap rates.
(b) Nine-year instantaneous real forward rate.

In particular, as with implied rates on long-dated nominal gilts, some market contacts have suggested that investment by UK pension funds was a significant influence on long-term sterling real forward rates. Over the year to June 2005, there was an increase in net purchases of index-linked gilts by institutional investors (Chart 13) and this may have continued over the review period.

**Chart 13**
**Institutional net purchases of index-linked gilts**




Sources: ONS and Bank of England calculations.

In recent years, UK pension funds have increasingly focused on 'liability-driven investment' (LDI) — giving investment managers mandates to match the expected liabilities of the fund rather than, for example, a market index or a peer-group comparison. This may have been prompted, at least in part, by recent accounting and regulatory changes. In particular, the introduction of the accounting standard FRS17 required the assets of defined-benefit pension funds to be measured at market values and their liabilities to be discounted using a market rate of interest. In addition, the Pension Protection Fund (PPF), financed by levies on eligible defined-benefit pension funds, has been set up to provide compensation to pension fund members in the event that their fund becomes insolvent. Under the direction of the Board of the PPF, funds eligible for protection must undertake a regular valuation of their assets and liabilities.

Against this background, the demand for index-linked gilts from UK pension funds may have become relatively price inelastic. Trustees of funds and corporate sponsors may have become more willing to mandate purchases of these securities even though they have become increasingly expensive, in order better to match their liabilities. The liabilities of these funds typically have a long maturity(3) and, at least in part, are linked to inflation. Combined with a relatively limited supply of long-dated bonds (especially long-dated inflation-linked

(1) This 'formula effect' is discussed in the speech by the Governor on 20 January 2004 to the annual Birmingham Forward/CBI business luncheon (reprinted on pages 74–76 of the Spring 2004 *Quarterly Bulletin*) and by Stephen Nickell in his British Academy Keynes Lecture in Economics, 'Practical issues in UK monetary policy, 2000–05', on 20 September 2005.
(2) A number of explanations for low global real forward rates have been considered in previous Bank publications. See the boxes 'The fall in global long-term real interest rates' in the Spring 2005 *Quarterly Bulletin* and 'The economics of low long-term bond yields' in the May 2005 *Inflation Report*.
(3) This makes them 'long duration', ie relatively highly sensitive to changes in the interest rate used to discount such liabilities.

bonds), the increased demand may have tended to push the prices of index-linked bonds higher and their yields lower.

To the extent that returns on index-linked bonds influence the discount rates that funds employ to assess their future liabilities, the recent falls in yields could have further reduced funding ratios — the ratio of a pension fund's assets to its liabilities.(1) In turn, this may have reinforced the demand for index-linked gilts and driven their yields even lower.

Pension funds can also gain long-term inflation-linked cash flows by using the inflation swap market. Market contacts have reported significant receiving of long-dated inflation by UK pension funds in the sterling swap markets — both linked to RPI and LPI (limited price indexation(2)). Some dealers and fund managers have also been marketing pooled funds offering pension schemes long-term real returns, perhaps backed by inflation swaps. Where dealers have paid inflation in the swap market, they too may have purchased index-linked gilts to hedge this exposure, although some dealers are said to have used other hedges, including index-linked loans to finance private finance initiative (PFI) projects and property investments.

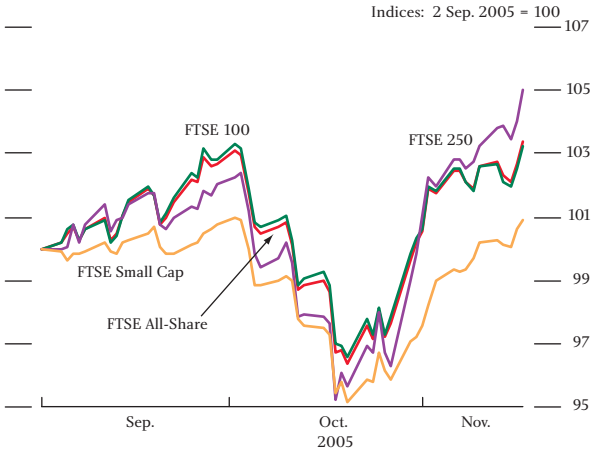
Some of the recent buying of long-dated bonds could have been associated with funds wanting to rebalance their portfolios ahead of the year-end. The high level of equity indices towards the start of the review period may also have acted as a trigger for some funds to switch from equities into bonds.

## Equity markets

Other things being equal, declining long-term sterling real interest rates might have supported UK equity prices over the past year or so via lower discount rates on future cash flows. However, equity price movements through the period would suggest other factors were probably more influential. UK equity indices fell sharply in October, along with those in the euro area and, to a lesser extent, in the United States, before rising towards the end of the period. The pattern was broadly similar for large, medium-sized and small UK-quoted companies (Chart 14).

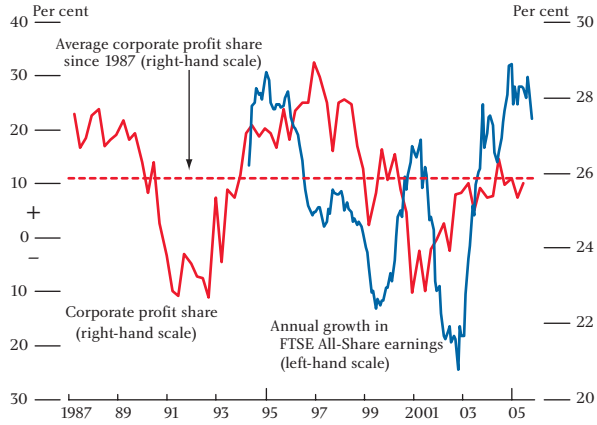
The falls in UK equity prices in the middle of the review period seemed to coincide with the increase in

**Chart 14**
**Cumulative changes in UK equity indices**




Sources: Bank of England and Bloomberg.

**Chart 15**
**Recent developments in UK corporate earnings**



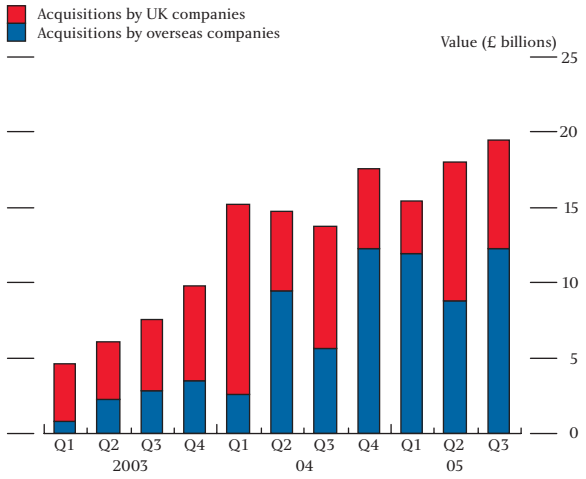

Sources: Bank of England, Bloomberg, ONS and Thomson Financial Datastream.

short-term market interest rates globally, perhaps as investors assessed the impact of tighter monetary policy on companies' earnings prospects. But with company profits having held firm despite the recent slowdown in UK domestic demand — reported earnings for quoted companies continued to grow strongly in the twelve months to the end of October (Chart 15) — any concerns about future corporate earnings seem to have been short-lived.

Some commentators have suggested that news about potential mergers and acquisitions could also have played a role, especially for the recovery in equity prices during the final few weeks of the review period. A number of prominent deals involving UK companies were announced at the beginning of November — for example, Telefonica's bid for O2 and Dubai Ports World's

(1) Under FRS17, funds are required to discount their future pension liabilities using AA-rated corporate bond rates. Under the PPF, future pension liabilities should be evaluated using rates derived from index-linked bond yields.
(2) Limited price indexation involves using an RPI-based index but with an upper bound on inflation.

**Chart 16**
**Acquisitions of UK companies**



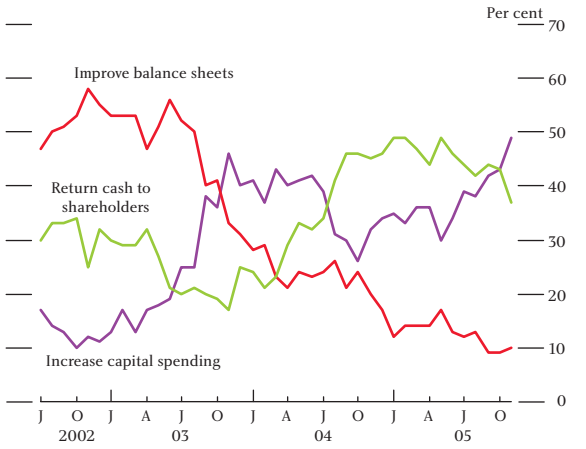

Source: ONS.

bid for P&O. More generally, takeover activity has increased over the past year, which market contacts suggest has helped to underpin the continued rise in equity prices through this year (Chart 16).

Indeed, there are some indications that the period of corporate balance sheet repair and shareholder distrust of expansion plans by company management after the 2001–02 equity market falls may be ending. For example, in the Merrill Lynch Global Fund Manager survey for November, more fund managers wanted companies to use their cash flows to increase capital spending than to return funds to shareholders through share buy-backs and dividends (Chart 17).

In principle, lower equity risk premia could also have boosted equity prices. However, uncertainty about

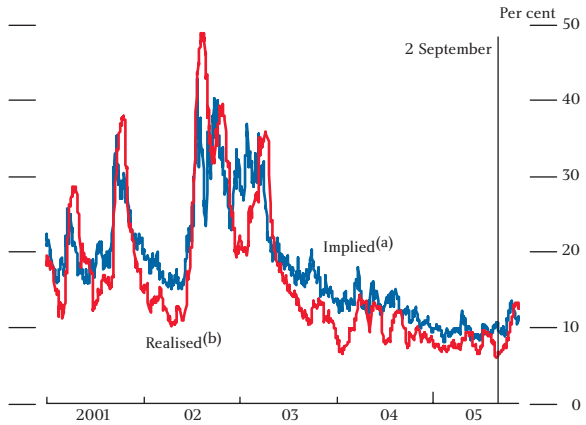
**Chart 17**
**Survey of fund managers' views about the preferred use of corporate cash flows**(a)




Source: Merrill Lynch.

(a) Survey question: 'What would you most like to see companies do with their cash flow at the current time?'.

**Chart 18**
**FTSE 100 equity index volatilities**




Sources: Bank of England and Bloomberg.

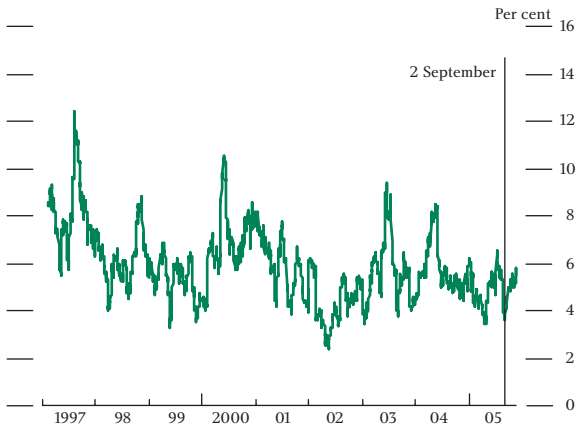
(a) Three-month constant maturity implied volatility.
(b) Annualised rolling standard deviation of log returns estimated over a 30-day window.

future equity price movements as implied from option prices rose slightly during the period. In October, implied volatility for the FTSE 100 index picked up to its highest level in 2005, echoing developments in realised equity market volatility. But both measures subsequently fell towards the end of the period and remained low by historical standards (Chart 18).

## Foreign exchange markets

Volatility in foreign exchange markets also remained relatively low over the period. The standard deviation of daily changes in the sterling effective exchange rate did pick up a little, having fallen during the summer months, but it remained at a low level (Chart 19). Forward-looking measures of uncertainty implied from option prices suggested market participants expected volatility to remain broadly unchanged over the next few months (Chart 20).

**Chart 19**
**Realised volatility of sterling exchange rate index**(a)



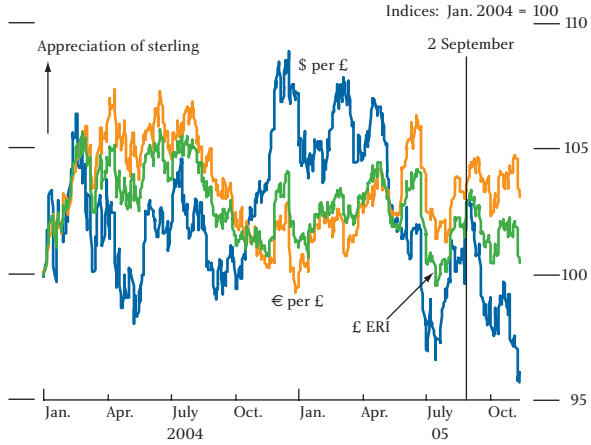

(a) Annualised rolling standard deviation of log returns estimated over a 30-day window.

The sterling exchange rate index (ERI) fell by around 2% over the period. This largely reflected a fall in the value of sterling against the US dollar which itself rose against all major currencies. Sterling depreciated by around 7% against the US dollar and 0.3% against the euro (Chart 21). The changes in these bilateral exchange rates were broadly consistent with movements in relative interest rates over the period. Comparing changes over a longer window, the sterling ERI has remained in a relatively narrow range.

**Chart 20**
**Three-month implied sterling exchange rate volatilities**


Source: Reuters.

**Chart 21**
**Sterling exchange rate indices**




## Developments in market structure

### 'Ultra-long' gilt issuance

In September, the United Kingdom's Debt Management Office issued an 'ultra-long' 50-year index-linked gilt. This followed the issue of a 50-year conventional gilt in May. These securities enable nominal, real and breakeven inflation forward curves to be extended out to a maturity of almost 50 years. On 18 November 2005, 49-year nominal and real forward rates were around 3.3% and 0.4% respectively. The box on pages 418–19 considers the interpretation of these forward rates.

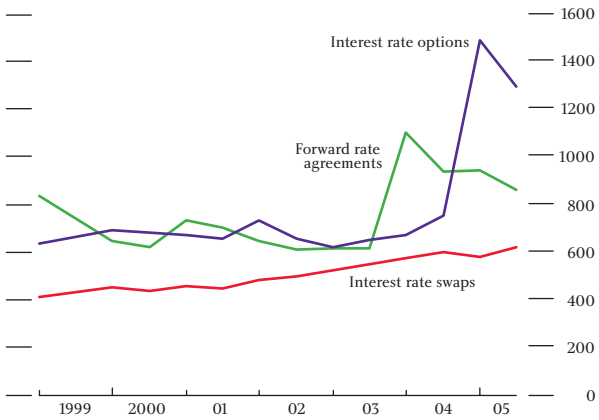
### Growth in over-the-counter derivatives markets

The market for over-the-counter (OTC) derivatives continued to grow through 2005 H1, according to the most recent survey by the Bank for International Settlements (BIS). The total notional amount of OTC derivatives outstanding in all currencies increased by around 7% during 2005 H1, compared with the 14% growth rate experienced during 2004 H2.

Amounts outstanding in sterling interest rate derivatives increased by around 9%. However, amounts outstanding in sterling foreign exchange OTC options declined slightly, by around 2%.

A measure of concentration of transactions undertaken by financial institutions included in the BIS survey fell in the OTC markets for sterling forward rate agreements and interest rate options, but rose slightly in the market for sterling interest rate swaps (Chart 22).

**Chart 22**
**Herfindahl indices of sterling transactions in exchange-traded derivatives**(a)




Source: Bank for International Settlements.

(a) The Herfindahl index is a measure of market concentration. It is calculated as $H = 10{,}000 \times \sum_{i=1}^{n} S_i^2$ where $S_i$ = share of the $i$th firm's transaction in total market and $n$ = number of firms. The higher the value, the more concentrated the market is.

## Bank of England official operations

### Changes in the Bank of England balance sheet

The size of the Bank's balance sheet increased over the review period. This was due to an increase in sterling and foreign currency-denominated customer deposits. Notes in circulation, the largest liability on the Bank's balance sheet, fluctuated with weekly variation in

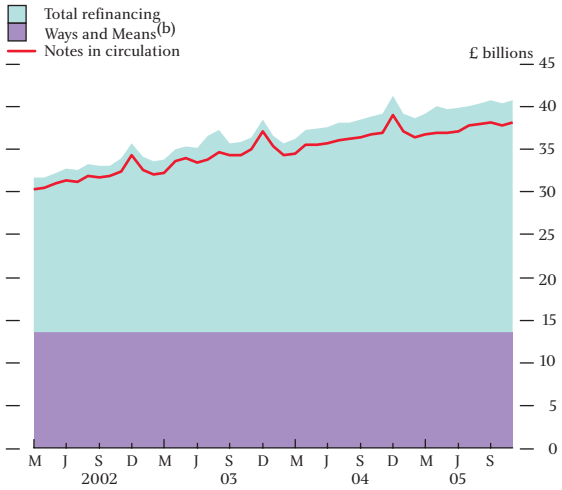
## Table B
## Simplified version of Bank of England consolidated[a] balance sheet[b]

£ billions

| Liabilities | 18 Nov. | 2 Sep. | Assets | 18 Nov. | 2 Sep. |
|---|---|---|---|---|---|
| Banknote issue | 40 | 41 | Stock of refinancing | 29 | 30 |
| Settlement bank balances | <0.1 | <0.1 | Ways and Means advance | 13 | 13 |
| Other sterling deposits, cash ratio deposits and the Bank of England's capital and reserves | 10 | 9 | Other sterling-denominated assets | 4 | 4 |
| Foreign currency denominated liabilities | 15 | 14 | Foreign currency denominated assets | 19 | 17 |
| **Total**[c] | **65** | **64** | **Total**[c] | **65** | **64** |

(a) For accounting purposes the Bank of England's balance sheet is divided into two accounting entities: Issue Department and Banking Department. See 'Components of the Bank of England's balance sheet' (2003), *Bank of England Quarterly Bulletin*, Spring, page 18.
(b) Based on published weekly Bank Returns. The Bank also uses currency, foreign exchange and interest rate swaps to hedge and manage currency and non-sterling interest rate exposures — see the Bank's 2003 *Annual Report*, pages 53 and 73–79 for a description.
(c) Figures may not sum to totals due to rounding.

## Chart 23
## Banknotes in circulation, the stock of OMO refinancing, and 'Ways and Means'[a]




(a) Monthly averages.
(b) An illiquid advance to HM Government. This fluctuated prior to the transfer of responsibility for UK central government cash management to the UK Debt Management Office in April 2000. The Ways and Means is now usually constant.

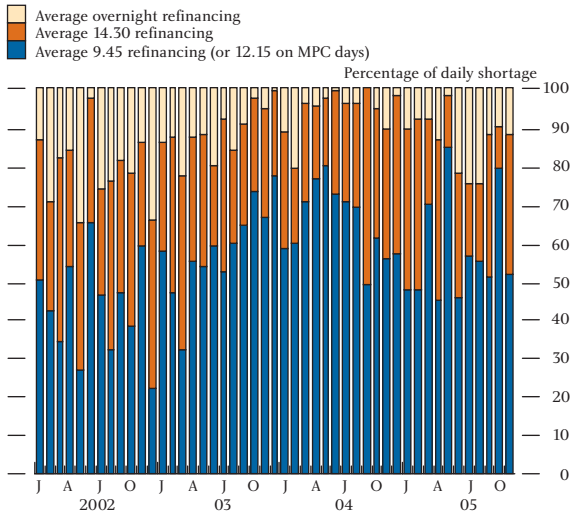
demand for banknotes and fell over the review period as a whole (Chart 23).

The Bank maintained the amount of its three and six-month euro-denominated bills outstanding at €3.6 billion, issuing new bills on a monthly basis as old bills matured. The average indicative spread to Euribor of three-month issuance narrowed to 9.0 basis points below Euribor, compared with 9.5 basis points over the previous review period; for six-month bills, the average issuance spread widened slightly to 11.0 basis points below Euribor from 10.6 basis points.

As set out in its *Annual Report and Accounts*, the Bank holds an investment portfolio of gilts (currently around £2 billion) and other high-quality sterling-denominated debt securities (currently £1.2 billion). These investments are held for a long period of time, generally to maturity. Over the current review period, gilt purchases were made in accordance with the published screen announcements; £31.4 million of 5% 2012 in August, £31.4 million of 5% 2014 in September and £31.4 million of 4.75% 2015 in October. A screen announcement on 1 December 2005 detailed the purchases to be made over the following three months.

The majority of refinancing in the Bank's open market operations (OMOs) in the sterling money market is carried out at a two-week maturity (Chart 24). As the shape of the money market yield curve steepened during the review period, counterparty participation in the Bank's two-week operations increased. The introduction of interim money market reforms on 14 March 2005, which included a narrowing of the rate 'corridor' on the Bank's deposit and late lending facilities, has led to narrower spreads between short-dated interest rates and the Bank's official rate, and therefore reduced the interest rate risk to counterparties on two-week borrowing from the Bank at the official rate.

## Chart 24
## Refinancing provided in the Bank's open market operations[a]




(a) Monthly averages.

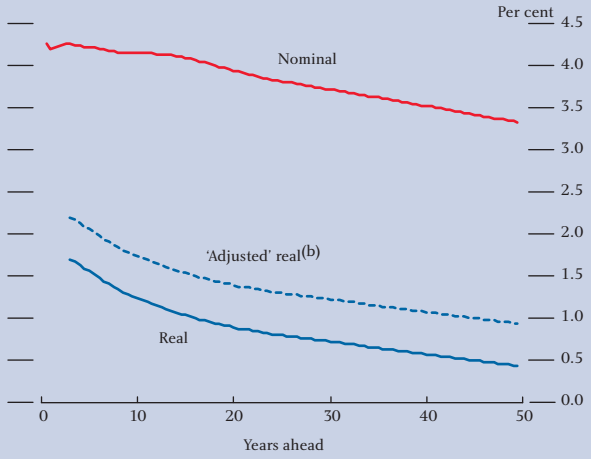
On average, the use of euro-denominated collateral by counterparties participating in the Bank's operations

## Interpreting long-term forward rates

The recent issuance in the United Kingdom of 50-year conventional and index-linked gilts has made it possible to estimate sterling nominal and real forward curves out to almost 50 years.

Chart A shows these extended real and nominal inflation forward curves on 18 November 2005, estimated using the Bank of England's VRP curve fitting technique.(1) At the 49-year maturity, the estimated nominal forward rate was around 3.3%, and the real forward rate was only around 0.4%.(2)

**Chart A**
**Sterling forward curves on 18 November 2005**(a)




(a) Instantaneous forward rates derived from the Bank's government liability curves.
(b) Index-linked gilt real forward rates adjusted to allow for the 'formula effect' associated with RPI measures of inflation.

Abstracting from the level of these forward curves, it is clear that 50-year nominal and real forward rates are lower than the equivalent 10-year forward rates. In other words, the nominal and real forward curves are *downward sloping*.

A popular framework for analysing the shape of the forward curve is to assume that forward rates reflect expectations of future short-term interest rates. So one interpretation of downward sloping (or inverted) forward curves is that investors in gilts expect future sterling short-term interest rates to be lower in 50 than in 10 years' time. However, it is not obvious why market participants might have more information with which to form expectations about short-term interest rates at the 50-year horizon than they have at the 10-year horizon.

There are other, perhaps more plausible, reasons for a downward sloping forward curve. Three possible explanations are (i) risk premia, (ii) convexity, and (iii) other 'market' factors, in particular, liability matching by long-term savings institutions.

### Risk premia

If market participants are risk-averse, they are likely to require a premium as compensation for uncertainty about future interest rates. In the absence of any other factors, a downward sloping forward curve would suggest this risk premium is negative and more negative with maturity.

Although this is theoretically possible,(3) the risk premium is typically thought to be positive and increasing with maturity. In this case, the risk premium would be expected to raise forward interest rates *above* underlying interest rate expectations, giving rise to an upward sloping forward curve. So risk premia alone seem unlikely to explain the downward sloping forward curves.

### Convexity

Convexity arises because of two factors. First, future interest rates are uncertain and second, there is a convex relationship between bond prices and yields. The convex relationship means that bond prices rise more for a given decrease in yield than they fall for an equivalent increase. This can be seen in Chart B, where a fall in yield from $Y_1$ to $Y_2$ causes a rise in price from $B_1$ to $B_2$, whereas a rise in yield of the same magnitude ($Y_1$ to $Y_3$) causes a smaller fall in bond prices ($B_1$ to $B_3$).

Given some degree of uncertainty about future interest rates, this convex relationship has positive value to bondholders because it amplifies the positive price impact of falls in yields and dampens price falls as yields rise. In the absence of other factors, this

(1) For details of how these curves are estimated, see Anderson, N and Sleath, J (2001), 'New estimates of the UK real and nominal yield curves', *Bank of England Working Paper no. 126*.
(2) As discussed on pages 412–13, there are reasons to be cautious in attaching too much significance to the precise level of real forward rates derived from index-linked gilts due to the 'formula effect'.
(3) See the box 'Real interest rates and macroeconomic volatility', on pages 308–09 in the Autumn 2005 *Bank of England Quarterly Bulletin* which describes possible conditions under which a negative risk premium can arise.

convexity value would lower forward rates below expectations of future short-term interest rates.

To see this, consider an investor who cares only about expected pay-offs (ie is risk-neutral). Suppose this investor wishes to invest £100 for one year starting in one year's time. One option would be simply to wait until next year and purchase a one-year bond. To introduce uncertainty, assume that the investor considers it equally likely that the interest rate on the one-year bond will change from 4% today to either 2% or 6% next year. In this case, the expected yield on the one-year bond is 4% and the expected price is £96.10.(4)

Alternatively, the investor could lock-in the yield today on a one-year bond starting next year by entering into a forward contract. Clearly, the forward-implied price of the bond must also be £96.10, otherwise the investor would be able to create a position that will generate a positive expected profit for zero cost. But this means that the yield on the forward contract would be 3.98% (because £100$e^{-0.0398}$ = £96.10), which is lower than the expected interest rate of 4%. In this example, the convexity effect therefore amounts to 2 basis points at the one-year maturity.

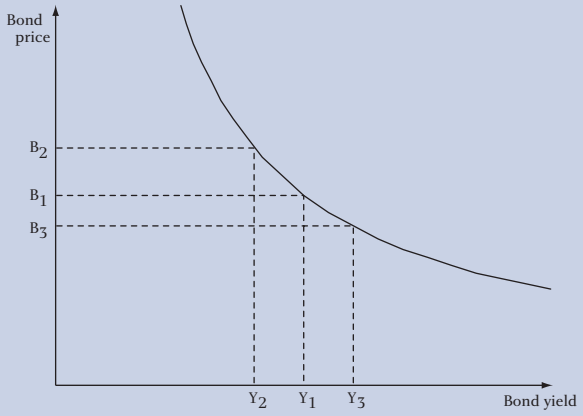
A rise in uncertainty about future interest rates increases the value of the convexity effect. For example, consider the impact of a rise in the uncertainty of the one-year yield from 2% or 6% next year, to 1% or 7%. In this case, the expected yield next year will still be 4%. But the expected price will now be higher at £96.12, corresponding to a lower forward rate of 3.96%, and therefore a higher convexity effect of 4 basis points.

In general, this convexity effect will increase with the maturity of the forward rate. So, in principle, the convexity effect could help to explain the downward sloping forward curve, although if there were a positive risk premium, convexity would have to be large enough to more than offset this premium.

## Market factors

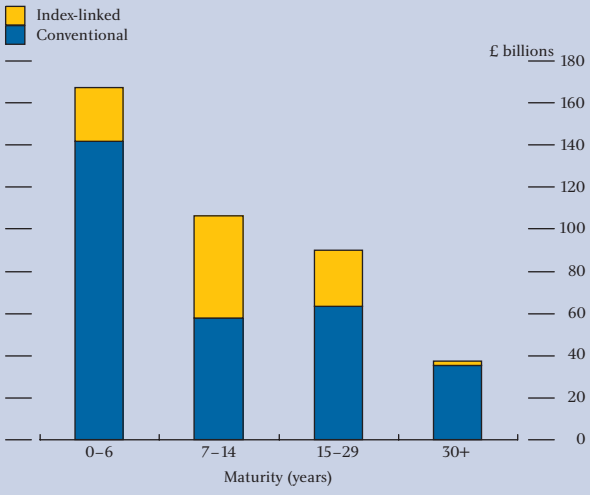
In addition to risk premia and convexity, on occasions, other non-fundamental factors in the bond market can move forward interest rates away from expected short rates. For example, if the yield curve is not perfectly arbitraged and some large investors prefer to hold bonds at particular maturities, forward rates can be determined by demand and supply factors.

**Chart B**
**Bond price-yield relationship**




As noted in the main text, demand for long-maturity gilts from institutional investors can at times become relatively price inelastic, and the value of outstanding nominal and index-linked gilts at long maturities is sometimes limited (Chart C).

**Chart C**
**UK gilts outstanding by maturity**(a)




Source: DMO.

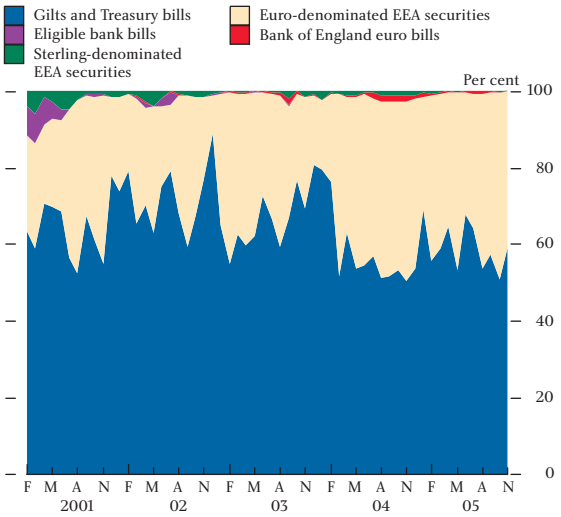
(a) Excludes the 3½% war loan and 'rump' gilts. Includes inflation uplift for index-linked gilts.

The combination of price-inelastic demand and the relative scarcity of long maturity bonds may result in investors paying a high price for long-dated gilts. This premium would tend to reduce the yield on such instruments, pushing long-maturity forward rates below the rate that would hold in the absence of these factors.

(4) This is the expected present value of £100 in one year's time, ie 0.5(100$e^{-0.02}$) + 0.5(100$e^{-0.06}$) = 96.10.

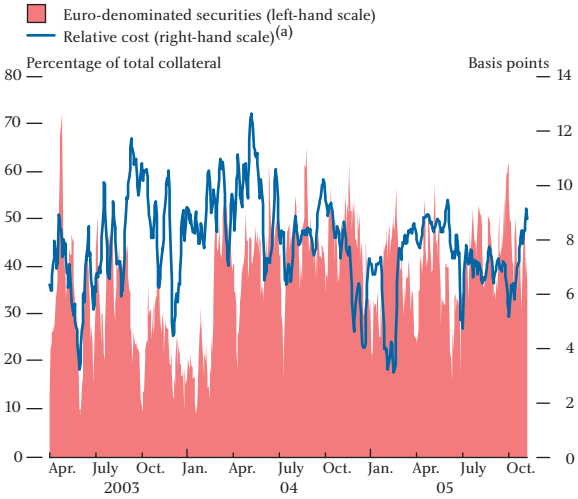
increased over the period (Chart 25), despite a small rise in its relative cost (Chart 26). This suggests that other factors can be important when a counterparty decides which collateral to pledge in the Bank's sterling operations, such as its own specific needs to finance positions in the sterling or euro bond markets.

### Chart 25
### Instruments used as OMO collateral(a)




(a) Monthly averages.

### Chart 26
### Relative cost and use in OMOs of euro-denominated EEA government securities



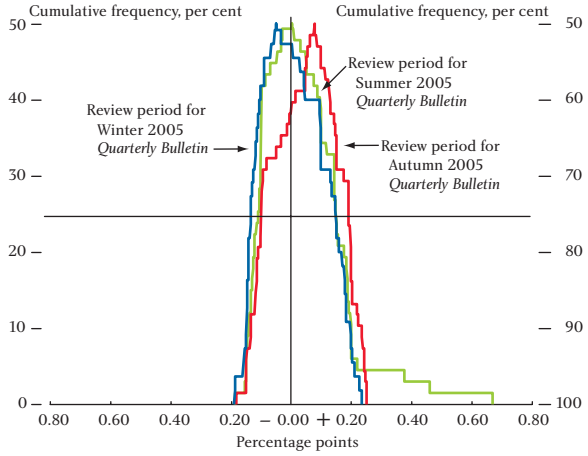

(a) The relative cost is calculated as the difference between one-month BBA repo and Libor fixing spread and one-month European Banking Federation repo and Euribor spread. A wider spread indicates a lower cost of repoing euro-denominated debt relative to repoing gilts.

The majority of OMO collateral continued to be denominated in sterling. One strategy often used by securities dealers is to give corporate or asset-backed bonds as collateral to borrow gilts from other investors, for example, UK insurance companies or pension funds. The gilts can then be used in a repo transaction with the Bank for cash, a so-called 'collateral upgrade' trade. Market contacts suggest these trades have become more popular alongside more traditional types of collateral used for borrowing gilts, such as bank's Certificates of Deposit. Until recently, commercial eligible bank bills were also accepted as collateral in the Bank's OMOs, although typically they accounted for a small proportion of total collateral pledged. As explained in the box on pages 422–23, however, in the past they were more significant.

## Short-dated interest rates

The distribution of the spread between the sterling secured (gilt GC repo) overnight rate and the Bank's official rate was more symmetric during the current review period than in the period covered by the Autumn *Quarterly Bulletin* (Chart 27), in part reflecting fewer days on which the overnight rate traded above the official rate. The volatility of this spread has also remained lower than in recent years.

### Chart 27
### Cumulative folded distribution of sterling secured overnight rates(a)



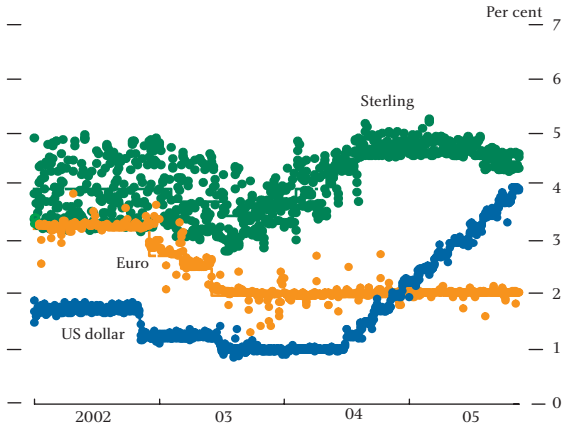

(a) Distribution of the spread between the GC repo rate and the official rate. A negative spread indicates that the market rate is less than the official rate; if more than 50% of the spread distribution is below zero, it has a negative bias.

Sterling overnight rates remained somewhat more volatile than comparable dollar and euro rates, although Charts 28 and 29 show that the difference has narrowed compared with recent years. However, volatility in sterling overnight interest rates is still undesirably large. The forthcoming money market reforms are designed to address this.

## Forecasting the liquidity shortage

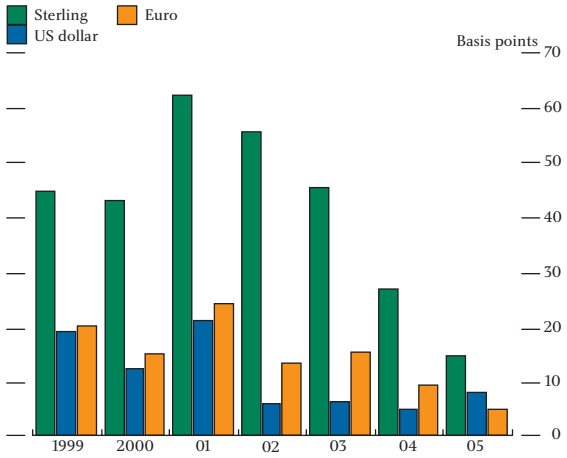
The accuracy of the Bank's liquidity forecast was better overall compared with previous quarters (Table C).

## Chart 28
## Overnight interest rates and policy rates




Sources: Bloomberg and Bank of England calculations.

## Chart 29
## Standard deviation of difference between official interest rates and overnight interest rates(a)




Sources: Bloomberg and Bank of England calculations.

(a) Overnight interest rates are SONIA for sterling, the Fed funds rate for US dollar and EONIA for euro.

A welcome development has been the low level of flows in the end-of-day schemes. Average daily payments in both the Bank of England Late Transfer Scheme (BELTS) and End-of-Day Transfer Scheme (EoDTS) have tended to be around or below £200 million, suggesting the CHAPS Sterling settlement banks are able to make more accurate forecasts of their end-of-day positions, consistent with fewer payments between banks towards the end of the trading day. The volatility of BELTS flows rose but declined for the EoDTS, although flows continued to be quite 'lumpy' (Chart 30).

### Progress on money market reform

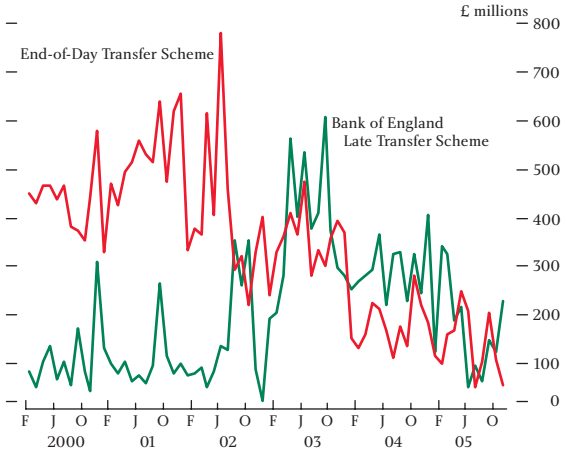
The final documentation for participants in the reformed framework was published on 31 October 2005.(1) These included the Eligibility Criteria, Terms and Conditions and Operating Procedures. The

## Table C
## Intraday forecasts versus actual liquidity shortages

Mean absolute difference, £ millions

| | 9.45 forecast | 14.30 forecast | 16.20 forecast |
|---|---|---|---|
| 2002 | 83 | 43 | 30 |
| 2003 | 101 | 61 | 51 |
| 2004 Q1 | 120 | 79 | 55 |
| 2004 Q2 | 115 | 58 | 61 |
| 2004 Q3 | 89 | 62 | 52 |
| 2004 Q4 | 107 | 69 | 57 |
| 2005 Q1 | 117 | 87 | 63 |
| 2005 Q2 | 122 | 67 | 62 |
| 2005 Q3 | 199 | 78 | 52 |
| Oct.-18 November | 95 | 77 | 45 |

## Chart 30
## Bank of England Late Transfer Scheme and End-of-Day Transfer Scheme(a)




(a) Monthly averages.

documentation had previously been published, in draft form, in July and there were no substantial revisions in the final document. On 23 September, the Bank published a document entitled 'Near-term milestones and overall timetable'.(2) This aimed to provide participants with more information on the timetable for implementing the new system. The Bank still expects to launch the new system during the period March-June 2006.

The Bank's own preparations are continuing to progress well. Some of the main IT systems have completed trialling (ie for collateral management and for handling reserve balances). A number of reserve scheme banks have successfully connected to the Bank's real-time gross settlement system.

The numbers of banks and building societies expecting to participate in the reformed system has also been encouraging; prospectively between 40–50 reserve banks, 50–60 standing facility members and 20–30 open market repo operation counterparties. Trialling of standing facilities and repo operations will take place from December.

(1) www.bankofengland.co.uk/markets/moneymarketreform/051031full.pdf.
(2) www.bankofengland.co.uk/markets/moneymarketreform/smmreform050923.pdf.

## Commercial bills at the Bank of England

The Bank began to discount bills in 1694, very shortly after its foundation. But from 17 August this year, commercial bills ceased to be eligible for use in the Bank's money market operations. Over the intervening 311 years the place of commercial bills in the Bank's activities had gone through many ups and downs.

Bills of exchange are negotiable instruments used particularly to finance trade. A seller of goods might draw a bill ordering the buyer of the goods to pay a sum of money at a point in the future — to the seller of the goods or to the bearer of the bill. If the buyer of the goods undertook to make that payment, by 'accepting' the bill, the seller of the goods might sell the bill in the money market, receiving payment straight away, while the buyer of the goods would have to pay up only later when the bill matured. As the bill passed from hand to hand in the market its creditworthiness might grow as successive sellers of the bill endorsed it, making themselves liable to later holders. The bill would trade more easily if it had been accepted by a bank on behalf of the buyer. It would then be a 'bank bill'. If accepted by a non-bank it would be a 'trade bill'. A bill of exchange might also be known as a commercial bill or an acceptance. A bank bill might also be called a banker's acceptance.

In the 18th century and through the Napoleonic Wars, discounting bills (buying them at a discount) was an important source of income for the Bank. In the 19th century, the 'bill on London' became the most important negotiable instrument in the world, being used to finance both inland trade and, increasingly, foreign trade. It remained significant into the early years of the 20th century. The law governing its use was codified in the Bills of Exchange Act 1882. The Treasury bill, a government liability and not a bill of exchange, had been introduced with the Treasury Bills Act 1877.

The scale of the Bank's bill discounting varied during this period, depending on the rate it applied and whether it was prepared to discount bills for bill brokers or only for ordinary Bank customers. Discounts did however peak at times of financial crisis. Only in 1890 did the Bank establish a discount mechanism as a means of controlling the market in normal times, when it granted discount facilities to the discount houses, the market-makers in bills.

The relationship with the discount houses continued, but the First World War (and indeed the Second War) saw such an increase in outstanding Treasury bills that from the 1920s to the early 1980s the Bank's use of commercial bills was very limited.(1) Low interest rates in the 1930s eroded the profitability of market-making in bills and the market was disrupted by wartime dislocation of trade. The Radcliffe Committee in its 1959 Report wrote of the 'irreversible shrinkage' in the relative supply of commercial bills. But as it turned out, the market revived to an extent during the 1960s, partly because bill finance was subject to less official restraint than other forms of lending.(2)

A more significant revival began in the early 1980s, when the Bank once again made extensive purchases of commercial bills. At that time the central government was draining cash from the money market by borrowing long-term to fund the Public Sector Borrowing Requirement which was then much greater than the central government's own needs.(3) Some of the cash was put back into the market when central government repaid most of its outstanding Treasury bills. But that still left the Bank needing to provide the market with a

(1) As noted in an article published in the December 1982 issue of the *Bank of England Quarterly Bulletin*, on the centenary of the 1882 Act, Coleby, A L, 'Bills of exchange: current issues in a historical perspective'.
(2) See 'The London discount market: some historical notes', *Bank of England Quarterly Bulletin*, June 1967, pages 144–56.
(3) The difference being sizable local authority and public corporation borrowing, other than from central government.

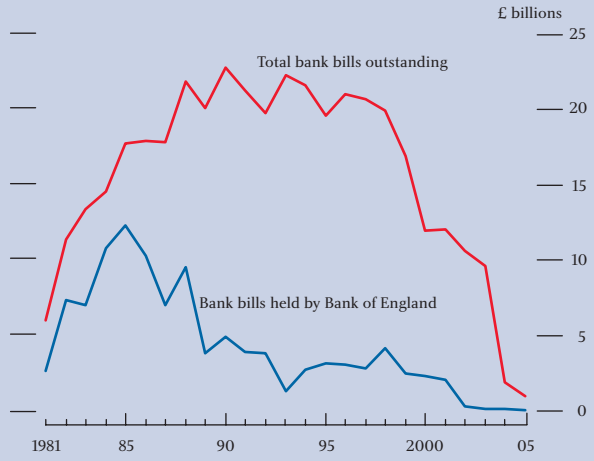
considerable amount of liquidity and to do so with an instrument other than the Treasury bill. A major part of the solution was to buy commercial bills — on such a scale that the Bank's holdings became known as 'the bill mountain'.

Initially the growth in outstanding bills went largely into the Bank's hands but then market holdings grew also (Chart A). The market was, however, still very much less significant than it had been in its heyday. It has been estimated that in the peak years of the 1860s, the value of bills drawn amounted to about 170% of net national income.(4) With an average maturity of around three months this would make the outstanding stock of bills equivalent to over 40% of annual net national income. In the 1980s and 1990s, the equivalent figure was 3%. By that stage the stock of bills in the market corresponded to only about 1½% of UK banks' sterling assets.

Official operations in such a small market were at times problematic. The market was easily cornered and partly for this reason the Bank encouraged the establishment of a gilt repo market and from March 1997 began to use gilt repo in its daily operations. Although bills could still be used alongside gilt repo, in practice their use began to fall as did the size of the bill market.

The decline slowed temporarily when the Bank allowed a wider range of bills to be used. The Bank had long had a list of requirements that a bill had to meet to be eligible for use in the Bank's operations. Some of these related to the maturity of the bill and to the accepting bank. But one was that the bill should identify the underlying transaction being financed, which was to be short-term, self-liquidating and not for

**Chart A**
**Bills issued by UK resident banks**




capital purposes. By 2000 the Bank had concluded that this 'clausing' did not add to the creditworthiness of the bill and dropped the requirement. One unintended effect of this was to make it easier for banks to draw bills on each other. Such 'bank-on-bank' bills came to form a significant part of the bill market. Because these bills were usable at the Bank they also counted towards banks' supervisory stock liquidity requirement.(5) However, the Bank prefers to provide liquidity to the banking sector against high-quality collateral in the form of claims outside the banking sector. Accordingly 'bank-on-bank' bills were made ineligible in 2003, and the decline in the bill market accelerated once more.

Although the change made this year is in a sense historic, experience suggests that central bank operations are best carried out using instruments that have a life and a market of their own. It is evident that the revival of the commercial bill in the 1980s and 1990s was not of this kind, but very dependent on the evolution of the Bank's own operations.

(4) Nishimura, S, *The decline of inland bills of exchange in the London money market 1855–1913*, Table 18.
(5) On the requirement see Chaplin, G, Emblow, A and Michael, I, 'Banking system liquidity: developments and issues', Bank of England *Financial Stability Review*, December 2000, especially Box 4 on page 101.