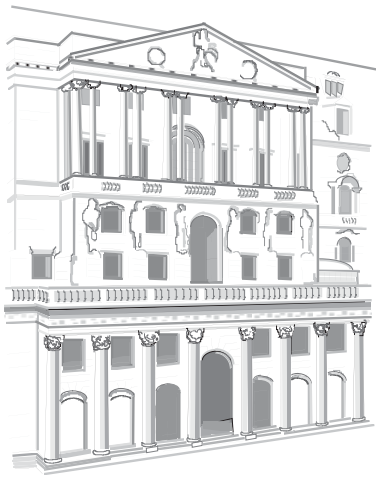
Bank of England Quarterly Bulletin



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The Quarterly Bulletin and Inflation Report

Inflation Report
(published separately)

The *Inflation Report* reviews developments in the UK economy and assesses the outlook for UK inflation over the next two years in relation to the inflation target. The *Report* starts with a short overview section. The following four sections analyse developments in money and financial markets, demand and output, the labour market and costs and prices respectively. The concluding sections present a summary of monetary policy since the August *Report* and an assessment of inflation prospects and risks. Minutes of recent Monetary Policy Committee meetings are attached as an annex.

Sterling market liquidity over the Y2K period
(pages 325–26)

Statement by the Bank of England. The Bank of England has been making active preparations to promote orderly market conditions over the Y2K period. This statement summarises the arrangements that will operate over the period.

Markets and operations
(pages 327–43)

This article reviews developments in domestic and international financial markets and describes Bank of England market operations in the period 30 June to 8 October 1999. Market interest rates rose in the United States, in response to stronger-than-expected economic growth and in anticipation of the Federal Open Market Committee's decision on 24 August to increase the Federal funds target rate by 25 basis points. The United Kingdom's yield curve also shifted upwards in response to stronger-than-expected activity indicators and, on 8 September, the Bank of England's repo rate was increased by 25 basis points. In the euro area, official interest rates remained unchanged during the period. Nevertheless, market-based measures of interest expectations rose; three-month rates implied by euribor futures contracts increased by around 35–75 basis points. In contrast, market interest rates fell in Japan. Expectations of increases in official interest rates and concerns about equity valuations in some countries led to falls in equity indices in the United States, the euro area and the United Kingdom. Partly linked to these developments, the US dollar's exchange rate index depreciated by 5%, while that of the yen appreciated by 11%. On 31 August, the Bank of England permanently extended the range of securities eligible for use in its repo operations. And on 20 September, the Bank announced a new temporary longer-term repo facility. Both actions will help to promote orderly conditions in the sterling money markets over the period spanning the Millennium date change.

The international environment
(pages 344–52)

This article discusses developments in the global economy since the August 1999 *Quarterly Bulletin*. Domestic demand growth remained strong in the United States, and with continued tightness in labour markets, the Federal funds target rate was increased by ¼% to 5¼% in late August. Growth in the euro area remained moderate in the second quarter, but survey evidence suggests that growth may have increased in the third quarter. In Japan, there was further evidence of a recovery in output in the second quarter. But with declining business investment and the possibility of further falls in employment, the recovery remains fragile. Current account imbalances between the major economies increased further in the second quarter. World trade growth appears to be increasing, partly in response to continued recovery in many emerging market economies. Sharp increases in oil prices put upward pressure on the major economies' import prices. But consumer price inflation remained subdued.

Public sector debt: end March 1999
(pages 353–64)

This article continues the annual series in the *Quarterly Bulletin* analysing the debt position of the UK public sector. It looks at market and statistical developments in the financial year to end March 1999, and examines some of the domestic and European issues that have influenced these measures. It also analyses the composition and distribution of the national debt. Public sector net debt fell by £3.7 billion to £349 billion, at nominal value, during the financial year to end March 1999. This was the first annual reduction since 1989/90. At

end March 1999 public sector net debt stood at 40.6% of GDP, the lowest end-March figure since 1994, and 2 percentage points lower than at end March 1998. General government gross debt—the 'Maastricht' measure—also fell during the year, to £399 billion at end March. At 47.4% of GDP, this is comfortably below the 60% reference value in the Maastricht Treaty. The general government had a financial surplus of 0.9% of GDP in 1998/99, well within the Maastricht reference value, which allows a deficit of up to 3% of GDP. All data presented in this article reflect the transition to the latest international statistical standards, the European System of Accounts (ESA95). This is consistent with the UK National Accounts, published by the Office for National Statistics. However, as before, government debt figures are still presented on a nominal, rather than a market, valuation. The box on pages 356–57 gives details of the changes and shows the impact on the measurement of the public sector debt position.

The external balance sheet of the United Kingdom: recent developments

(pages 365–73)

This article summarises the development of the international investment position of the United Kingdom between 1988 and the first half of 1999. It continues an annual series begun in 1985. The article describes how financial flows and changing asset values affect the United Kingdom's external balance sheet. It relates investment income flows and capital gains to stocks of assets and liabilities, and compares the United Kingdom's international investment position with those of other major economies. A box gives details of the UK participation in the IMF-sponsored coordinated portfolio investment survey.

Research and analysis

(pages 374–96)

Research work published by the Bank is intended to contribute to debate, and is not necessarily a statement of Bank policy.

News and the sterling markets (by Martin Brooke, Graeme Danton and Richhild Moessner of the Bank's Gilt-edged and Money Markets Division). The *Quarterly Bulletin* reports developments in financial markets in detail each quarter in the regular 'Markets and operations' article. Day by day, items of news about the economy—in the form of data releases and news about policy—are the most significant market-moving events. This article looks over a longer time period than is usually possible in the 'Markets and operations' article to answer the following two questions: Which news items tend to move the sterling interest rate markets most? How do different parts of the sterling yield curve respond to news?

New estimates of the UK real and nominal yield curves (by Nicola Anderson and John Sleath of the Bank's Monetary Instruments and Markets Division). This article presents some new improved estimates of the UK yield curve, both nominal and real. It describes the rationale for changing the estimation techniques that we have previously used, in the light of our own experience and developments in the academic literature. The article also illustrates the use of data from the general collateral repo market to derive estimates of the nominal yield curve at short maturities.

Government debt structure and monetary conditions (by Alec Chrystal of the Bank's Monetary Assessment and Strategy Division, Andrew Haldane of the Bank's International Finance Division, and James Proudman of the Bank's Monetary Instruments and Markets Division). In June 1998 the Bank of England organised a conference on 'Government debt structure and monetary conditions'. The aim of the conference was to discuss the interactions between the size and structure of government debt and the concerns of monetary policy. The proceedings of the conference will be published shortly. This article summarises the issues discussed.

The contents page, with links to the articles in PDF format, is available at www.bankofengland.co.uk/qb/n99qbcon.htm The speeches contained in the *Bulletin* can be found at www.bankofengland.co.uk/speeches

Sterling market liquidity over the Y2K period

Statement by the Bank of England

The Bank of England has been making active preparations to promote orderly market conditions over the Y2K period. The successful testing of the key sterling market systems—CGO, CMO, CREST and RTGS—reported in the Bank's *Blue Book* series gives assurance to market participants that the infrastructure will operate normally. In parallel, the Bank has taken a number of steps to ensure that sterling market participants who have made proper preparations for Y2K can obtain adequate liquidity over the period to enable them to maintain normal business activity.

This statement summarises the arrangements that will operate over the period.

Liquidity for the whole financial system. The Bank of England has made clear from the outset that it will at all times ensure that it provides fully adequate liquidity to meet the needs of the financial system as a whole, as it does every day. This will primarily be provided through the Bank's normal daily open market operations, conducted in two-week repo against eligible collateral with the Bank's sterling money-market counterparties, who are the main active participants in the sterling money markets. The Bank's counterparties in turn distribute the liquidity provided by the Bank around the financial system as a whole. The Bank has carefully reviewed the system's prospective need for liquidity over the Y2K period, and is satisfied that it is both able and ready to supply the necessary liquidity throughout the period.

Liquidity management by market participants. To ensure that the liquidity provided by the Bank is distributed smoothly round the financial system, the Bank, working with the Financial Services Authority, has maintained close liaison with a wide range of sterling market participants, in order to monitor their plans for the Y2K period. These discussions have covered market participants' plans for management of their liquidity, their holdings of eligible collateral, credit limits, relationships with customers, correspondents and counterparties, and business activity over the Y2K period. The picture that emerges from these discussions is that, although the markets may be thinner than normal, as indeed is typically the case at the end of any year, market participants are well advanced with making sensible plans to maintain business largely as normal over the period. From the review of these plans taken as a whole, the Bank sees no reason why there should be any material disturbance to the orderly functioning of markets. The Bank will, however, in conjunction with the Financial Services Authority, continue to monitor market participants' plans closely, and will be ready to respond if undue strains should arise in the markets.

Adequate availability of collateral. A key requirement for the orderly conduct of business over the Y2K period is that market participants should equip themselves with adequate marketable collateral, which they can then mobilise if necessary to obtain liquidity in the market. To ensure that there is adequate collateral available for this purpose, the Bank has over the past year progressively extended the range of collateral eligible to be used on repo to obtain liquidity from the Bank in its daily open market operations. In the latest step in this process, which was implemented on 31 August, the pool of eligible securities was enlarged by some £2 trillion—a six-fold increase—to include government securities issued in euro by the European Economic Area countries. Details of eligible collateral now accepted by the Bank are given in the box below. Market participants have indicated that this extensive range makes ample collateral available for firms to manage their liquidity on an orderly basis through the Y2K period. This extension of the range of collateral taken by the Bank is permanent. The Bank has also held discussions with participants in the stock lending and repo markets and is satisfied that, there too, participants are planning to maintain orderly trading activity through the Y2K period.

Securities eligible for repo operations with the Bank of England

The following securities are eligible for use by the Bank's counterparties in repo operations with the Bank of England, both in the Bank's daily open market operations to provide two-week liquidity and in the new longer-term repo facility for (initially) three-month repos:

- Gilts (including gilt strips).
- Sterling Treasury bills.
- Bank of England euro bills.
- Eligible bank bills.
- Eligible local authority bills.
- UK government non-sterling marketable debt.
- Sterling-denominated securities issued by European Economic Area (EEA) governments and major international institutions.(1)
- Securities (including strips) denominated in euro, issued by the central governments and central banks of the EEA and major international institutions, which are eligible as Tier 1 collateral for use in ESCB monetary policy operations.(1)

(1) Eligible securities in these categories are listed on the 'Eligible securities' page on the Bank's web site (www.bankofengland.co.uk/eligsec.htm).

Longer-term repos

The longer-term repo facility will be available from Wednesday 13 October 1999 through to the early months of 2000 and will be operated once each week. Applications to utilise the facility will be invited on the Wednesday of each week and proceeds will be made available to successful applicants on the Thursday and Friday of the same week, with the amounts spread equally between the two days in order to smooth the impact on the daily pattern of money-market shortages. Liquidity provided under the facility will be in the form of repo against the full range of collateral eligible for use in the Bank's normal daily open market operations, which provide two-week liquidity and will continue unchanged in parallel with the new longer-term repo facility.

Ahead of each week's activation of the new facility, the Bank may set a maximum amount to be provided under the facility that week in order to avoid undue fluctuations in the daily profile of money-market shortages. In the event that market demand exceeds the maximum, the Bank would endeavour to increase the amounts available under the facility in succeeding weeks in order to meet the market's needs in full over the period.

Repos under the facility will initially be offered for three months' maturity, ie across the end of the year. After October, repos may also be offered for two months, and possibly also for one month; the precise pattern of maturities available will be determined in the light of experience with the use of the facility. The rate of interest charged on amounts taken under the facility will be the Bank's repo rate, but will vary so that, if the Bank's repo rate is changed during the life of a longer-term repo, interest from that point will be charged at the new repo rate.

The new facility will be available to firms who are the Bank's counterparties in its daily open market repo operations. It is the Bank's intention that the facility should also provide an opportunity for market participants who are not counterparties of the Bank to obtain longer-term liquidity from the Bank's counterparties for periods ranging across the Y2K date change, against collateral which the Bank's counterparties can in turn use to obtain equivalent-term liquidity from the Bank. The Bank is encouraging its counterparties to make active use of the new facility for this purpose.

Longer-term repos. To provide further help to market participants in planning their liquidity management over the Y2K period as a whole, the Bank is putting in place a temporary facility, for longer-term repos with its counterparties, to run from October 1999 through to the early months of 2000. This facility will enable the Bank's counterparties to obtain liquidity from the Bank, on repo against eligible collateral, for periods of up to three months. It will run in parallel with the Bank's normal daily open market operations under which it provides liquidity against eligible collateral for two-week periods. Details of the longer-term repo facility are given in the box above.

Distribution of liquidity across the financial system. The longer-term repo facility will be of particular interest to market participants who are not counterparties of the Bank. It will provide an opportunity for them to obtain liquidity from the Bank's counterparties for periods ranging across the Y2K date change, against collateral which the Bank's counterparties can in turn use to obtain equivalent-term liquidity from the Bank. The Bank is encouraging its counterparties to make active use of the new facility to distribute liquidity to other market participants against eligible collateral, as is the case already for the Bank's normal daily two-week repo operations. The Bank will be monitoring the process closely and, if appropriate, will be prepared to put in place arrangements to enable non-counterparties who hold eligible collateral to obtain liquidity against that collateral direct from the Bank.

Contingency preparations. The Bank is confident that the careful planning of operations over the Y2K period undertaken by market participants, and the facilities the Bank has put in place to assist the market, as described above, should ensure that orderly market conditions are maintained over the period. Market participants are well advanced with planning orderly conduct of their business activities over the period. The structure of market rates is consistent with this view: while unsecured rates for the period over the year-end have tightened somewhat, though less than in some overseas markets, secured money rates in the repo market for liquidity obtainable against marketable collateral show no material end-year effect. This indicates that an adequate supply of collateral is available and that liquidity can freely be obtained against it. Nevertheless, the Bank is alert to the possibility that conditions could change, and has undertaken contingency preparations to enable it to respond quickly, in a variety of different ways as necessary, if strains should emerge at any time. These preparations include discussions with overseas central banks to ensure that relevant cross-border developments can if necessary be addressed quickly. The Bank will stand ready to put these contingency preparations into operation if the need should arise.

Market participants are encouraged to remain in close contact with the Bank of England throughout the Y2K period if they have any questions about the arrangements described in this paper or wish to communicate or seek clarification on developments in markets or in their own operations.

Markets and operations

This article reviews developments in domestic and international financial markets and describes Bank of England market operations in the period 30 June to 8 October 1999.

- *Market interest rates rose in the United States, in response to stronger-than-expected economic growth and in anticipation of the Federal Open Market Committee's decision on 24 August to increase the Federal funds target rate by 25 basis points.*

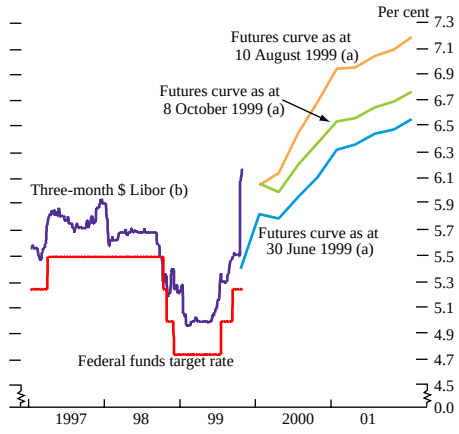
- *The United Kingdom's yield curve also shifted upwards in response to stronger-than-expected activity indicators and, on 8 September, the Bank of England's repo rate was increased by 25 basis points.*

- *In the euro area, official interest rates remained unchanged during the period. Nevertheless, market-based measures of interest expectations rose; three-month rates implied by euribor futures contracts increased by around 35–75 basis points. In contrast, market interest rates fell in Japan.*

- *Expectations of increases in official interest rates and concerns about equity valuations in some countries led to falls in equity indices in the United States, the euro area and the United Kingdom. Partly linked to these developments, the US dollar's exchange rate index depreciated by 5%, while that of the yen appreciated by 11%.*

- *On 31 August, the Bank of England permanently extended the range of securities eligible for use in its repo operations. And on 20 September, the Bank announced a new temporary longer-term repo facility. Both actions will help to promote orderly conditions in the sterling money markets over the period spanning the Millennium date change.*

Chart 1
US official and market interest rates



Source: Bloomberg.

(a) Interest rates implied by eurodollar futures contracts at the three dates specified. From September 1999, the x-axis relates to contract expiry dates.
(b) Three-month Libor increased at the end of September 1999 when the rate started to encompass the calendar year end.

International markets(1)

US developments

Concerns about further possible increases in US official interest rates were an important influence on world financial markets for much of the period, following the policy tightening announced on 30 June. By the time of the Federal Open Market Committee (FOMC) meeting on 24 August, most market participants had come to expect the announced 1/4 percentage point increase in the Federal funds target rate to 5.25%. Relief that there was no announcement of a bias towards tighter policy led market interest rates to fall. At its meeting on 5 October, the FOMC left the target rate unchanged but adopted 'a directive that was biased toward a possible firming of policy going forward', and this was followed by a modest rise in market interest rates.

By 8 October, the three-month interbank rate implied by eurodollar futures for March 2000 was 6.0%, around 20 basis points higher than at the end of June (see Chart 1). Federal funds futures, which provide a clearer indication of expected official interest rates, implied an average Federal funds rate of 5.6% for March 2000.(2)

(1) Further discussion of international economic developments can be found in 'The international environment' article on pages 344–52.
(2) Each month's Federal funds futures contract settles on the simple average of the effective overnight Federal funds rate for that month.

The short-term interest rate curve implied by eurodollar futures shifted up over the period: interest rates for March 2001 and March 2002 increased by 20 basis points. However, at the end of the period, the yield curve implied by eurodollar futures was as much as 40 basis points below the peak reached on 10 August.

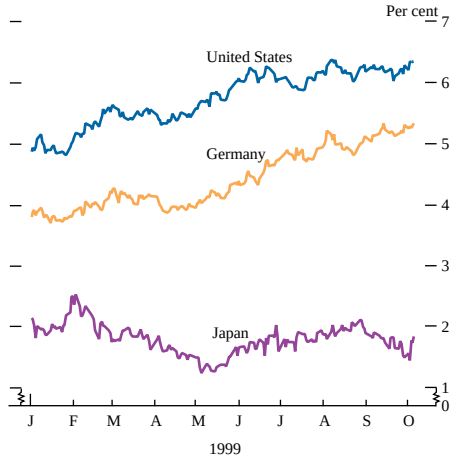
The December 1999 eurodollar futures contract has been affected by concerns that liquidity conditions may deteriorate around the year end because of potential Millennium-related IT problems. The interest rate implied by this contract fell by nearly 10 basis points following the Federal Reserve's announcement, on 8 September, of measures to address liquidity concerns over this period. These included: repos with extended maturities of up to 90 days; an expansion of eligible collateral to include *inter alia* some mortgage-backed securities; and auctions of options to participate in repo transactions with the Federal Reserve Bank of New York in the period around the Millennium date change.(1) Three-month dollar Libor increased by around 60 basis points when the rate began to encompass the year end, reflecting the interest rate premium on lending over that period (see Chart 1). However, Libor is an offshore lending rate, and may not accurately reflect the premium on lending in domestic dollar markets over the year end if lenders differentiate between US-based and overseas-based institutions.

US inflation outturns, as measured by the PPI and CPI, were below expectations in Q3; short-term market interest rates fell in response to these data releases. But other data led market interest rates to rise. Both the May and July trade figures (released on 20 June and 21 September respectively) triggered large increases in money-market rates, as did some of the monthly labour and retail sales releases. However, data announcements which precipitated substantial falls in equity prices also tended to diminish concerns that interest rates might need to rise—because of the anticipated negative effect of lower equity prices on personal sector wealth and corporate balance sheets, and thus on aggregate demand. Towards the end of the period in particular, implied future interest rates tended to fall on days when US equity prices fell. The main US equity market indices ended the period lower (see the box on pages 330–31).

Ten-year Treasury yields averaged slightly above 6.1% in Q3, around 40 basis points higher than the second-quarter average (see Chart 2), but moved in a narrower range than in the previous four quarters. The Treasury market responded to domestic economic data in much the same way as the eurodollar futures market. However, the spread between US swap rates and Treasury yields widened further in Q3, and exceeded the levels seen during the financial turbulence of autumn 1998, with the ten-year US swap spread reaching 110 basis points at times (see Chart 3).

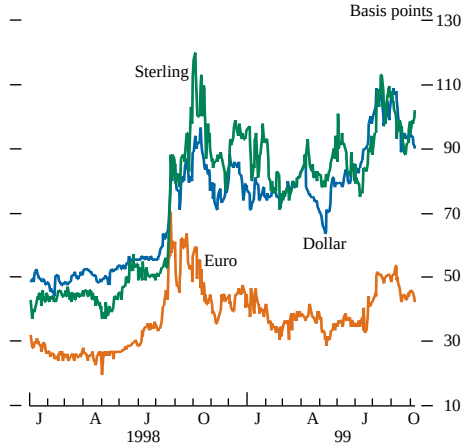
The widening of swap spreads is unlikely to have reflected perceptions of greater credit risk alone; US corporate bond spreads over US Treasuries rose by much less.(2) There are four possible explanations.

Chart 2
Nominal ten-year government bond yields(a)



(a) Derived from Svensson par yield curves.

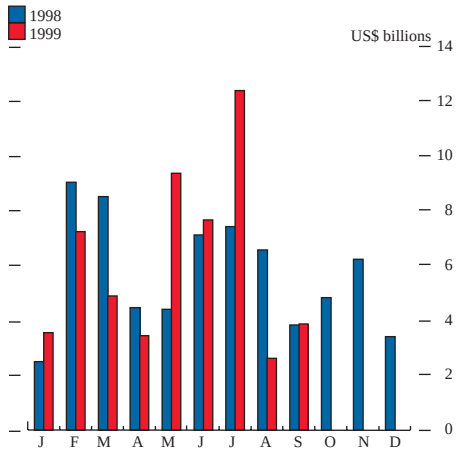
Chart 3
Ten-year swap spreads, by currency



Source: Bloomberg.

(1) For further details of the Federal Reserve's arrangements, and those of other central banks, see Issue 6 of the Bank of England's *Financial Sector Preparations for the Year 2000* series. On 21 October, the Federal Reserve made an additional Y2K announcement, expanding the collateral acceptable for discount window and payment system risk purposes.
(2) The ten-year US corporate bond spread for AA-rated corporate bonds widened from around 100 basis points at end June to 115 basis points on 8 October. Its peak was around 125 basis points, reached in early August.

Chart 4
US corporate dollar-denominated bond issuance[a]



Source: Capitaldata Bondware.

(a) Internationally targeted issuance by private sector banks, other financial institutions, utilities and other corporates.

First, US corporates are understood to have brought forward debt issuance from Q4 in order to avoid possible funding difficulties close to the Millennium date change. Chart 4 illustrates the sharp increase in US corporate bond issuance in July. Because of fears of an increase in short-term interest rates, corporate issuers may have been less inclined than usual to enter into swaps to pay floating and receive fixed interest. Such a fall in the demand to receive fixed interest would lead swap rates to rise in absolute terms, and perhaps also relative to US Treasury yields. At the same time, the increase in corporate issuance may have required underwriters to carry significant inventory. With liquidity in the Treasury market diminishing, and with market participants more aware of the basis risk involved in hedging a corporate issue by forward selling government paper, these transactions are being hedged increasingly by paying fixed interest in a swap transaction. A switch by underwriters towards hedging through swaps, rather than US Treasuries, increases the demand to pay fixed, putting upward pressure on swap rates and spreads.

Second, there may also have been a similar change in hedging behaviour associated with mortgage-backed securities. When longer-term interest rates rise, the probability of early repayment of fixed-rate mortgages declines and so their effective duration lengthens.[1] The holders of mortgage-backed assets typically offset this increase in duration by selling longer-duration government bonds. However, this adjustment is also increasingly being accomplished by paying fixed income in the swap market. Increased demand to pay fixed will have put upward pressure on swap rates. At the same time, there will have been less upward pressure on Treasury yields, leading swap spreads to widen.

Third, on 4 August, the US Treasury announced proposals to buy back Treasury notes and bonds over the next ten years, as a result of its strong fiscal position. This may have increased the premium on Treasury securities over private sector assets.

Fourth, increasing concerns about market conditions over the Millennium date change may have strengthened the demand for Treasury securities, because they are eligible for use in the Federal Reserve's open market operations, thus widening swap spreads.

By 8 October, the ten-year dollar swap spread had narrowed to 90 basis points, still high by historical standards. Three factors may explain the narrowing. First, US corporate bond issuance is believed to have declined in August and September (see Chart 4), reducing underwriters' inventories and their recourse to hedging via swaps. Second, it is possible that hedging activity associated with the lengthening duration of mortgage-backed securities declined. Third, some of the narrowing in spreads coincided with the Federal Reserve's announcement of its year-end liquidity measures, which may have eased concerns about poor market conditions over the year end. The decision to expand the range of eligible collateral reduced the premium of Treasuries over private sector assets, including mortgage-backed securities in particular.

(1) Duration measures the average life of a bond, weighted by the size and frequency of a bond's coupon payments and the repayment of principal. If cash flows are postponed, the duration of the bond increases. The longer the duration of a bond, the greater the bond's price sensitivity to a given change in interest rates.

International equity market valuations

Equity prices fell during the third quarter in the United States, and the United Kingdom and were almost unchanged in Germany (see the table below). The September Merrill Lynch Fund Managers Survey indicated that a majority of fund managers continue to regard US equities as overvalued. However, the degree of perceived overvaluation has fallen (see Chart A).

International equity market performance

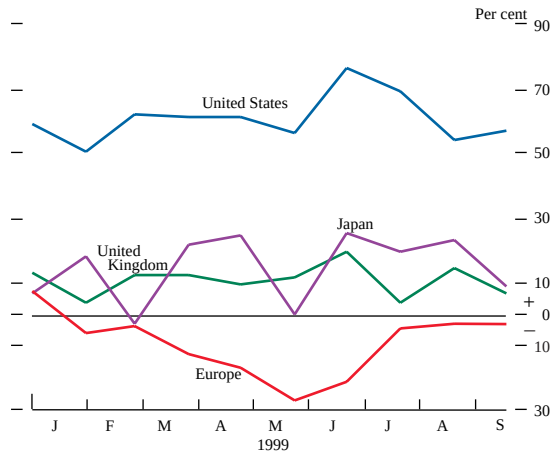
Percentage changes between ends of period, in local currencies

Index	1998 Year	1999 Q1	Q2	Q3 (a)
United States				
S&P 500	26.7	4.6	6.7	-2.7
Dow Jones 30	16.1	6.6	12.1	-2.9
Nasdaq	39.6	12.3	9.1	7.5
Europe				
FTSE 100	14.5	7.0	0.4	-1.9
Dow Jones Euro Stoxx 50	32.0	6.5	6.4	-0.1
Dax (Germany)	17.7	-2.4	10.1	0.8
CAC 40 (France)	31.5	6.5	8.1	4.1
Japan				
Nikkei 225	-9.3	14.4	10.7	3.0

Source: Bloomberg.

(a) 1 July–8 October 1999.

Chart A
Balance of fund managers saying that equity markets are overvalued



Source: Merrill Lynch.

One way to assess market valuations is to use the conventional equity valuation model: the dividend discount model. This states that the current equity price, P_t, is equal to the present value of future dividends expected at time t:

$$P_t = \sum_{i=1}^{\infty} \frac{D^e_{t+i}}{(1+\rho_t)^i} \qquad \textbf{(1)}$$

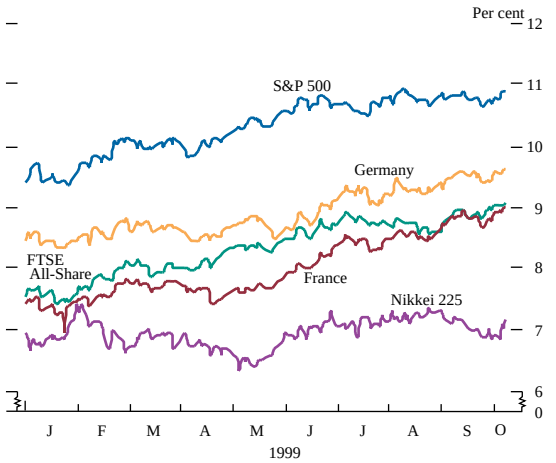
where ρ_t is the relevant discount rate. If dividends are expected to grow at a constant rate, g^e_t, then equation **(1)** can be simplified and rearranged as:

$$g^e_t = \frac{\rho_t - d_t}{1+d_t} \qquad \textbf{(2)}$$

where d_t is the prevailing dividend yield (D_t/P_t). The discount rate is assumed to consist of a risk-free component and a premium for the risk associated with the return on equities. If we assume that government bond yields are a good proxy for the risk-free rate and that the equity risk premium is constant, then we can use the formula above to trace out the expected growth rate of dividends implicit in market valuations. In what follows, the ten-year nominal bond yield is used as a proxy for the risk-free rate and an equity risk premium of 6% is assumed, consistent with historical evidence of the excess returns on equities relative to bonds.

It is interesting to see how these implicit expected dividend growth rates change over time in each market and how the levels compare across markets. Chart B shows that in all markets except Japan, implied future nominal dividend growth rates have increased since the beginning of the year. However, they have remained broadly constant in the United States in recent months. This finding is consistent with changes in the short-term outlook for growth in these economies: the United States is expected to slow as growth in Europe picks up. Implied future dividend growth in the United States appears high relative both to other countries and to historical experience. This perhaps explains fund managers' concerns about valuations. However, one qualification is that the above calculation assumed a constant equity risk premium of 6%. In practice, we do not know the current level of the equity risk premium, and historical experience may not be a good guide to its current size.

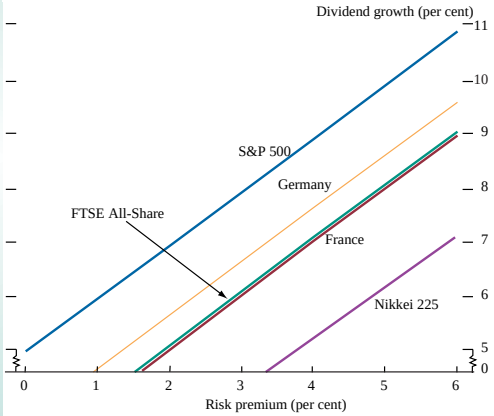
Chart B
Implied nominal dividend growth rates



Sources: Bank of England and Datastream.

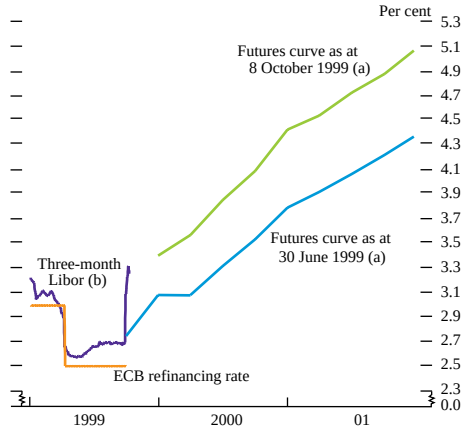
Chart C shows future dividend growth rates implicit in market valuations, based on different assumed values of the equity risk premium. It indicates that the equity risk premium would have to be close to zero for the 8 October valuation of the S&P 500 to be consistent with the historical growth rate of US nominal dividends of 5¼%. It is of course possible that recent changes in technology may have raised the trend growth rate of dividends, or that the volatility of business cycles and hence the equity risk premium has fallen. Hence, current valuations suggest either that the equity risk premium is lower than historical excess returns, or that dividend growth will be higher in the future than in the past. Chart C also indicates relatively high dividend growth expectations in Germany, France and the United Kingdom.

Chart C
Implied nominal dividend growth/risk premium trade-offs as at 8 October 1999



Sources: Bank of England and Datastream.

Chart 5
Euro-area official and market interest rates



Source: Bloomberg.

(a) Interest rates implied by euribor futures contracts at the two dates specified. From September 1999, the x-axis relates to contract expiry dates.
(b) Three-month Libor increased at the end of September 1999 when the rate started to encompass the calendar year end.

Euro-area developments

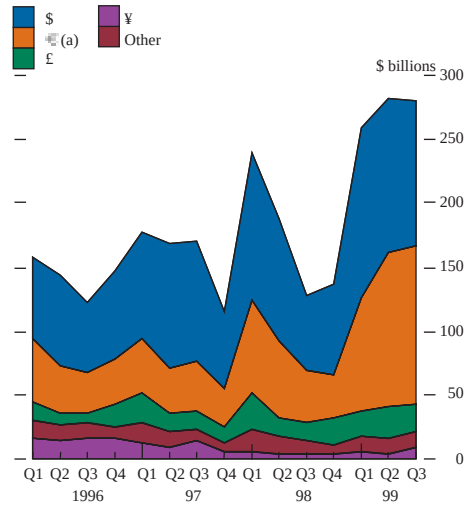
Euro-area official interest rates remained unchanged in Q3, but market expectations of a rise in the ECB's repo rate grew. Short-term interest rates implied by euribor futures increased over the quarter, by around 30 basis points for end 1999, 60 basis points for end 2000 and 70 basis points for end 2001 (see Chart 5). Similarly, business economists' rate expectations increased by around 40 basis points over the period.(1) Bund yields increased by some 50 to 80 basis points for all maturities (ten-year yields are shown in Chart 2).

Market interest rates increased in response to signs of a strengthening economic outlook for the euro area, accompanied by perceptions in the market that a bias to tighten monetary policy was gradually creeping into the ECB Governing Council's discussions. PMI surveys for the largest euro-area economies and M3 data releases for the euro area as a whole were generally stronger than expected. In France, activity measures such as industrial production and consumer expenditure, as well as measures of business and consumer confidence, also exceeded expectations. Consequently, business economists revised their forecasts for French GDP growth upwards. In Germany, confidence indicators were strong, but activity measures were generally weaker than expected. News of higher German import prices (largely reflecting an increase in the price of oil) raised interest rate expectations, but there was little market reaction to euro-area PPI and CPI data. The euro exchange rate (see below) was also an important influence on interest rate sentiment, especially in July, when the euro fell to a new low against the dollar.

Although euro-denominated non-government international bond issuance remained high in Q3 (see Chart 6), euro swap spreads remained much narrower than in the United States and the United Kingdom (see Chart 3). This may have reflected the greater supply of government debt in the euro area. Nonetheless, euro swap spreads did widen over the quarter, influenced by some of the same factors that affected dollar swap spreads.

(1) A Reuters poll of business economists, conducted on 4–6 October, found the average forecast of the ECB repo rate to be 3.1% for July 2000, up from 2.7% three months earlier. The July 2000 forecast is interpolated for the 4–6 October poll (from forecasts for April 2000 and October 2000). The business economists polled differed between the two surveys.

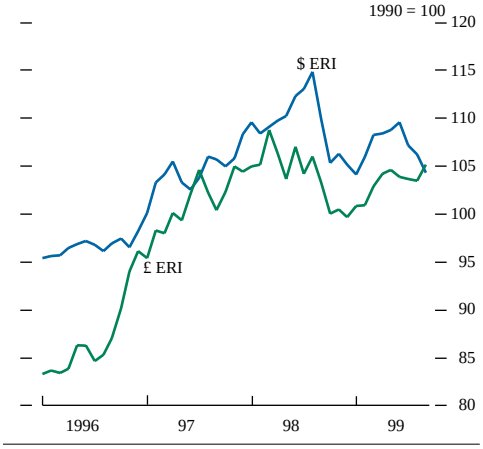
Chart 6
Non-government international bond issuance, by currency



Source: Capitaldata Bondware.

(a) Based on issuance in the eleven euro-area legacy currencies before 1 January 1999.

Chart 7
US dollar and sterling effective exchange rates



Japanese developments

Japanese market interest rates continued to fall over the period as the Bank of Japan (BoJ) maintained its policy of near-zero overnight call money rates and as the yen appreciated. By 8 October, three-month interest rates implied by euroyen futures were around 50 basis points lower than at the end of June, at around ½% for end 2000, rising to around 1% for end 2001. Data releases generally showed improving economic conditions in Japan. When stronger-than-expected data were released, interest rates implied by futures tended to increase. On balance, however, statements by the BoJ about its policy intentions tended to have a greater impact and short-term market rates fell. This contrasted with the rise in the Nikkei and the appreciation of the yen in response to the same data releases.

Yields on ten-year Japanese government bonds (JGBs) rose slightly in July and August, before falling back in September (see Chart 2). The principal stimulus for rising JGB yields was probably changing market sentiment about the likelihood of an increase in fiscal spending. Some market participants were concerned that the supply of JGBs would increase if greater reliance were placed on fiscal rather than monetary policy to promote economic growth. In September, the main factor behind the fall in ten-year yields was the strength of the yen. Falling bond yields were sometimes also associated with large falls in the Nikkei index. Speculation by market participants that the BoJ might increase money-market liquidity further by buying JGBs may also have been an influence.

Foreign exchange markets

The US dollar depreciated in the period under review, by 11.2% against the yen and by 4.6% and 2.9% against sterling and the euro respectively. Its exchange rate index fell by 5.0% (see Chart 7).

The dollar's depreciation occurred in spite of monetary policy tightening by the FOMC and a rise in the US yield curve over this period (see above).(1) To some extent, this reflected the fact that US market interest rates increased by less than in other currencies (including sterling and the euro). But, in addition, the dollar seemed more sensitive to the performance of the US stock market than to shifts in the yield curve. Falls in equity prices tended to be accompanied by falls in the dollar: the correlation coefficient for daily returns in the S&P 500 index and changes in the euro-dollar exchange rate was more than 0.5 during this period (compared with an average of around 0.25 in the first half of the year). One possible explanation is that the news that made a rise in interest rates seem more likely—such as stronger-than-expected economic data—made market participants more concerned about the outlook for US domestic demand and the prospect of a sharp correction in equity prices (see the box on pages 330–31). This news may also have increased concerns about the financing of the US current account deficit.(2) US equities and the dollar both fell after the FOMC announcement on 5 October that it had adopted a bias towards tightening monetary policy. Data from options markets suggest that, at the end of the period, investors had a preference for

(1) It is possible to decompose movements in exchange rates into those that result from changes in either domestic or overseas interest rate changes—so-called 'monetary news'—and those that result from other factors: see 'Decomposing exchange rate movements according to the uncovered interest rate parity condition' by Brigden, Martin and Salmon, *Bank of England Quarterly Bulletin*, November 1997, pages 377–89.

(2) The US current account deficit, currently some 3½% of GDP, was financed in 1998 by net foreign purchases of US bonds ($224 billion), net foreign purchases of US equities ($43 billion) and net foreign direct investment ($193 billion).

Chart 8
Dollar-euro exchange rate

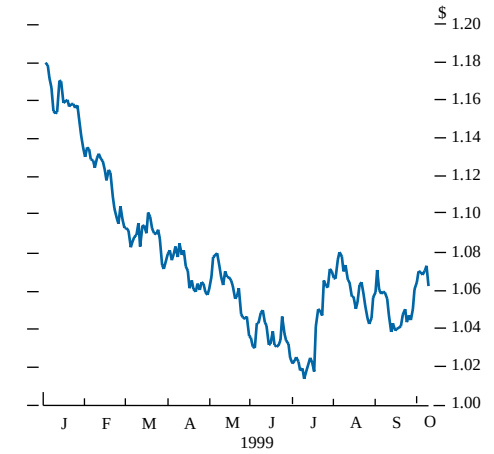


Chart 9
Yen exchange rates

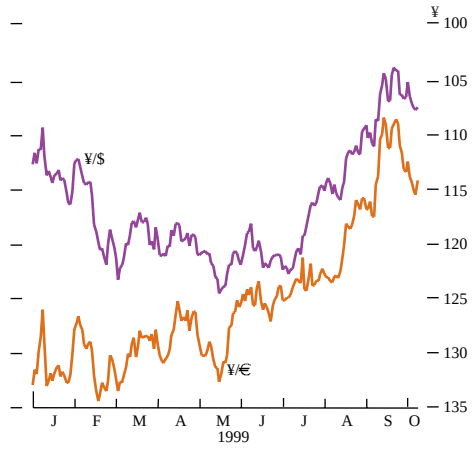
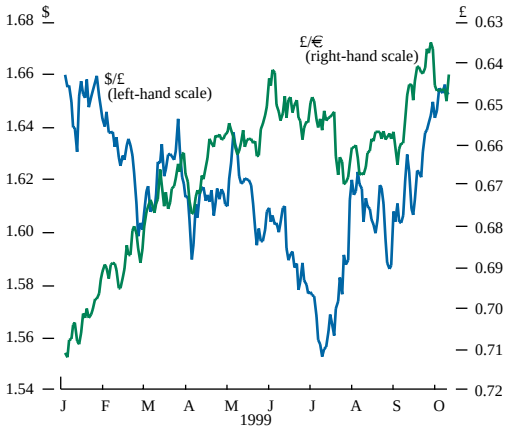


Chart 10
Sterling exchange rates



protection against dollar depreciation against the yen, the euro and to a lesser extent the pound, rather than protection against dollar appreciation.(1)

The exchange rate index of the euro fell by 1.0% between 30 June and 8 October. The euro appreciated by some 3% against the dollar, but depreciated by 8.6% against the yen and 1.8% against sterling (see Charts 8, 9 and 10).

The euro continued to depreciate against the dollar until mid July, reflecting ongoing concerns about the prospects for growth in the largest euro-area countries and amid increasing market speculation about the possibility of parity with the dollar being breached. On 14 July, the euro reached a low of just above $1.01¼. Thereafter it recovered, with the change in sentiment said to reflect both increasing optimism about the outlook for the euro-area economy, a perceived increase in the probability of a rise in official rates by the ECB, and concerns about possible weakness in US asset markets.

The Japanese yen appreciated against all major currencies during the period, and the yen exchange rate index rose by 11.1%. On 15 September, the yen reached a three-year high against the dollar, close to ¥103¼, and a record high against the euro of around ¥107 (see Chart 9). The appreciation of the yen partly reflected the unexpected strength of the Japanese economy. The prospect of stronger growth attracted capital inflows into Japan as foreign investors sought to increase their exposure to yen assets. Merrill Lynch's regular surveys of the asset allocation intentions of US fund managers suggested that the demand for Japanese equities continued to be strong. Japanese institutions are also thought to have sold loss-making foreign (particularly euro) assets and converted the proceeds into yen ahead of the half-year end on 30 September. So flows between euros and yen occasionally attracted more market attention than flows in the normally more active dollar-yen market.

The Bank of Japan was reported to have intervened on three occasions in July and twice in September, selling yen and buying dollars, in order to moderate the yen's appreciation. Although the yen continued to appreciate, the market remained nervous about the possibility of further intervention. As already noted, data from options markets suggested that, at the end of the period, investors continued to have a preference for protection against further yen appreciation against the dollar; and implied volatilities remained above their historical average levels.

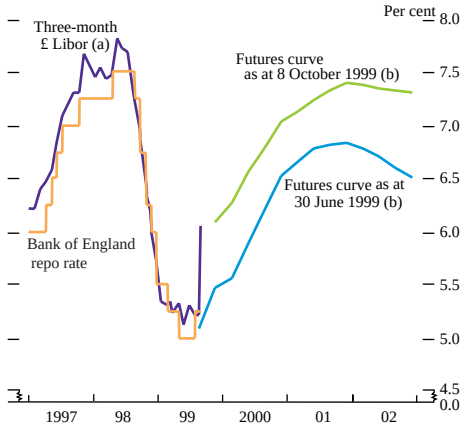
Sterling

Sterling appreciated over the period by 1.8% against the euro and by 4.9% against the dollar (see Chart 10), but depreciated by 6.9% against the yen. Its exchange rate index (in which the euro has a 65% weight) rose by 1.7%. Relative interest rate movements help to explain sterling's rise against the dollar and the euro.

In July and August, sterling continued to receive support from actual and anticipated mergers and acquisitions activity, with inward takeovers of UK companies generating demand for sterling in excess of the supply generated by outward takeovers by UK

(1) Risk reversals showed dollar puts to be more expensive than dollar calls.

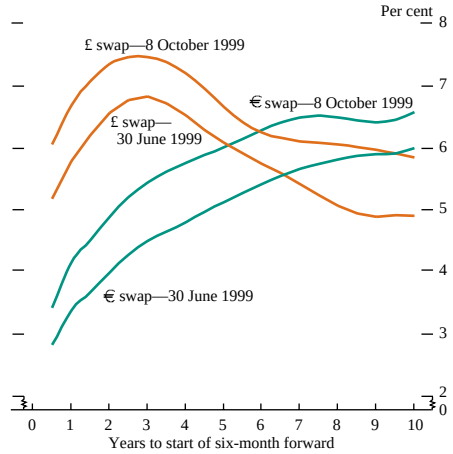
Chart 11
UK official and market interest rates



Sources: Bank of England and Bloomberg.

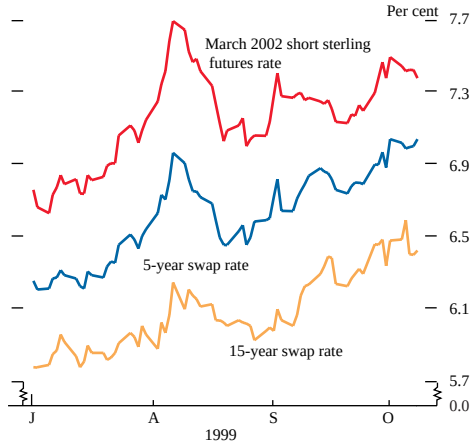
(a) Three-month Libor increased on 1 October 1999 when the rate started to encompass the calendar year end.
(b) Interest rates implied by short sterling futures contracts on the dates specified. From September 1999, the x-axis relates to contract expiry dates.

Chart 12
Sterling and euro six-month forward swap rates



Sources: Bank of England and Bloomberg.

Chart 13
UK futures and swap rates



Source: Bloomberg.

companies. However, sterling was influenced primarily by sentiment towards other currencies, rather than by UK-specific factors. Sterling more than reversed its Q2 decline against the dollar in this period, and reacted little to UK data releases, even those that differed substantially from market expectations. Likewise, sterling's depreciation against the euro in August seemed mainly to reflect the euro's recovery.

Following the MPC's decision to increase UK interest rates on 8 September, sterling appreciated sharply. Towards the end of the period it reached an eight-month high against the dollar of around $1.66 and a record high of £0.632 against the euro (equivalent to just under DM3.10). Sterling's exchange rate also appeared to be boosted by continuing demand related to the inward takeover of UK companies. The MPC's decision to leave official interest rates unchanged on 7 October was accompanied by a small appreciation of sterling.

Sterling markets

Interest rates

The MPC left the Bank's repo rate unchanged at 5.00% at its July and August meetings. Although both of these outcomes were widely expected, a sharp market reaction followed the August announcement (see below). On 8 September, the MPC voted to raise the repo rate by 25 basis points to 5.25% (see Chart 11). This was the first increase since June 1998, and its timing came as a surprise to most market participants; the interest rate implied by the December 1999 short sterling futures contract immediately increased by roughly the full amount of the policy change. The Bank's repo rate was left unchanged at the October MPC meeting, as the market had expected.

Reflecting the rise in the Bank's repo rate in September and increasing evidence of the strength of domestic activity, future interest rates implied by futures and swap markets rose during the period. The six-month forward interest rate curve derived from the swap market shifted up by around 60 basis points at five years and 95 basis points at ten years, and the implied peak in interest rates moved forward slightly, suggesting that it would be reached sooner (see Chart 12).

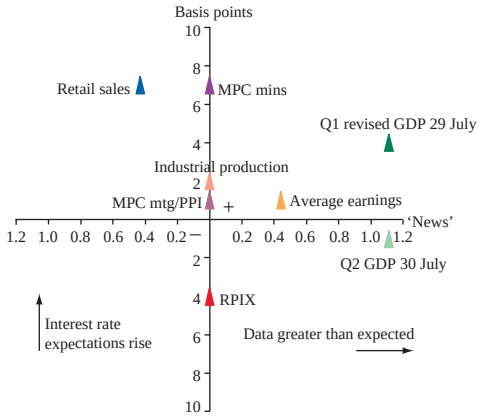
Much of the rise in sterling interest rates occurred during the second half of July and the first week in August (see Chart 13). In early July, many market participants thought that a further lowering of the Bank's repo rate was possible, but talk of a 5% 'floor' emerged as the month progressed. The MPC minutes published on 21 July reinforced this view; market commentary noted the Committee's discussion of the possible need to reverse June's repo rate reduction. Implied future interest rates also rose in response to stronger-than-anticipated data released in July for average earnings, Q1 GDP and retail sales (see Chart 14).(1) Oil prices continued to rise and there were indications that UK house price inflation was gathering pace. Reflecting these developments, most private sector economists revised their projections for UK growth upwards during the third quarter—the mean forecast for growth in 1999 derived from Consensus Economics' early October survey rose to 1.7%, from 0.9% in mid June. Rising interest rate expectations in the

(1) Although the monthly change in June retail sales was weaker than expected, the rise in the annual growth rate, which reflected revisions to back data, came as a surprise.

CONNECT

On 6 September, the London International Financial Futures and Options Exchange (LIFFE) listed three-month short sterling futures contracts for intra-day trading on LIFFE CONNECT, the electronic screen-based trading system. CONNECT is being run in tandem with the open outcry system until 19 November. The percentage of trade transacted on CONNECT was steady in the first month, averaging 24% of total trading in these contracts. Intra-day electronic trading was extended to LIFFE's euribor and eurolibor three-month futures contracts on 20 September.

Chart 14
Effect of July data releases on interest rate expectations(a)



Sources: Bank of England and Bloomberg.

(a) 'News' is measured as the data outturn minus the median survey-based market expectation, divided by the standard deviation of past surprises. Interest rate expectations are measured by the change in the interest rate implied by the September 1999 short sterling futures contract between close of business the day before the data release and close of business on the day of the data release.

Table A
Interest rate expectations for December 2000

Per cent

	14–16 July	2 September	30 September
Short sterling futures (a)	6.36	7.03	6.96
Reuters survey (b)	5.38	5.77	6.03
Difference	*0.98*	*1.26*	*0.93*

Sources: Bloomberg and Reuters.

(a) Adjusted to remove year-end effects by interpolating interest rates implied by September 2000 and March 2001 contracts. Contracts settle on three-month Libor.
(b) Economists' forecasts relate to the Bank's repo rate at end December 2000.

United States and the euro area added to the upward pressure on UK money-market interest rates.

In addition, market anecdote continued to identify the unwinding of EMU convergence positions as an influence on futures and swap rates. These positions were initially established in the expectation that UK and euro interest rates would converge over the next few years, with short-dated UK rates falling and long-dated UK forward rates rising to euro-area levels (see Chart 12). Following the European Parliament elections, markets became less confident of early UK participation in the single currency, and there were sales of longer-dated UK sterling futures contracts and operations in the swap and bond markets to receive forward fixed interest. These position-closing transactions may help to explain the sharp rise in interest rates implied by short sterling futures and the continuing downward pressure on the long end of the yield curve in late July and early August (see Chart 13).

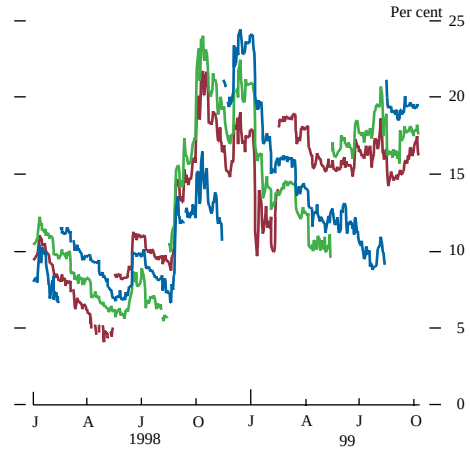
At times, short-term market positioning may also have exaggerated these interest rate movements. For example, although the market was not surprised when the Bank's repo rate was left unchanged at the August MPC meeting, some traders had expected a 'relief' rally (a rise in the price of the futures contracts) to follow. When this failed to materialise, these traders sold their loss-making futures contracts, pushing implied rates higher.

Over the summer, future short-term interest rates implied by the short sterling futures market diverged from those forecast by private sector economists (polled by Reuters). On 14–16 July, the difference between these two measures of interest rate expectations for the December 2000 period was nearly 100 basis points (see Table A). This gap widened to around 125 basis points in early September. The two measures of expectations are not directly comparable, however. The futures contracts relate to three-month Libor, and this is usually higher than the Bank's official two-week repo rate, to which the polls refer.(1) Furthermore, the size of this difference will be greater when interest rates are expected to rise. Nevertheless, even allowing for these considerations and for the possibility of genuine differences in rate expectations between economists and traders, the gap still appears unusually large. Two factors may help to explain it. First, increased risk-aversion (associated with a desire for lower leverage among some fund managers) may have inhibited market participants from pushing the rates implied by futures markets closer into line with economists' expectations. And second, the rapid change in market participants' views about the likely date of the turning-point in the interest rate cycle may have prompted significant position-closing sales of futures contracts. This, combined with the closing of EMU convergence trades described above, could have pushed interest rates implied by futures markets to levels which exceeded actual interest rate expectations.

Implied volatilities derived from options on short sterling futures contracts were high by recent historical standards in Q3 and in some cases rose during the period (see Chart 15). Volatilities did not return to the levels seen at the height of the Russian and Long Term Capital Management crises last year, but were much higher than in the first half of 1998. The high volatility measures may be

(1) For a fuller discussion of the relationship between Libor and the Bank's repo rate, see the November 1997 *Quarterly Bulletin*, page 331.

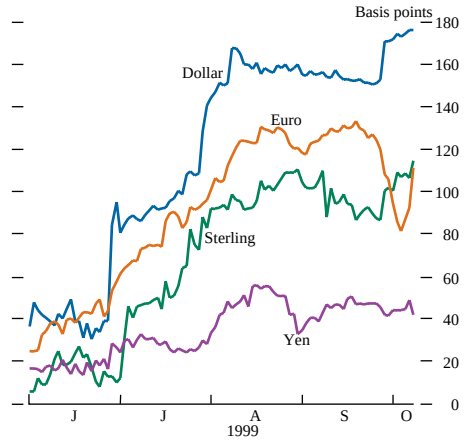
Chart 15
Implied volatility of front three short sterling contracts(a)



Sources: Bank of England and Bloomberg.

(a) Contracts switched one month prior to expiry date.

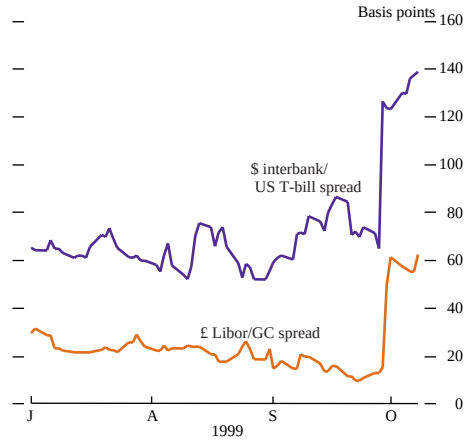
Chart 16
December interest rate premium(a)



Sources: Bank of England, Bloomberg and BBA.

(a) Measured as the difference between the December one-month forward interbank rate and the average of the November and January one-month forward interbank rates.

Chart 17
Spreads between unsecured and secured three-month lending rates(a)



Sources: Bank of England and Bloomberg.

(a) For the United Kingdom, £ Libor rate minus GC repo rate. For the United States, $ interbank rate minus Treasury bill yield.

further evidence of increased risk-aversion, but they could also have been influenced by rapid portfolio adjustments as interest rates appeared to reach a turning-point.

Unsecured deposit rates continued to be affected by year-end factors. Chart 16 plots the interest rate spread between the interbank one-month forward rate implied for December and the average of the forward rates implied for November and January in the United Kingdom, United States, Japan and the euro area. In the United Kingdom, this spread rose from around 20 basis points in June to around 100 basis points by the second half of August, and has maintained this level since. Also, as from 1 October, when the repayment date of three-month interbank deposits moved into the year 2000, the spread of three-month sterling Libor against the three-month general collateral (GC) repo rate widened sharply to around 60 basis points, from around 15 basis points (see Chart 17). US money markets experienced similar developments.

Other influences on short-term interest rates were the Bank's permanent extension of the range of collateral eligible for use in open market operations (described on page 341) and its announcement on 20 September of a temporary longer-term repo facility over the year end, enabling counterparties to repo eligible securities to the Bank for a longer term than in its usual market operations. Following the latter announcement, the implied interest rate for the December short sterling futures contract fell slightly relative to the interest rates implied by 2000 contracts, suggesting a reduced premium for lending over the year end.

Conventional gilts

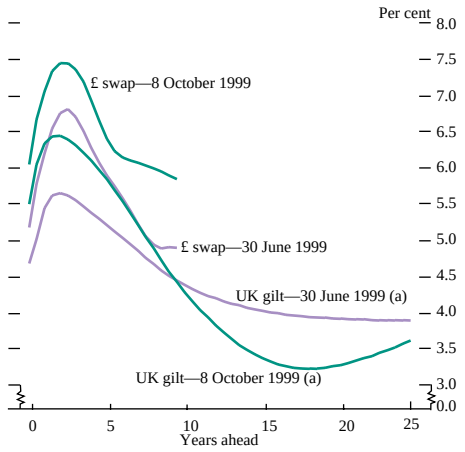
Nominal par gilt yields rose during the period under review, by around 90, 60 and 10 basis points for 2, 10 and 25-year maturities respectively.(1) Thus the gilt curve inverted further during the period. Movements in short-dated gilt yields and swap rates were broadly similar, but at the ten-year maturity and beyond swap spreads widened. Six-month forward rates derived from gilts also increased by around 90 basis points at two years but were unchanged at the ten-year horizon, and fell further out along the curve (see Chart 18).

Following the Bank's announcement on 30 July of its plans to extend the range of collateral eligible for use in its daily repo operations, the yield on short-dated gilts (notably 8% Treasury 2000 and 10% Treasury 2001) rose. This reflected lower demand to hold gilts for use in repo operations since UK banks would in future have a much wider choice of assets to hold to meet their liquidity needs.

The rise in longer-dated gilt yields was dampened by the ongoing and relatively price-insensitive demand from UK insurance companies and pension funds for such assets. Many funds buy long-dated fixed interest debt to hedge guaranteed minimum annuity rates. In addition, the Minimum Funding Requirement, applied under the Pensions Act 1995, continues to be cited as encouraging the holding of long-dated conventional and index-linked gilts; demographic change will tend to increase this demand.

(1) Derived from the VRP fitted curve. For an explanation of this fitting technique, see the article on pages 384–92.

Chart 18
UK gilt and swap six-month forward rates(a)



(a) Derived using the VRP curve fitting technique.

Table B
Gilt market turnover

£ billions nominal value

	1998			1999		
	Q2	Q3	Q4	Q1	Q2	Q3
Gilts						
Conventional	406	411	347	368	357	233
Index-linked	11	7	7	7	7	3
Total	**417**	**418**	**354**	**375**	**364**	**236**
Futures						
Long gilt futures contract (a)	316	419	241	262	231	211

Sources: London Stock Exchange and Bloomberg.

(a) Relates to the front two contracts traded in the quarter.

Two other developments during the period moderated institutional demand for longer-dated gilts. First, on 6 July the Inland Revenue announced new options to make tax-approved occupational pension schemes more flexible. The changes related to the rules governing the payment of additional voluntary contributions (AVCs), and were interpreted by markets as suggesting that pension fund demand for long-dated gilts would be lower. And second, on 9 September, the High Court ruled that the Equitable Life Assurance Society had discretion on granting guaranteed rates of annuity. The ruling was interpreted by market participants as indicating that there could be less demand from life assurance companies to hold and purchase long-dated gilt-edged stocks; as a result, yields in this part of the curve edged higher following the ruling.

Participants talked of poor liquidity conditions in the gilt market during Q3, particularly for longer maturities. Turnover in the gilt market fell sharply in Q3 to £236 billion, from £364 billion in Q2 (see Table B). Furthermore, the total volume traded by the front two long gilt futures contracts also declined during the quarter. This deterioration in liquidity seems to be largely related to the limited supply of gilts and the continuing strength of price-insensitive demand, mentioned above. In an attempt to help liquidity at the long end of the yield curve, the UK Debt Management Office (DMO) issued a nominal £400 million tap of 6% Treasury 2028 at the beginning of August.

During the period, the DMO held one auction of conventional gilts, one auction of index-linked gilts, and completed a conversion operation (see Table C). On 13 September, the DMO published its response to the consultation document of 7 July on switch auctions and 'cash-plus' conversion offers.(1) Respondents generally welcomed the concept of switch auctions as a portfolio and market management tool, and the DMO decided to proceed broadly along the lines outlined in the original consultation document. Also, at the end of September, the DMO made the Q4 funding announcement: 2½% Index-linked Treasury 2016 and 6% Treasury 2028 were to be auctioned on 27 October and 24 November respectively. A switch auction from 8% Treasury 2003 into 5% Treasury 2004 was scheduled for 21 October.

Other sterling bond issues

Total fixed-rate issuance (other than gilts) was £11.6 billion in Q3, slightly less than in the previous three quarters but substantially

Table C
DMO operations

Auctions

Date	Stock	Amount issued (£ millions)	Cover	Yield at common accepted price	Lowest accepted price
28.07.99	2½% Index-linked Treasury Stock 2011	375	1.93	2.19%	£225.50
06.08.99	6% Treasury Stock 2028 (a)	400	n.a.	4.45% (b)	£125.30 (b)
28.09.99	5¾% Treasury Stock 2009	2,750	2.54	5.71% (c)	£100.30

Conversion

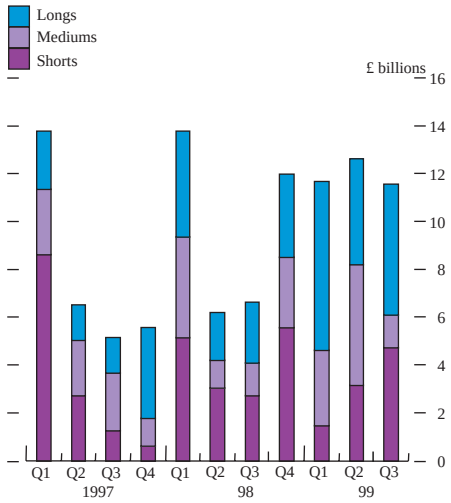
Date	Source stock	Nominal converted (£ millions)	Destination cover	Nominal converted into (£ millions)
22.07.99	9½% Treasury Stock 2004	3,100	5% Treasury Stock 2004	3,800

Notes: n.a. = not available.
Real yields are calculated assuming 3% inflation.

(a) For sale by tap.
(b) Yield and price when exhausted.
(c) Yield at lowest accepted price.

(1) See 'Response to DMO consultation document on switch auctions and cash-plus conversion offers' available on the DMO's web site at: www.dmo.gov.uk.

Chart 19
Sterling non-government bond issuance(a)



(a) By maturity: shorts <7 years, mediums 7–15 years and longs >15 years.

Table D
Sterling bond issuance in Q3

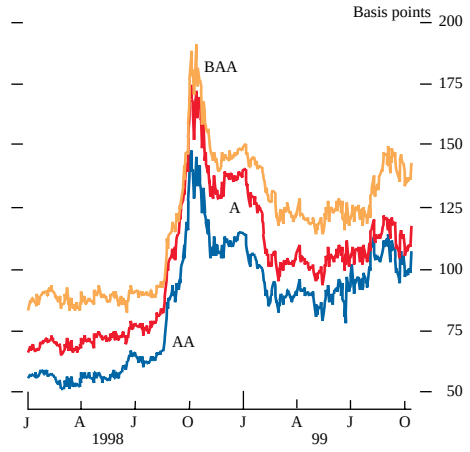
	Number of companies	Amount (£ billions) Total	By credit rating: AAA	AA/A	BBB and below
Fixed-rate issues					
UK corporates	9	1.6	0.0	0.5	1.1
UK financials	14	3.4	0.1	2.9	0.4
Overseas corporates	4	1.5	0.9	0.6	0.0
Overseas financials	17	4.6	3.4	1.1	0.1
Overseas public sector	3	0.5	0.3	0.2	0.0
Total (a)	**47**	**11.6**	**4.7**	**5.3**	**1.6**
	51	*12.6*	*5.0*	*4.7*	*2.9*
Floating-rate issues					
UK financials	10	2.3	0.4	1.1	0.8
Overseas financials	2	0.4	0.2	0.2	0.0
Total (a)	**12**	**2.7**	**0.6**	**1.3**	**0.8**
	20	*5.2*	*1.9*	*1.9*	*1.4*

Note: Credit-rating figures may not sum to sector totals because of rounding.

Sources: Bank of England, credit ratings from Moody's, and Standard and Poor's.

(a) Q2 figures shown in italics.

Chart 20
UK corporate bond spreads by Moody's credit ratings(a)



Sources: Bank of England and Bloomberg.

(a) Derived from five-year corporate bonds, and comparable duration-matched gilts.

more than in 1998 Q3 (see Chart 19). More than half the issues (£6.3 billion) were announced in July.

Redemption flows, from the maturity of the 6% 1999 gilt (on 10 August) and several large eurobonds, generated demand for shorter-dated stock; £4.8 billion of bonds with maturities of less than seven years were issued in the quarter. There was less appetite for medium-dated stock, with just £1.3 billion issued. However, a wide variety of UK and overseas borrowers targeted the ongoing institutional demand for long-dated sterling bonds to take advantage of the inverted yield curve. Consequently, total issuance of long-dated bonds (more than 15 years) reached £5.5 billion.

Mergers and acquisitions were again a significant motivation for corporate bond issuance, with bonds increasingly being used in preference to bank lending. Lloyds TSB's takeover of Scottish Widows and National Westminster's bid for Legal & General were both financed through bonds in the form of subordinated, callable perpetuals, totalling £880 million and £525 million respectively. There were also several securitised issues enabling firms to refinance acquisitions or finance new investments.

Non-financial UK corporates raised £1.6 billion in fixed-rate issues, rather less than in previous quarters. The market had expected corporate borrowers to bring forward funding plans from Q4 out of concern that market liquidity might deteriorate ahead of the year end and also to lock in funding ahead of the expected rise in UK interest rates. But this effect appears to have been smaller than expected.

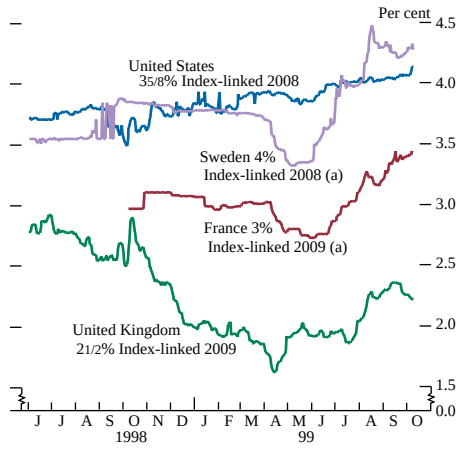
There were two UK corporate index-linked issues during the quarter, possibly reflecting the low real yields on index-linked gilts. In August there was a £137 million issue for a PFI-led hospital project and, in late September, British Gas announced that it would include a £500 million index-linked bond in its £1.5 billion financial restructuring package scheduled for December. The British Gas bonds will become the largest UK corporate index-linked issue, equivalent to around a half of the total of such bonds currently outstanding.

There were fewer borrowers at investment grade BBB and below during this quarter (see Table D). However, widening swap spreads and the appreciation of sterling continued to provide incentives for AAA-rated international borrowers and overseas financial institutions to use interest rate or currency swaps to raise relatively cheap floating-rate dollar or euro finance from fixed-rate sterling bond issuance. Although swap opportunities did motivate several long-dated capital issues for overseas borrowers, a lack of liquidity in the longer-dated swaps market meant that swap-driven issuance was concentrated at shorter maturities.

Some £2.7 billion of floating-rate notes were issued during the quarter. Of these, £1.5 billion were short-dated, primarily for UK banks and building societies, with the remainder almost exclusively long-dated notes or mortgage-backed securitisations.

Corporate bond spreads over gilts widened following heavy issuance in July and in anticipation of further heavy corporate supply. However, they narrowed again in September, as issuance was not as heavy as had been expected and investor demand remained strong (see Chart 20).

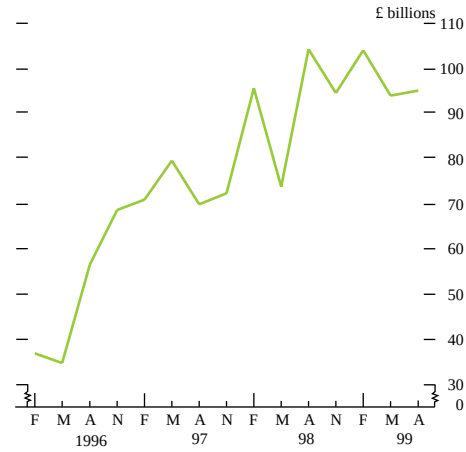
Chart 21
Real yields on index-linked government bonds



Source: Bloomberg.

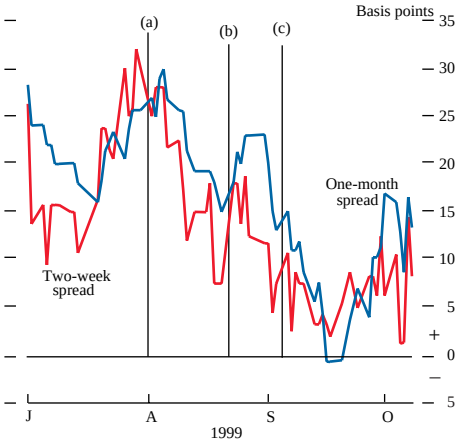
(a) Some data interpolated.

Chart 22
Gilt repo outstanding



Source: Bloomberg.

Chart 23
Interbank versus GC repo, spreads by maturity



Sources: Bank of England and Bloomberg.

(a) Announcement of extension of eligible collateral—30 July 1999.
(b) Announcement of details—18 August 1999.
(c) Implementation—31 August 1999.

Index-linked gilts

Real yields on index-linked gilts (IGs) rose by 50 and 30 basis points at the two and ten-year maturities, respectively, between July and early October, less than the rise in nominal yields on conventional gilts. By the end of the period, the yield curve derived from IGs had become more inverted.

IG yields rose both before and after the DMO's 28 July auction of 2½% Index-linked Treasury 2011. Although less stock was offered for sale than the market had expected, the lowest accepted price was below that prevailing in the market at the close of bidding. Market participants indicated that retail demand had been weak, possibly reflecting a reluctance to participate in the auction at a time when real yields were still low by historical standards. Liquidity conditions continued to be relatively poor.

During the period, some overseas index-linked government bond yields rose by more than those in the United Kingdom (see Chart 21). In France the yield on 3% Index-linked 2009 rose by nearly 60 basis points to 3.45% on 8 October,(1) though in the United States, the yield on 3⅝% Index-linked 2008 rose only slightly to 4.1%.

Gilt repo

The outstanding amounts of gilt repo and reverse repo were little changed in the three months to end August, at £96 billion and £93 billion respectively.(2) This compares with an increase of nearly £30 billion in the repo market in the same period of 1998 (see Chart 22). The steady level of outstandings this year is likely to have reflected three considerations. First, market participants' risk appetite may have decreased, following the financial turbulence of autumn 1998. This will have reduced the size of the market, since repo is used by financial firms as a means of gearing. Second, this risk-aversion effect may have been heightened by concern about trading conditions over the year end; in general, firms say that they do not wish to carry large short or long positions on their balance sheets over the year-end period. Third, the stock of refinancing (the amount of private assets which the Bank holds as a result of its open market operations, OMOs) fell between May and August 1999, while it rose slightly in the same period in 1998. The size of the stock of refinancing and the amount of repo outstanding are usually positively correlated—increases in the stock of refinancing tend to raise the size of money-market shortages which, in turn, gives the Bank's OMO counterparties an incentive to acquire more collateral to use with the Bank.

On 31 August, the Bank implemented a major and permanent extension to the range of collateral eligible for use in its repo operations. This helped ease market fears of a collateral shortage over the turn of the year and may have contributed to the decline in the spread between the interbank offer rate and the market general collateral repo rate in August and September (see Chart 23). However, it is likely that the lower stock of refinancing also contributed to the reduced premium on gilt collateral, since the lower stock of refinancing would have reduced the demand for gilt collateral to be used in the Bank's OMOs.

(1) A new 3.4% Index-linked 2029 was issued by the French authorities on 21 September.
(2) The reverse repo statistics have been revised upwards owing to the inclusion of transactions by the Issue and Banking Departments of the Bank of England.

Table E
Correlations between equity market movements(a)

1998 Q1 to 1999 Q2

	FTSE	S&P	Dax	Nikkei
FTSE 100	1	0.39	0.696	0.329
S&P 500		1	0.359	0.113
Dax			1	0.309
Nikkei 225				1

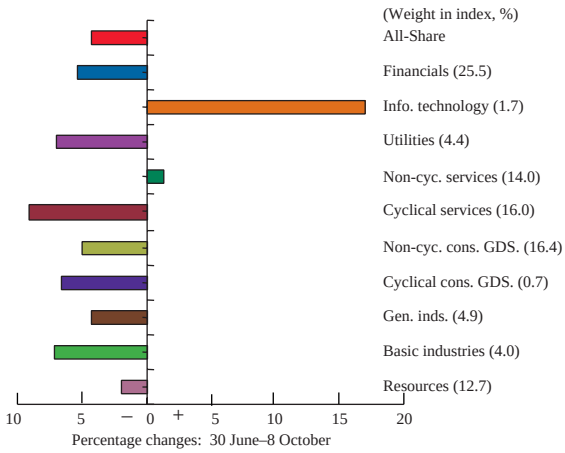
1999 Q3

	FTSE	S&P	Dax	Nikkei
FTSE 100	1	0.557	0.806	0.182
S&P 500		1	0.591	0.176
Dax			1	0.232
Nikkei 225				1

Sources: Bank of England and Datastream.

(a) Figures show correlation coefficients between daily percentage changes in the respective stock market indices.

Chart 24
FTSE All-Share sectoral indices



Source: Datastream.

Table F
Average daily money-market shortages

£ millions

1996	Year	900
1997	Year	1,200
1998	Year	1,400
1999	Q1	1,700
	Q2	1,200
	July	1,200
	August	1,000
	September	700

Table G
Size of weekly Treasury bill tenders

	Amount (£ millions)	
Period beginning	One-month tender	Three-month tender
25 June	500	200
9 July	300	200
13 August	500	200
20 August	700	200
27 August	900	200
17 September	600	200
1 October	300	100

Development of clearing and netting systems for the gilt repo market is continuing. One system, Repoclear, has already been put in place for bund repo, and preparations are being made for the system to go live for gilts and several euro-area government bonds by the summer of next year. Netting of repo offers participating banks the opportunity to reduce risk exposures and to use their balance sheets more efficiently.

Equities

Movements in the major equity markets were unusually highly correlated in Q3 (see Table E). Growing expectations of increases in official interest rates in the United States, the euro area and the United Kingdom were accompanied by declines in equity prices in all of these markets. In Q3, the S&P 500 index fell by 6.6%, the Dax index fell by 4.3% and the FTSE 100 index fell by 4.6%. However, some of these losses were reversed in early October following decisions by the FOMC, ECB, and the Bank of England's MPC to leave their respective official interest rates unchanged. On 8 October, the FTSE 100 index stood at 6,199, 1.9% below its level at the end of June; the FTSE 250 index fell by 1.6%, while the SmallCap rose by 1.4% over the same period.

Each of the sectors in the FTSE All-Share index fell in Q3, apart from IT and non-cyclical services (see Chart 24). Equity prices for companies in the cyclical services sector have suffered from recent disappointing retail trade results. Similarly, several other sectors have also been adversely affected by concerns that increased competition may reduce profit margins. The weak performance of the cyclical consumer goods and basic industries sectors may partly have been related to sterling's appreciation. However, merger and acquisition activity had a positive influence on share prices over the summer. Deutsche Telekom's acquisition of One2One helped to increase prices in the telecommunications sector and there have been growing expectations of M&A activity in the banking sector, following Bank of Scotland's bid for NatWest. The relative performance of the resources sector has been aided by the continued strength of the oil price following OPEC's agreement to renew production quotas.

Market operations

Open market operations and sterling Treasury bill issuance

Daily money-market shortages in Q3 were, on average, smaller than earlier in the year (see Table F). This largely reflected the redemption of 6% Treasury Stock 1999 on 10 August which resulted in a £7 billion cash flow to the market.

The stock of money-market refinancing held by the Bank averaged £9 billion in July and August. Daily money-market shortages averaged £1.2 billion in July and £1.0 billion in August, compared with £0.9 billion in June. In anticipation of this period of slightly larger shortages, the Bank reduced the size of the one-month Treasury bill tender from 9 July (see Table G).

Daily money-market shortages were smaller in September, reflecting both the gilt redemption and the seasonal pattern of government revenue and expenditure (see Table H). Accordingly, the Bank increased the size of the one-month Treasury bill tender

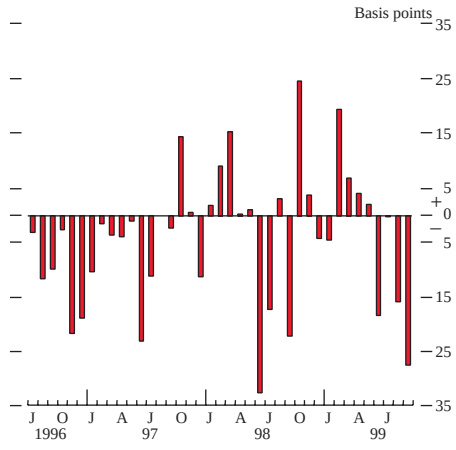
Table H
Influences on the cash position of the money market

£ billions; *not seasonally adjusted*
Increase in settlement banks' operational balances (+)

	1999 Apr.–June	1999 July	Aug.	Sept.
CGNCR (+)	5.2	-4.9	1.2	1.6
Net official sales of gilts (-) (a)	-4.9	0.0	5.2	-2.7
National Savings (-)	0.3	0.0	0.1	0.2
Currency circulation (-)	-0.1	-2.2	1.2	0.3
Other	0.0	0.6	-1.0	-0.6
Total	**0.5**	**-6.5**	**6.7**	**-1.1**
Outright purchases of Treasury bills and Bank bills	0.1	0.2	0.1	-0.9
Repos of Treasury bills, Bank bills, EEA bonds, and British Government stock and non-sterling debt	2.5	2.6	-3.5	0.3
Late facilities	0.0	0.1	-0.1	-0.2
Total refinancing	2.6	2.9	-3.4	-0.8
Foreign exchange swaps	-1.0	1.7	-2.0	2.2
Treasury bills: Market issues and redemptions (b)	2.1	-1.8	1.1	0.5
Total offsetting operations	**-0.5**	**6.4**	**-6.6**	**1.0**
Settlement banks' operational balances at the Bank	0.0	-0.1	0.2	-0.2

(a) Excluding repurchase transactions with the Bank.
(b) Issues at weekly tenders plus redemptions in market hands. Excludes repurchase transactions with the Bank (market holdings include Treasury bills sold to the Bank in repurchase transactions).

Chart 25
Monthly average of SONIA minus the Bank's repo rate



during August (see Table G); this supported the money-market shortages in September at a daily average of £0.7 billion. In anticipation of larger shortages, the one-month tender was then reduced from 17 September. The three-month Treasury bill tender remained unchanged throughout the period, at £200 million a week, until 1 October, when it was reduced to £100 million a week. Demand for Treasury bills continued to be strong: cover at the tenders averaged around five times the amount of bills on offer and the average yields were around 20 basis points below Libid.

Short-dated interest rates (as measured by two-week interbank rates and the sterling overnight index average, SONIA) generally traded below the Bank's repo rate during the period of smaller shortages in August and September (as in previous years, see Chart 25). On three days in the quarter, there were money-market surpluses—once in August and twice in September. The Bank's operations on these days involved absorbing the surplus by the sale of short-dated ('mop') Treasury bills to the market (the first time this operation had been undertaken since June 1994). There was little evidence from the structure of short-term interest rates on those days that the Bank's influence on rates was materially diminished; the largest liquidity surplus, £725 million on 27 September, resulted in the firmest profile of short-term rates. On each occasion, the maturity date of the Treasury bills (which ranged from 2 to 15 days) was chosen to coincide with a day when a large shortage was otherwise expected (therefore partly offsetting it). The short-dated Treasury bills were sold at an average of 20 basis points below the Bank's repo rate.

Foreign exchange swaps are also used by the Bank to supply liquidity to the sterling money market (mostly when the money-market shortages are large). Limited use was made of foreign exchange swaps in July, August and September, given the smaller daily money-market shortages relative to previous quarters. A daily average of £0.3 billion was outstanding during the quarter, compared with £0.4 billion in Q2 and £1.6 billion in Q1 (see Chart 26).

Extension of eligible collateral

From 31 August, the Bank extended the range of securities eligible as collateral in its repo operations to include approximately £2 trillion of securities denominated in euro issued by the central governments and central banks of the countries in the European Economic Area (EEA).(1) The Bank accepts these issuers' euro-denominated securities where they are eligible as Tier 1 collateral in ESCB monetary policy operations and where the relevant central bank of a country participating in EMU has agreed to act as the Bank's custodian under the Correspondent Central Banking Model (CCBM).(2) This major extension to the Bank's eligible collateral was a further step in the process first announced on 15 October last year. The Bank's counterparties began using the new eligible securities as collateral immediately.

(1) A list of the new eligible securities ('CCBM securities') is available on the Bank's web site: www.bankofengland.co.uk/eligsec.htm. These new eligible securities are also eligible as sterling stock liquidity under the FSA sterling stock liquidity regime.
(2) The CCBM was set up by the EU Member States to facilitate the cross-border use of collateral, and is already used for ESCB and TARGET operations. Under CCBM arrangements, EU central banks have agreed to act as one another's custodians.

Money-market instrument review

On 4 November, the Bank of England issued a consultation document on the future of money-market instruments (MMIs). This follows the Securities Settlement Priorities Review, which indicated strong support for the integration of the settlement arrangements for MMIs into CREST.(1) MMIs are currently largely settled in the Central Moneymarkets Office system.

Against this background, a working group, chaired by the Bank and including CRESTCo and market participants, considered the options for the integration of MMI settlement arrangements into CREST. The working group also considered the changes to MMIs that would be necessary to allow such integration, and identified areas for further work.

Consideration focused on the four main types of MMIs—certificates of deposit, Treasury bills, bills of exchange and commercial paper. These are currently bearer-negotiable instruments, mainly in paper form (although most certificates of deposit are already dematerialised). Unlike gilts or equities, they are not registered and are not fungible (ie divisible and interchangeable within an issue).

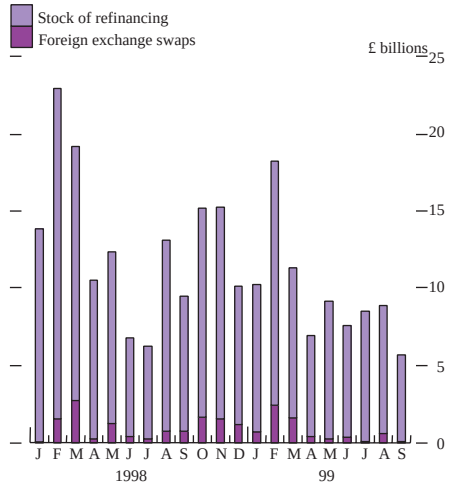
Subject to the consultation, it is envisaged that MMIs would be issued in dematerialised form and settled in the CREST system by means of secondary legalisation under the Companies Act 1989. CREST records would serve as the definitive record of ownership of MMIs. There would be no paper interface. They would cease to be bearer or negotiable instruments, but the CREST arrangements would ensure at least as good certainty of title and transfer. Also, MMIs would become fungible instruments, and so MMIs with the same economic characteristics would become interchangeable. This would enable MMIs to be issued as 'issues' where they have the same features. MMIs would be identifiable by ISINs (International Securities Identification Numbers, the standard numerical identifier for securities) and would serve as collateral for the CREST assured payments system.

Bills of exchange would be simplified. It is proposed to abolish endorsement as a feature of the settlement system, and to abolish the underlying transaction and associated clausing requirements, which only allow bills eligible for use in the Bank's open market operations to be drawn to finance short-term and 'self-liquidating' transactions.

These changes should achieve considerable cost savings and efficiency gains, both for front and back offices, and should assist the development of deeper and more liquid markets in MMIs. Decisions on the changes will be taken next year, and the timing of implementation will depend on the timetable for secondary legislation and on other CREST-related priorities, including the introduction of electronic transfer of title and full Delivery Versus Payment.

(1) CREST is the UK system for the electronic transfer and settlement of dematerialised (ie non-paper) equities and (from later in 2000) gilts.

Chart 26
Stock of money-market refinancing and foreign exchange swaps outstanding (average balance)



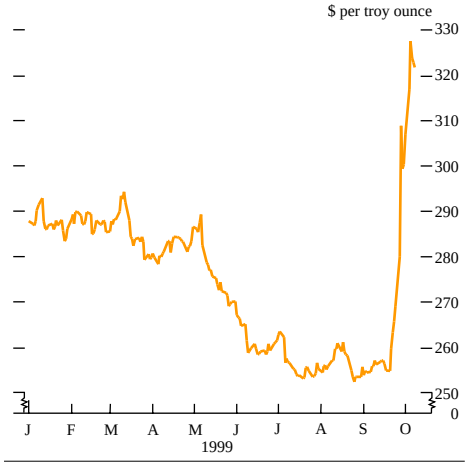
Exchequer cash management

On 29 July, the Debt Management Office issued an Operational Notice on its Exchequer cash management operations, which it expects to implement during the early part of 2000. The transfer will occur gradually: processing of the weekly Treasury bill tenders will transfer in January 2000; from February, the DMO intends to undertake a limited range of bilateral transactions with counterparties with the intention of smoothing part of the Exchequer component of the Bank's money-market forecast; and from around the end of March, the DMO intends to assume full responsibility for Exchequer cash management.

HM Treasury and Bank of England euro issues

In Q3, the Bank of England completed the process of taking over from HM Treasury as the issuer of euro bills, as had been announced on 5 January. Each monthly auction comprised €200 million of one-month bills, €500 million of three-month bills and €300 million of six-month bills. The three and six-month auctions consisted entirely of Bank of England bills, while the one-month auctions were of Treasury bills in July and August but Bank of England bills in September. The auctions continued to be

Chart 27
Gold price



oversubscribed, with issues being covered by an average of 3.8 times the amount on offer. By end September, all remaining euro Treasury bills had matured, and the programme consisted entirely of Bank of England euro bills, with €3.5 billion outstanding with the public.

On 20 July, the Bank reopened the UK Government euro Treasury Note maturing on 28 January 2002 with a further auction for €500 million, raising the amount of this note outstanding with the public to €1.5 billion. The amount on offer at the auction was covered 2.8 times and bids were accepted at an average yield of 3.55%. The total of notes outstanding with the public under the UK euro note programme thus rose from €5.0 billion at the end of June to €5.5 billion at the end of September.

UK gold auctions

Gold

In Q3, the Bank of England conducted two gold auctions on behalf of HM Treasury (on 7 July and 21 September). Each auction of 25 tonnes of gold was well covered at an allotment price close to the auction day's morning London gold fixing. Three further auctions of 25 tonnes each will be conducted by the Bank during the financial year 1999/2000.

On 26 September, 15 European central banks, including the Bank of England (acting on behalf of HM Treasury), issued a joint statement on gold (see the box below). The gold price rose sharply following the announcement (see Chart 27). Gold lending rates also increased initially, but subsequently fell back towards preannouncement levels.

Statement on gold

Österreichische Nationalbank
Banque de France
Banca d'Italia
Banco do Portugal
Schweizerische Nationalbank

Banque Nationale de Belgique
Deutsche Bundesbank
Banque centrale du Luxembourg
Banco de Espana
Bank of England

Suomen Pankki
Central Bank of Ireland
De Nederlandsche Bank
Sveriges Riksbank
European Central Bank

Press communiqué

26 September 1999

In the interest of clarifying their intentions with respect to their gold holdings, the above institutions make the following statement:

1 Gold will remain an important element of global monetary reserves.

2 The above institutions will not enter the market as sellers, with the exception of already decided sales.

3 The gold sales already decided will be achieved through a concerted programme of sales over the next five years. Annual sales will not exceed approximately 400 tonnes and total sales over this period will not exceed 2,000 tonnes.

4 The signatories to this agreement have agreed not to expand their gold leasings and their use of gold futures and options over this period.

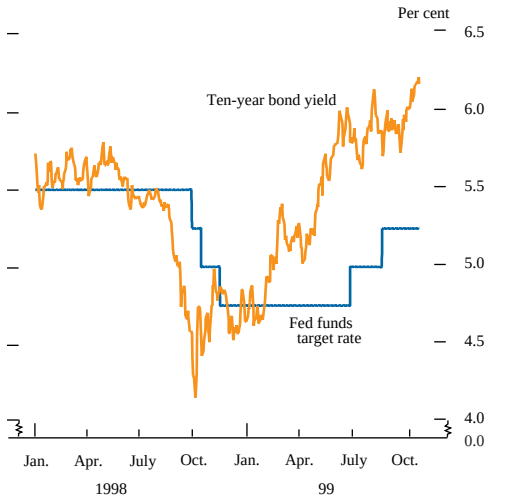
5 This agreement will be reviewed after five years.

The international environment

This article[1] *discusses developments in the global economy since the August 1999* Quarterly Bulletin.

- *Domestic demand growth remained strong in the United States, and with continued tightness in labour markets, the Federal funds target rate was increased by ¼% to 5¼% in late August.*
- *Growth in the euro area remained moderate in the second quarter, but survey evidence suggests that growth may have increased in the third quarter.*
- *In Japan, there was further evidence of a recovery in output in the second quarter. But with declining business investment and the possibility of further falls in employment, the recovery remains fragile.*
- *Current account imbalances between the major economies increased further in the second quarter.*
- *World trade growth appears to be increasing, partly in response to continued recovery in many emerging market economies.*
- *Sharp increases in oil prices put upward pressure on the major economies' import prices. But consumer price inflation remained subdued.*

Chart 1
US interest rates



Overview

World GDP growth slowed to 2.5% last year, from 4.2% in 1997, but forecasters generally expect growth to increase, with the latest IMF *World Economic Outlook* forecasting growth of 3% this year and 3.5% next year. Consequently, growth in the 1990s is likely to average about 3% per year, compared with 3.5% in the 1980s and 4.5% in the 1970s.

World growth in the second half of the 1990s has depended, to a large extent, upon the US economy. But a more balanced pattern of growth has emerged in recent months. There has been more evidence of a recovery in a number of emerging markets, particularly in Asia, a largely unexpected pick-up in Japan, and evidence that growth is increasing in the euro area. In the United States, growth slowed in the second quarter but increased in the third quarter. However, the current account imbalances between the major economies that resulted from sustained divergences in growth persist.

One consequence of the contraction in demand in many emerging market economies over the last two years has been falling commodity and trade prices. There are signs that these deflationary forces are abating, most notably the strong rise in oil prices since the beginning of this year, but also the increase in industrial commodity prices. So far, consumer price inflation has been muted in most countries. Nevertheless, signs of emerging inflationary pressures will need to be watched carefully.

(1) Based on data up to 28 October 1999.

Domestic demand growth remained strong in the United States, and with continued tightness in labour markets, the Federal funds target rate was increased by ¼% to 5¼% in late August.

The Federal Open Market Committee (FOMC) increased the Federal funds target rate by ¼ percentage point to 5¼% on 24 August (see Chart 1). In support of this increase it cited 'financial markets functioning more normally,…persistent strength in domestic demand, foreign economies firming and labour markets remaining very tight'. It also said that the increase in the Federal funds target rate, combined with previous monetary tightening and improved financial conditions more generally, 'should markedly diminish the risk of rising inflation going forward'. Subsequently, the rate was left unchanged on 5 October, but the FOMC announced a 'bias toward a possible firming of policy going forward', citing the risk of higher labour cost pressures, given the continued tightness of the labour market. But the Committee also emphasised that 'such a directive did not signify a commitment to near-term action'.

In financial markets, perhaps the most significant development between 1 August and 28 October was the 9% appreciation of the yen against the dollar (see the section on Japan for more details). The dollar appreciated by about 2% against the euro. Ten-year bond yields increased by almost 30 basis points (see Chart 1). Equity prices increased in August, but then fell back. For example, the Dow Jones index increased by more than 6% up to 25 August, but then fell back by around 8% by 28 October, partly reflecting higher expectations for interest rates.(1)

GDP growth increased to 1.2% in the third quarter of 1999, after slowing in the first two quarters. Chart 2 shows the contributions to growth from different expenditure components. Consumption slowed in the first three quarters, but continued to grow strongly (by 1.1% in the third quarter). With growth in real personal disposable income of 0.6%, the personal savings rate fell further. Fixed investment remained strong, reflecting continued increases in expenditure on equipment and software. Net trade made a smaller negative contribution to growth in the third quarter than in the previous two quarters because of increasing growth in exports (import growth also increased slightly). The increase in export growth may partly reflect the weaker dollar, but it is more likely to relate to stronger external demand.

The main reason for the increase in GDP growth in the third quarter was the positive contribution from stockbuilding after a strongly negative contribution in the second quarter. The increase in stockbuilding may partly relate to preparations for the Millennium. (The September National Association of Purchasing Managers (NAPM) survey suggested that 38% of manufacturers intend to build up inventories ahead of the Millennium.) If this is the case, the growth in inventories could be lower in the new year.

Over the longer run, inventory levels have fallen relative to final sales during the 1990s (see Chart 3). This reflects the adoption of improved inventory management systems, related to continued improvement in information and communications technology. Federal Reserve Chairman Greenspan has suggested that these developments have increased the efficiency of distribution and

Chart 2
Contributions to US GDP

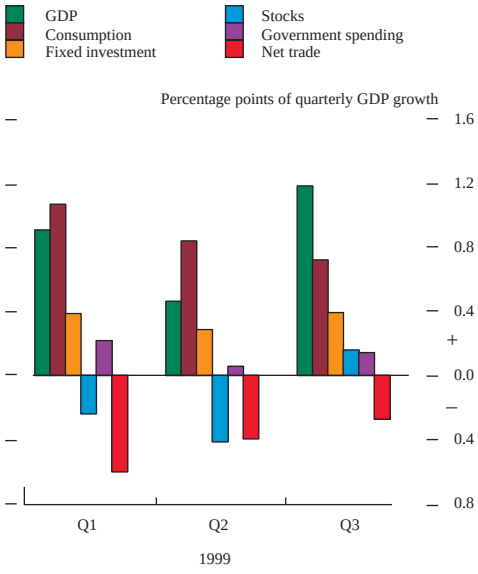
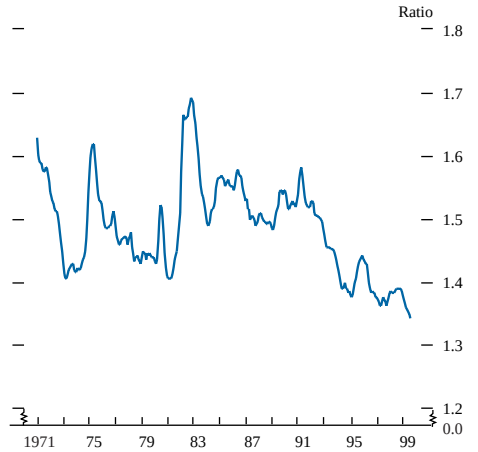


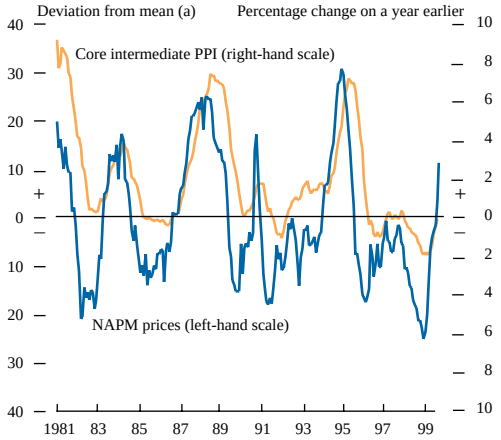
Chart 3
US ratio of business inventories to sales(a)



(a) Three-month moving average.

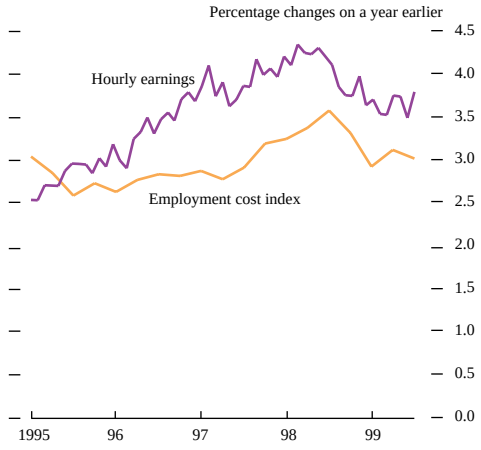
(1) See the *Markets and operations* article on pages 327–43 for more information on financial market developments.

Chart 4
US intermediate producer prices and NAPM price survey



(a) Mean calculated over period since 1980.

Chart 5
US earnings and employment costs



production and so 'apparently added to growth of multifactor productivity'.(1) The adoption of better stock systems may also have reduced the volatility of US output,(2) partly because it enables a better matching of supply to demand, and so reduces the need for large corrections in output levels. Moreover, it has reduced the level of stockbuilding relative to GDP, and stockbuilding is the most volatile expenditure component.

On 28 October, the US Bureau of Economic Analysis (BEA) released the 1999 comprehensive revisions of the national income and product accounts. These included some significant changes to the way US GDP is measured. The key changes include recognising business and government expenditure on software as investment, which has the effect of increasing measured GDP and the gross national savings rate. And there are various reclassifications which increase the level of personal saving and reduce government saving. As a result of all of the changes, the average measured growth rate of real GDP has increased by 0.2 percentage points between 1959 and 1992, and by 0.4 percentage points between 1992 and 1998. However, the profile of GDP growth was little changed in recent quarters. At the same time, average measured growth in GDP prices (which measure whole-economy price inflation) was reduced by 0.2 percentage points between 1959 and 1998.

The recovery in industrial production continued. The three-month on three-month growth rate of industrial production rose from near zero at the start of 1999 to 0.9% in September, despite a small fall in production in September because of Hurricane Floyd. NAPM survey data indicated that manufacturers' confidence had continued to improve, suggesting that growth in industrial production may remain strong in the months ahead.

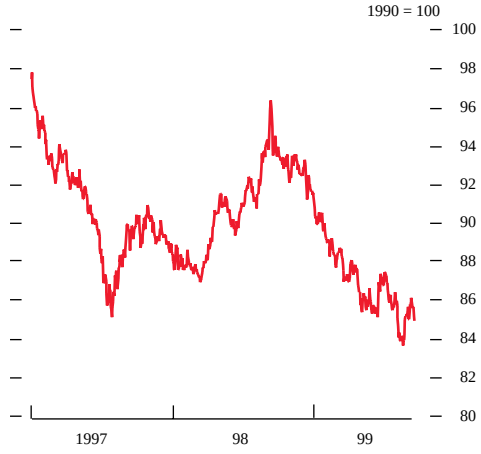
Headline consumer price inflation was 2.6% in September, up from 2.1% in July. But the increase in inflation was mainly attributable to further increases in energy prices. Core price inflation (which excludes energy and food prices) was 2.1% in September, little changed from 2.0% in July. Oil price inflation had a greater impact on producer output prices: annual inflation increased from 1.1% in April to 3.1% in September. Excluding energy and food, producer output price inflation was 1.7% in September, up from 1.3% in August. But this pick-up seems to be entirely attributable to a sharp increase in tobacco prices in September (up 8.8% on the month).

Further up the supply chain, deflationary pressures appear to be coming to an end. The twelve-month rate of growth of core intermediate producer prices (the prices paid for basic materials and semi-finished inputs, but excluding energy prices) increased from –1.8% in January to +0.3% in September. The NAPM survey of manufacturers showed that prices had increased strongly in September (see Chart 4). The survey question refers to manufacturers' input prices, and in the past it has been a good leading indicator of intermediate goods price inflation.

The labour market remained tight, with unemployment unchanged, at 4.2%, in September. Employment fell slightly in September

(1) 'The American economy in a world context', speech at the Federal Reserve Bank of Chicago on 6 May, 1999.
(2) See, for example, McConnell, Mosser and Quiros (September 1999), 'A decomposition of the increased stability of GDP growth', *Federal Reserve Bank of New York—Current Issues*.

Chart 6
Euro effective exchange rate



Source: Bank of England.

Chart 7
Contributions to euro-area GDP

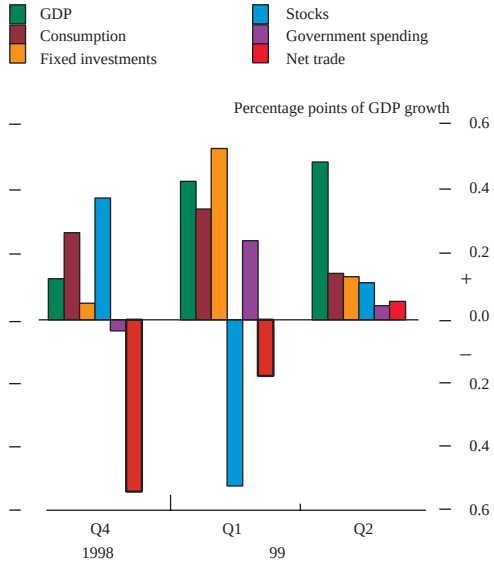
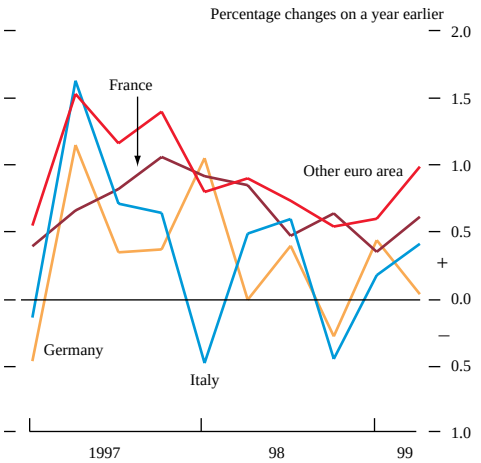


Chart 8
Euro-area GDP



after modest growth in August. The US Bureau of Labour Statistics attributed some of this slowdown to the effects of Hurricane Floyd, which disrupted some activities.

Despite low levels of unemployment, wage inflation remained subdued. Chart 5 compares the growth of hourly earnings with growth in the employment cost index (a broader measure of labour costs). Annual average hourly earnings growth was broadly flat, at 3.7%, in the first three quarters of 1999. Growth in the employment cost index has also been flat this year, at close to 3%. Employment costs have risen less than earnings because they include benefits which have grown less quickly than earnings.

Growth in the euro area remained moderate in the second quarter, but survey evidence suggests that growth may have increased in the third quarter.

The European Central Bank (ECB) left interest rates unchanged between August and October. Euro-area M3 increased at an average annual rate of 5.9% between July and September, compared with the ECB reference value of 4.5%. Growth in private sector credit also remained strong (up by 10.5% on a year earlier in September). Consumer price inflation, as measured by the harmonised index, increased slightly, to 1.2% in September, but was still consistent with price stability, defined by the ECB as below 2%. In September, the ECB commented that 'upward risks to price stability merit closer attention as monetary growth has been moving upwards from the reference value'.

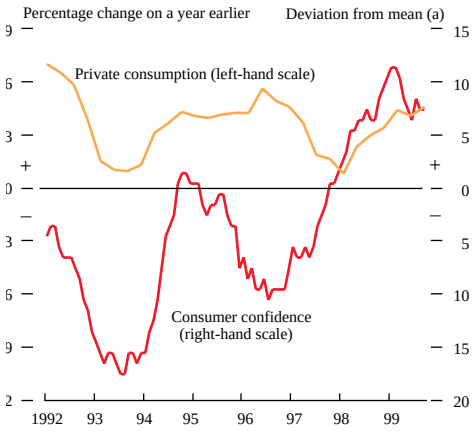
Between 1 August and 28 October, the euro effective exchange rate fell by 3%. It fell against the yen and, to a lesser extent, the dollar in August and September, but strengthened in October (see Chart 6). Ten-year bond yields continued to increase, and rose by more than 60 basis points over the same period. Equity prices also increased; for example the German Dax index increased by 5%, and the French CAC index increased by more than 7%.

Euro-area GDP increased by 0.5% in 1999 Q2, following growth of 0.4% in Q1. Growth in final domestic demand was considerably weaker in the second quarter than in the first, with lower growth in both private consumption and gross fixed capital formation. However, this was mostly offset by a slightly positive contribution from stockbuilding, after a strongly negative contribution in the first quarter (see Chart 7).

There was a sharp increase in trade in the second quarter, with exports and imports both growing by more than 2%. Exports grew slightly more than imports, so net trade made its first positive contribution to euro-area GDP since 1998 Q2. The growth in exports may reflect strengthening demand in Asia and the effects of the euro depreciation earlier this year. Survey data suggest that export growth may strengthen further in the second half of 1999.

Chart 8 compares growth in the different euro-area economies. French and Italian growth picked up in the second quarter. Output in Germany was flat, after 0.4% growth in the first quarter. This may have been, at least partly, because mild weather, announced tax changes and the timing of holidays in Germany brought expenditure forward into Q1, at the expense of growth in Q2. Growth in the rest of the euro area increased to 1.0% in Q2, significantly above growth in the three largest euro-area economies.

Chart 9
Euro-area private consumption and consumer confidence

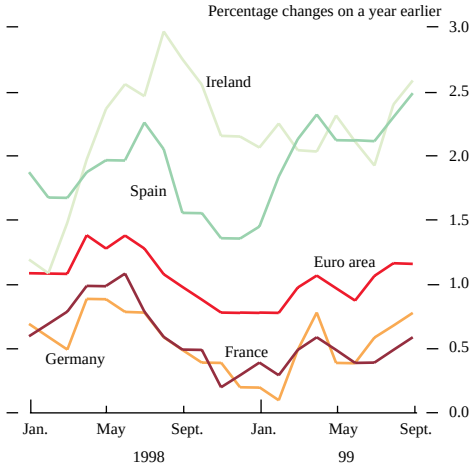


(a) Mean calculated over period since 1985.

Chart 10
Euro-area industrial production and industrial confidence

(a) Mean calculated over period since 1985.

Chart 11
Harmonised index of consumer prices



The European Commission (EC) survey of consumer confidence was broadly unchanged in the third quarter, remaining at historically high levels. But the survey data have shown only weak correlation with growth in euro-area consumption in the past (see Chart 9).

The level of industrial production in the euro area was broadly flat from March 1998 to July 1999. But there is evidence that growth may have resumed in the second half of this year. German industrial production grew by 2% between June and August, and German manufacturing orders in August were up 8.8% on a year earlier. The EC survey indicated that business confidence (which has shown strong correlation with euro-area industrial production) continued to rise in Q3, taking it back to its longer-run average level (see Chart 10).

In the three months to September, consumer price inflation remained subdued, with euro-area annual inflation of 1.2% on a harmonised basis in September. This was slightly higher than the average rate of 1.0% in 1999 Q2, largely reflecting sharp increases in oil prices. This upward pressure was partially offset by slowing food price inflation, as a result of good harvests. Excluding energy, food, alcohol and tobacco, annual price inflation was 0.9% in September—broadly unchanged from its rate in Q2.

Headline inflation increased in most euro-area countries in September. But it increased more in Ireland and Spain, countries which already had relatively high inflation (see Chart 11).

In the euro area as a whole, firms' costs showed positive annual inflation for the first time since April 1998. Industrial producer output prices (excluding construction) were 0.5% higher than a year earlier in August. However, this reflected the effect of higher oil prices on intermediate goods prices. Capital and consumer goods price inflation remained at 0%. The growth of labour costs was subdued, at 2.2% on a year earlier in Q2 compared with 2.3% in Q1. Labour costs grew at different rates in different countries, broadly in line with the inflation differentials mentioned above.

In Japan, there was further evidence of a recovery in output in the second quarter. But with declining business investment and the possibility of further falls in employment, the recovery remains fragile.

The Bank of Japan continued its policy of targeting a zero overnight interest rate between August and October (see Chart 12), but made some changes to operational policy. On 21 September, because 'monetary policy had attracted unusually high attention', the Bank issued a statement describing its policies. The statement explained that in order to achieve interest rates of virtually zero, the Bank was continually providing funds in excess of the required reserve, and that the majority of the excess funds had been accumulated by fund brokers rather than other financial and non-financial institutions. The Bank of Japan concluded that any further injections of liquidity were unlikely to influence interest rates, asset prices or the exchange rate.

The Bank of Japan's statement was followed by a series of operational changes on 13 October affecting the structure rather than the scale of its operations. The Bank announced that it would

Chart 12
Japanese interest rates

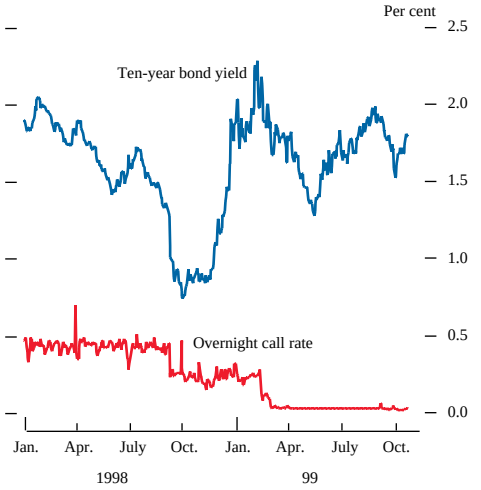


Chart 13
Japanese export prices and the exchange rate

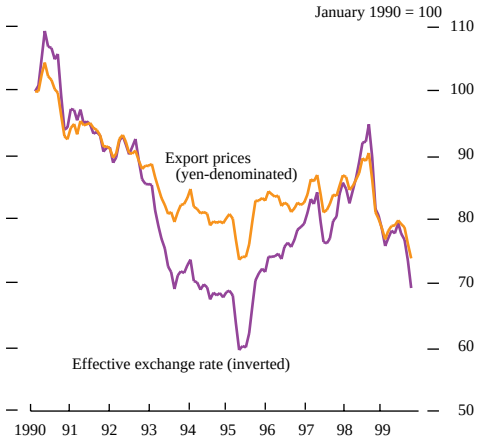
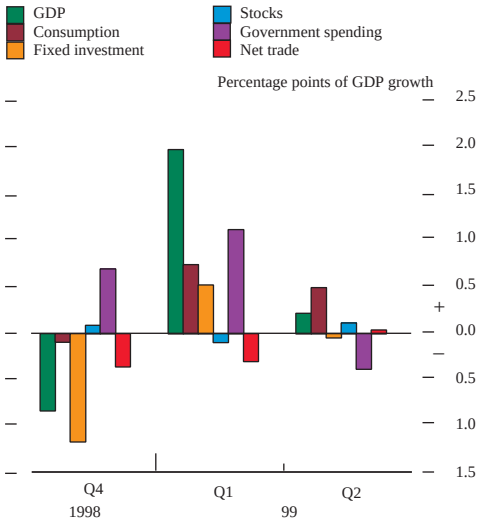


Chart 14
Contributions to Japanese GDP



conduct outright purchases of Treasury bills, and include two-year government bonds in its repo operations. There were a series of other measures related to Y2K issues.

The Bank also said that it 'views the current state of the Japanese economy as having stopped deteriorating with some bright signs, though a clear and sustainable recovery of private demand has yet to be seen'. It added that it would continue a policy of 'easy monetary policy for the periods ahead'.

Over the August-October period, expectations of Japanese short-term interest rates six months ahead, implied by futures contracts, fell by around 20 basis points. The profile of futures contract rates implies that the markets expect the Bank of Japan to continue a policy of virtually zero overnight interest rates until the second half of next year. The ten-year benchmark bond yield had been on an upward trend since May 1999, but fell from 2.0% on 25 August to 1.7% by 28 October (see Chart 12). Equity prices fell by 2.6% over the period, but had still risen by more than 30% since 1 January.

The yen exchange rate continued to appreciate. Between 1 August and 28 October, the effective exchange rate increased by more than 10%. The rise of the yen was fairly consistent against all major currencies and other Asian currencies.

It is unclear how much the appreciation of the yen is likely to depress growth in Japan. Japan is a relatively closed economy—both exports and imports make up about 10% of GDP. This is a similar proportion to the United States and the euro area, but much lower than the proportion of output typically traded by smaller economies. Furthermore, exporting firms have been able to offset some of the loss in competitiveness by reducing their yen-denominated export prices (see Chart 13). Since August 1998, the exchange rate has appreciated by 36%, while export prices have fallen by 18%.

However, if Japanese exporters do not pass on the yen appreciation to their export prices, it will be at the expense of their profitability. Lower profitability might reduce growth in investment in the future and put downward pressure on equity prices, which would also depress growth in investment and consumption. And even if the yen appreciation does not reduce Japanese export volumes, it could cause import volumes to increase, at the expense of domestic production.

GDP grew by 0.2% in the second quarter, after 2.0% growth in the first quarter and four quarters of falling output in 1998. Chart 14 shows the contributions to GDP growth of different expenditure components. The stimulus to growth from government spending was very strong in 1999 Q1, but was negative in Q2. This may have reflected an unusual pattern of public expenditure around the end of the financial year (in March), and consequently a drop-off in expenditure in the second quarter. Public work starts declined in both July and August, suggesting that public expenditure is unlikely to make a significant contribution to growth in the second half of 1999. However, on 8 October, the government announced plans for a further fiscal package, which should support growth in 2000.

Chart 15
Japanese industrial production

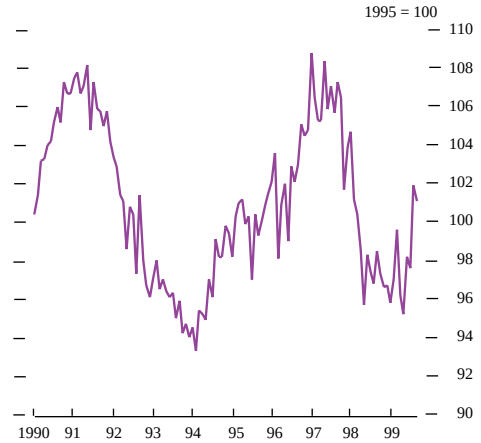
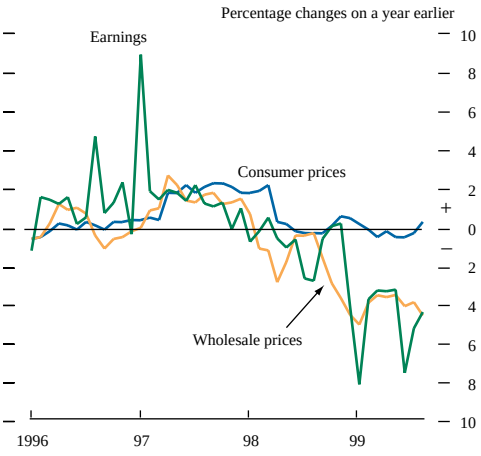


Chart 16
Japanese consumer prices, wholesale prices and earnings



Private demand increased in the first half of 1999, compared with falling expenditure in 1998. Growth was weaker in the second quarter, but this partly reflected the unwinding of special factors. For example, in the first quarter there was a strong increase in car sales. There was also a large increase in investment by small firms, before the government's loan guarantee scheme ended. In the second quarter, although consumption growth was weaker (0.5% compared with 0.7% in Q1), it was reported to be more broadly based. Business investment fell in the second quarter, but this was mostly offset by continued strong growth in housing investment (up by 16.4%), which has been supported by very low interest rates and targeted fiscal measures.

Net trade made a small positive contribution to growth in the second quarter, after two quarters of negative contributions. This partly reflected further recovery in demand in Asia.

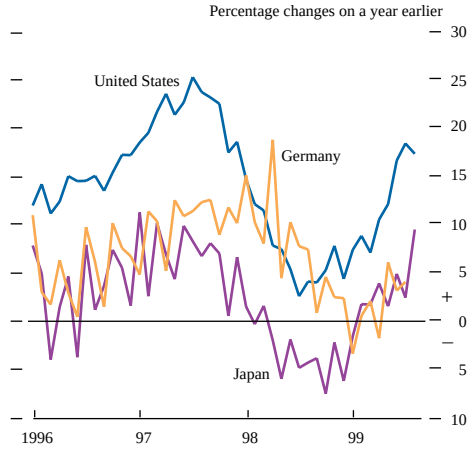
Developments in the third quarter have been broadly positive so far. Industrial production grew by 3.8% in Q3, the strongest rise since 1976 Q2. As Chart 15 shows, the level of production was still below output in 1997, but after broadly flat output from May 1998, there is increasing evidence of recovery. This was supported by the September Tankan survey which showed an improvement in business confidence in all sectors, although confidence remained low. Employment grew by 1% in August, largely in the construction sector, and the unemployment rate fell back (from 4.9% to 4.7%). The large increase in employment (+610,000) relative to the fall in unemployment (-130,000) suggests that inactivity also fell in August.

Nevertheless, some questions remain over whether the recovery in Japan will be sustained. As well as showing an increase in confidence, the September Tankan survey also showed that firms continued to expect to reduce employment, so it is not clear that the labour market has stopped deteriorating. Firms also still believed that inventory levels were too high, and that investment would continue to fall. Furthermore, the growth in consumption in the first half of this year corresponds to a lower savings ratio, given that income from employment declined over the period. Should Japanese households start increasing their savings rate, consumption might stop increasing and could even fall back. But this seems unlikely, at least in the short run, as consumer confidence increased slightly in Q3.

Japanese consumer price inflation was 0.4% in August compared with -0.2% in July. This reflected strong increases in prices of food, with other prices showing zero annual inflation on average. (The stronger oil price was offset by falling prices elsewhere.) Wholesale prices continued to show annual inflation of -4%, and earnings also fell by 4% on a year earlier (see Chart 16). Unemployment may continue to increase, perhaps putting further downward pressure on earnings. And the appreciation of the yen will also dampen any inflationary pressures from import prices.

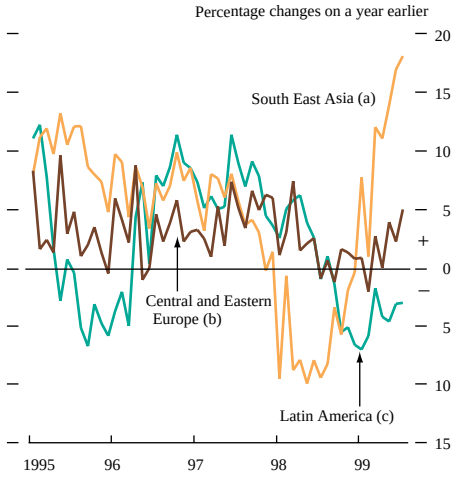
Current account imbalances between the major economies increased further in the second quarter. World trade growth appears to be increasing, partly in response to continued recovery in many emerging market economies.

Chart 17
Trade flows[a]



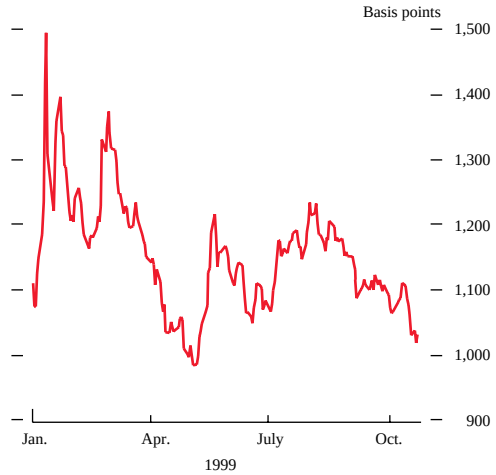
(a) Average of goods' import and export volumes.

Chart 18
Emerging market industrial production



(a) Korea, Malaysia, Singapore, Taiwan and Thailand.
(b) Czech Republic, Hungary, Poland and Russia.
(c) Argentina, Brazil, Colombia, Peru and Venezuela.

Chart 19
Emerging market sovereign spread over US Treasury bills



Source: J P Morgan (EMBI+).

Current account imbalances persisted in the second quarter of this year. The US deficit rose from 3.1% of GDP in Q1 to 3.6% in Q2, while the current account surplus rose in Japan (from 1.5% of GDP to 1.6%) and the euro area (from 0.8% to 1.0%). Monthly data suggest that the US deficit may have increased further in Q3. But the Japanese surplus appears to have fallen in the third quarter, owing to a decline in yen-denominated export prices.

Chart 17 shows the growth in trade (the average of imports and exports) for the United States, Japan and Germany. Despite very different growth rates in domestic demand, trade growth declined sharply for all three countries in the second half of 1997. (World trade growth is estimated to have slowed from 9.9% in 1997 to 3.6% in 1998.) This followed the collapse in domestic demand in some emerging markets as a result of financial crisis. However, growth in trade started increasing again in mid 1998 in Japan and the United States, and at the start of 1999 in Germany, suggesting that world trade may be starting to grow at more normal levels.

There has been a general improvement in the prospects for output in many emerging markets (see Chart 18), which is consistent with the increase in world trade growth. Industrial output in most South East Asian economies grew strongly in the second quarter of this year, as business confidence started to return. By July, the level of industrial output in most of these economies was above pre-recession levels. In the Central and Eastern European countries, after flat industrial production in the first quarter of this year, annual growth increased to about 5% in July. Industrial production in Latin America continued to fall, compared with output in the previous year. In Argentina the rate of decline in industrial production was unchanged (-12.5%), but the rate of decline in most other Latin America countries had started to moderate.

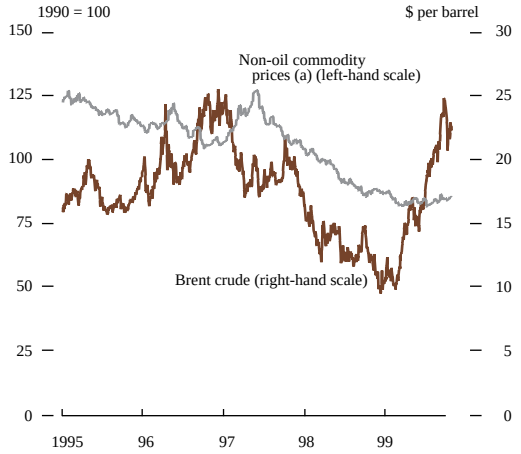
As a result of the improvements in the prospects for output, the IMF revised up their forecast for most developing economies in the October *World Economic Outlook*. For example, the forecast of GDP growth in developing countries in 1999 was revised up from 3.1% to 3.5%, with particularly large upward revisions to forecast growth in South East Asia, Brazil, and Russia. Private sector forecasts, as surveyed by Consensus Economics, were also generally revised up.

The average spread between emerging market bond yields and US Treasury yields fell during much of August and September, reflecting stronger evidence of recovery in many emerging markets. By 28 October, spreads were more than 100 basis points lower than at the start of August, indicating some reduction in financial markets' assessment of emerging market risk (see Chart 19). Nevertheless, in the third quarter, the volume of gross financial flows to emerging markets was less than half the volume in 1997, and showed little sign of increasing.

Sharp increases in oil prices put upward pressure on the major economies' import prices. But consumer price inflation has remained subdued.

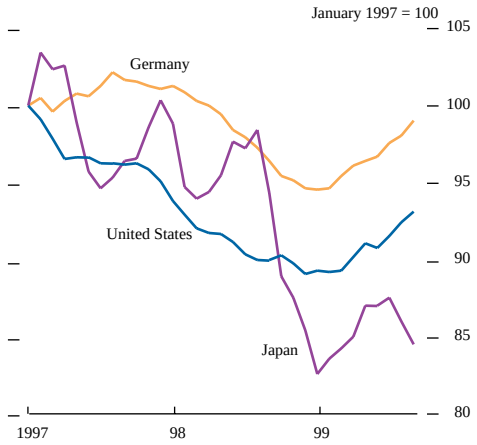
The price of oil continued to increase. On 28 October Brent crude was $21.66 per barrel, up by 13% since the previous *Quarterly Bulletin* (see Chart 20). The increase in oil prices can be attributed

Chart 20
Commodity prices



(a) Economist ($) index.

Chart 21
Major economies' import prices(a)



(a) Not seasonally adjusted.

to several factors: OPEC members' unexpectedly high compliance with the quotas agreed in March; low production by non-OPEC members as a result of low oil prices over the past few years; a stronger than expected bounce-back in demand from Asian countries; low and falling stocks of oil; and possibly a desire to increase stocks ahead of the Millennium. Some of these factors may have only a temporary effect on the oil price. On 28 October, oil futures suggested a price of $19.82 per barrel by April 2000.

After falling by around 30% since mid 1997, commodity prices in dollar terms increased 2.8% between 1 August and 28 October (see Chart 20). While food prices were unchanged overall, industrial commodity prices (mostly metals) increased by 4.8%, partly as a result of stronger demand in Asia following the strong recovery in industrial production.

The turnaround in oil prices, and to a lesser extent other commodity prices, has impacted on import prices to the major economies. Between January and September, import prices increased by 4.3% in the United States, 4.7% in Germany and 2.3% in Japan (although Japanese data may have been affected by seasonal factors). Throughout much of 1997 and 1998 the major economies enjoyed falling import prices (see Chart 21).

The IMF's October *World Economic Outlook* contained some analysis of the potential impact of higher oil prices on the world economy. They estimate that a sustained 10% increase in oil prices would increase CPI inflation in the major economies by between 0.1 and 0.2 percentage points, and reduce the level of GDP by 0.1 percentage points. However, Consensus Economics surveys showed little change in private sector forecasts of CPI inflation in the major economies between April and September, although the oil price increased by about 40% over that period.

The IMF's estimates suggest that a sustained 10% increase in oil prices would reduce the current account balances of advanced economies by around $13 billion in total. Reflecting this, the current account balances of Middle Eastern economies would increase by $7 billion, and the remainder would be divided between the African, Latin American and Eastern European oil producers. Although this could significantly change the current account balances of some developing countries, the magnitudes involved are small relative to, for example, the US current account deficit of around $300 billion and the Japanese surplus of $150 billion.

Public sector debt: end March 1999

By Jonathan Bailey of the Bank's Monetary and Financial Statistics Division.

This article continues the annual series in the Quarterly Bulletin *analysing the debt position of the UK public sector. It looks at market and statistical developments in the financial year to end March 1999, and examines some of the domestic and European issues that have influenced these measures. It also analyses the composition and distribution of the national debt.*

- *Public sector net debt fell by £3.7 billion to £349 billion, at nominal value, during the financial year to end March 1999. This was the first annual reduction since 1989/90. At end March 1999 public sector net debt stood at 40.6% of GDP, the lowest end-March figure since 1994, and 2 percentage points lower than at end March 1998.*

- *General government gross debt—the 'Maastricht' measure—also fell during the year, to £399 billion at end March. At 47.4% of GDP, this is comfortably below the 60% reference value in the Maastricht Treaty. The general government had a financial surplus of 0.9% of GDP in 1998/99, well within the Maastricht reference value, which allows a deficit of up to 3% of GDP.*

- *All data presented in this article reflect the transition to the latest international statistical standards, the European System of Accounts (ESA95). This is consistent with the UK National Accounts, published by the Office for National Statistics. However, as before, government debt figures are still presented on a nominal, rather than a market, valuation. The box on pages 356–57 gives details of the changes and shows the impact on the measurement of the public sector debt position.*

Introduction

This article first looks at how the UK public sector debt (the stock of debt) relates to the public sector net cash requirement, ie the balance between the public sector's cash income and expenditure. Central government debt—by far the largest component of public sector debt—is then analysed in more detail, including changes in market holdings of each instrument during the year. The British Government Securities (gilts) market is considered in some detail, as gilts outstanding constitute the bulk of government debt. The structure of the outstanding gilt portfolio and developments in the gilt market during 1998/99 are discussed. This is followed by an analysis of the sterling national debt by economic sector of holders of the debt instruments. Separate boxes consider issues affecting the measurement of public sector debt during the year, and a detailed list of notes and definitions is given at the end of the article.

Public sector debt

Public sector debt (net of short-term financial assets) fell by 1% in the financial year 1998/99, from £353 billion to £349 billion (see Table A). In relation to GDP, it fell by 1.6 percentage points, from 42.2% to 40.6%. This is near the middle of the range of debt ratios during the past 25 years, with the highest (54%) recorded in 1976 and the lowest (26%) in 1991 (see Chart 1). By historical standards the recent ratio is low, as Chart 2 shows. The chart illustrates how the ratio can decrease (eg during the 1970s), even when the nominal level of debt is rising, if nominal GDP increases more quickly because of high inflation (as in the 1970s) or real output growth. Inflation erodes the real value of debt stocks (with the exception of index-linked debt, which rises in value in line with inflation).

The ratio of public sector net debt (PSND) to GDP is used to measure the Government's objective of holding debt at a 'stable and prudent level over the economic cycle' (the 'sustainable investment' rule). In its 1999 Budget, the Government stated that it 'believes that a modest reduction is desirable, other things being equal, to below 40% of GDP over the economic cycle'. HM Treasury forecasts that the PSND will fall to below 40% of GDP by March 2000, and that the downward trend will continue until at least 2004.

The main component of public sector debt is the liability of central government. Central government gross debt fell by £1.7 billion to £392.1 billion by end March 1999. Local government and public corporations' gross debt both rose by less than £1 billion in 1998/99. The fall in central

Table A
Public sector net debt

£ millions, nominal values (a); *percentages in italics*

31 March (b)	1997	1998	1999	Changes 1998–99
Central government				
Market holdings of national debt (Table D)	379,736	381,878	380,187	-1,691
as a percentage of GDP	*48.0*	*45.7*	*44.2*	*-1.5*
National Savings Ordinary Account	1,419	1,398	1,371	-27
Accrued interest and indexing on National Savings	3,422	2,932	2,746	-186
Coin in circulation	2,363	2,472	2,637	165
Funds lodged in courts	1,980	2,180	2,550	370
Other	2,996	3,019	2,656	-363
Total central government gross debt	**391,916**	**393,879**	**392,147**	**-1,732**
as a percentage of GDP	*49.6*	*47.1*	*45.6*	*-1.5*
Local government				
Total gross debt	51,598	51,932	52,793	861
less holdings of other public sector debt:				
Central government holdings of local government debt	42,555	43,397	45,277	1,880
Local government holdings of central government debt	155	170	274	104
General government consolidated gross debt	**400,804**	**402,245**	**399,389**	**-2,855**
as a percentage of GDP	*50.7*	*48.1*	*46.5*	*-1.6*
Public corporations				
Total gross debt	26,158	26,044	26,775	731
less holdings of other public sector debt:				
Central government holdings of public corporation debt	25,664	25,668	26,440	772
Local government holdings of public corporation debt	1	0	4	4
Public corporation holdings of central government debt	7,107	7,467	6,336	-1,131
Public corporation holdings of local government debt	805	810	780	-30
Public sector consolidated gross debt	**393,385**	**394,344**	**392,604**	**-1,739**
as a percentage of GDP	*49.8*	*47.2*	*45.7*	*-1.5*
Total public sector liquid assets (Table B)	**44,888**	**41,468**	**43,439**	**1,971**
as a percentage of GDP	*5.7*	*5.0*	*5.1*	*0.1*
Net public sector debt	**348,497**	**352,876**	**349,165**	**-3,710**
as a percentage of GDP	*44.1*	*42.2*	*40.6*	*-1.6*

(a) Figures shown may not sum to totals because of rounding.
(b) Data from 1975–99 are published in the *Bank of England Statistical Abstract 1999*, Part 1, Table 14.1.

Table B
Public sector liquid assets

£ millions, nominal values

31 March (a)	1997	1998	1999	Changes 1998–99
Central government				
Official reserves	25,547	21,293	22,147	854
Bank and building society deposits	2,067	2,286	1,635	-651
Total central government liquid assets	**27,614**	**23,579**	**23,782**	**203**
Local government				
Bank deposits	7,134	7,994	8,040	46
Building society deposits	4,142	3,796	4,235	439
Other short-term assets	3,256	3,693	4,295	602
Total local government liquid assets	**14,532**	**15,483**	**16,570**	**1,087**
Public corporations				
Bank and building society deposits	1,778	1,469	1,860	391
Other short-term assets	964	937	1,227	290
Total public corporation liquid assets	**2,742**	**2,406**	**3,087**	**681**
Total public sector liquid assets	**44,888**	**41,468**	**43,439**	**1,971**

(a) Data from 1975–99 are published in the *Bank of England Statistical Abstract 1999*, Part 1, Table 14.1.

government gross debt and an increase of nearly £2 billion in public sector liquid assets (which are deducted from gross debt in calculating net debt) were the main components of the fall of more than £3 billion in public sector net debt in 1998/99.

Chart 1
Measures of public sector debt as a percentage of GDP, 1975–99

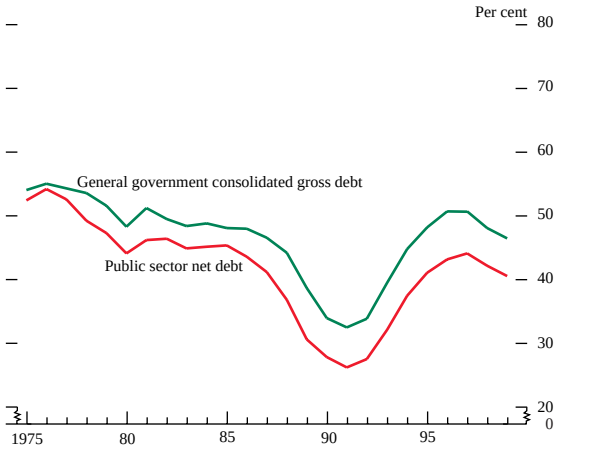
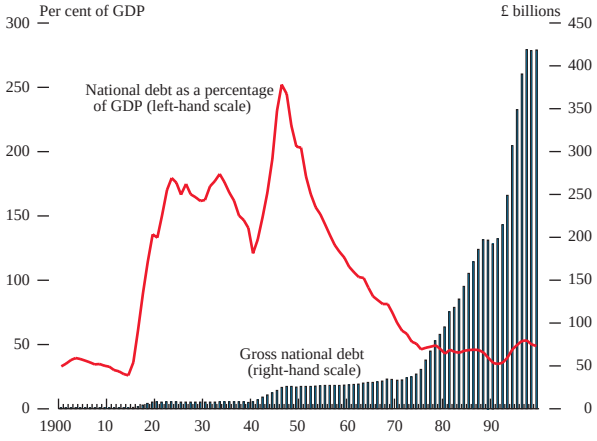


Chart 2
Gross national debt: 1900–99



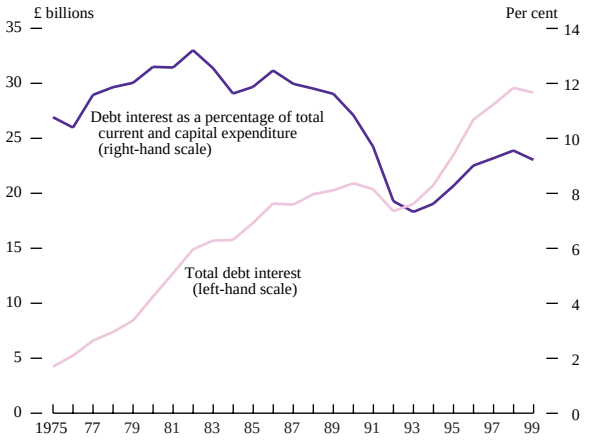
Source: HM Treasury.

Debt financing

The government's ability to finance its expenditure plans has a direct link with the amount of outstanding debt. A fiscal stance is considered sustainable if the government can expect to maintain its current spending and taxation policies indefinitely, while continuing to meet its debt-servicing obligations.

Interest payments on public sector debt in 1998/99, at £29.2 billion, were £0.4 billion lower than in the previous twelve months (see Chart 3). This was the first annual fall since 1990/91, and partly reflects the lower absolute level of the public sector debt. Falling short-term interest rates also reduce the amount of debt interest payable; interest rates payable on short-term instruments such as Treasury bills and certain National Savings accounts react quickly to changes in short-term interest rates, and coupons on new gilt issues are closely related to the prevailing rates at the time of issue. HM Treasury forecasts that gross interest will fall sharply again in 1999/2000. Interest payments accounted for 9.2% of total government current and capital spending in 1998/99, slightly lower than in the previous year (9.6%).

Chart 3
Public sector debt interest(a)



Source: ONS.

(a) At end March each year.

The public sector net cash requirement (PSNCR) moved into a surplus (ie a net repayment) of £7.0 billion in 1998/99 (see Table C). This continues the trend since 1993/94, when the PSNCR was £46.2 billion, and is the first annual repayment since 1990/91. The main reason for this change was the central government's net repayment of £4.5 billion in 1998/99. Local government and public corporations also made net repayments in 1998/99, as in the previous financial year.

Table C
Composition of the PSNCR

£ millions

	1996/97	1997/98	1998/99
Central government net cash requirement (CGNCR)	**25,156**	**3,542**	**-4,537**
Memo item: CGNCR on own account	24,995	2,650	-6,163
Local authority net cash requirement (LANCR)	**-843**	**-820**	**-481**
less borrowing from central government	*1,517*	*955*	*1,869*
General government net cash requirement (GGNCR)	**22,796**	**1,767**	**-6,887**
Public corporations' net cash requirement (PCNCR)	**-1,424**	**-719**	**-387**
less borrowing from central government	*-1,356*	*-63*	*-234*
Public sector net cash requirement (PSNCR)	**22,728**	**1,111**	**-7,040**
as a percentage of GDP	*2.9*	*0.1*	*-0.8*

The PSND is the approximate stock counterpart of the PSNCR. The two measures differ, however, because of a number of factors unrelated to expenditure, such as the revaluation of debt held in foreign currencies. The box opposite explains the differences.

Debt and deficit under the Stability and Growth Pact

EU countries are required to report debt and deficit ratios to the European Commission, and the Stability and Growth Pact ('the Pact') requires that Member States keep their public finances under tight control.

The measure of debt specified for the purposes of the Pact (as in the Maastricht Treaty) is general government consolidated gross debt (GGCGD) as a percentage of GDP.

The PSNCR and changes in the public sector net debt: reconciliation

Public sector net debt (PSND) is a stock measure, and its change is calculated on a nominal, accrued basis. In contrast, the PSNCR, financed by transactions in assets and liabilities, is measured on a cash-flow basis. This leads to differences between the change in PSND and the PSNCR for any given period, mainly because of the following:

- The value of foreign currency liabilities and assets is affected by fluctuations in exchange rates, and so the debt changes independently of any transactions that affect the PSNCR.
- When gilts are issued (or bought in ahead of their redemption date) at a discount or premium, the PSNCR is financed by the actual cash amount received (or paid out). The level of debt, however, is deemed to have changed by the nominal value of gilts issued (or redeemed).
- The capital uplift on index-linked gilts is recorded in the PSNCR only when it is paid out, ie when the stock is redeemed. In the measure of debt outstanding, it is accrued over the life of the stock.

£ billions	Year ending March 1999
PSNCR	**-7.0**
Plus	
Revaluation of foreign currency assets/liabilities	0.5
Capital uplift on index-linked gilts	2.0
Discount/premium on gilt issues	1.2
Other	-0.4
Equals	
Change in public sector net debt	**-3.7**

Note: Figures may not sum to total because of roundings.

Now that the United Kingdom's public debt measure is consistent with the latest international definitions (see the box on pages 356–57), the absolute level of GGCGD is consistent with the requirements of the Pact. However, the debt to GDP ratio still differs slightly, because until March 2000, submissions under the Pact will continue to be based on GDP as measured under the old system of National Accounts (ESA79). On current ESA79 measurements, the United Kingdom's debt was 47.4% of GDP at end March 1999, comfortably below the reference level of 60%. The box on pages 358–59 compares the UK figures with those of other EU countries.

The deficit measured under the Pact is the ratio to GDP of general government net borrowing, previously known as the general government financial deficit. As with the debt ratio, GDP is currently measured according to ESA79 for this purpose. In the year to March 1999, the United Kingdom's general government net borrowing was

European System of Accounts 1995

The UK National Accounts are produced by the Office for National Statistics (ONS) according to the latest international definitions, the European System of National and Regional Accounts, 1995 edition (ESA95). This replaced the European System of Integrated Economic Accounts (ESA79). Public sector net debt figures are now also published regularly on the new basis, but this is the first time that ESA95-consistent figures have been used in this annual series of *Quarterly Bulletin* articles.

One of the effects of moving to the new definitions is the introduction of the central bank sector. This new sector, separate from central government, means that the sector classification of the Bank of England has changed. The UK central bank sector is constituted as follows:

- *the Bank of England Issue Department* has the primary function of issuing banknotes, and holds assets to back the note issue; and
- *the Bank of England Banking Department* reflects the rest of the Bank's business, eg banker to the government, other UK banks and overseas central banks.

Before the implementation of ESA95, the Issue Department was classified in the National Accounts within the central government sector; notes issued by the Issue Department were recorded in central government debt as a liability of central government. The Banking Department was classified in the banking sector and so as part of the market. However, Banking Department's holdings of national debt instruments were classified as official holdings, and reflected in central government debt through net indebtedness to the Bank of England Banking Department.

Both the Issue and Banking Departments of the Bank of England are now classified in the central bank sector, a sub-sector of the monetary financial institutions sector. As the Issue Department is now part of the market, liabilities of the Issue Department—notes in circulation—are no longer components of central government gross debt. Similarly, Issue Department's holdings of central government debt instruments have become market holdings of debt. The Banking Department remains a part of the market. For simplicity, both the Banking and Issue Departments' holdings of national debt instruments are now classified as market holdings of national debt. The concept of net indebtedness to the Bank of England therefore disappears.

The introduction of the central bank sector also affects the components of public sector liquid assets, which are deducted from gross debt to derive the public sector net debt. Assets of the Bank of England Issue and Banking Departments—mainly gilts, Treasury bills and commercial paper held under sale and repurchase agreements—are now excluded. Offsetting this is the inclusion of debt instruments issued by the Issue and Banking Departments held by the public sector. In practice, this means banknotes held by public corporations. These were previously consolidated out of the public sector liquid assets calculation.

The new definitions also include certain components, not previously seen as liabilities of the government, within the definition of central government debt. These are:

- deposits with the National Debt Commissioners of funds lodged in courts;
- third-party deposits from the Insolvency Service; and
- funds held on behalf of the European Commission.

Following the reclassification of its transactions to central government, the net liabilities, guaranteed by government, of the Guaranteed Export Finance Company (GEFCO) are also now included in central government gross debt. Interest-free notes held by the International Monetary Fund are now excluded from the central government gross debt, since they represent the United Kingdom's subscription to the IMF, and any drawing down creates an equivalent UK asset (an increase in the reserve position with the IMF) or a decrease in other UK debt to the IMF. This treatment is consistent with the calculation of the public sector net cash requirement.

Overall, these changes have led to a slight downward movement in gross debt measures, because the Issue Department's assets include non-government debt instruments. The effect on net debt measures is broadly neutral, since decreases in gross debt have been offset by the reduction in central government's liquid assets. The table opposite illustrates these changes in more detail.

The Bank of England is planning to begin publishing monthly figures for components of the PSND from November 1999. The information, to be included in its monthly publication, *Monetary and Financial Statistics*, will supplement the existing quarterly information on the breakdown of central government gross debt.

Public sector net debt at end March 1999

£ millions

	Before implementation of ESA95			After implementation of ESA95	
	Market holdings of national debt (excludes holdings of the Bank of England Issue and Banking Departments, and includes IMF interest-free notes)	363,410		Market holdings of national debt (includes holdings of the Bank of England Issue and Banking Departments, and excludes IMF interest-free notes)	380,187
+	Net indebtedness to the Bank of England Banking Department	0		Banking Department's holdings are included in market holdings of national debt	
+	Notes and coin in circulation	26,845	+	Coin in circulation	2,637
			+	Funds lodged in courts, Insolvency Service Investment account, EC funds and GEFCO net liabilities	4,926
+	Other central government liabilities	4,397	+	Other central government liabilities	4,397
=	Central government gross debt	394,652	=	Central government gross debt	392,147
+	Local government and public corporations' consolidated debt	457	+	Local government and public corporations' consolidated debt	457
=	Public sector consolidated gross debt	395,109	=	Public sector consolidated gross debt	392,604
			–	Short-term assets of Bank of England Issue and Banking Departments	1,058
–	Net claim on Bank of England Banking Department	893			
–	Debt instruments issued by the Issue or Banking Departments held by the public sector	6,365			
–	Other public sector liquid assets	42,381	–	Other public sector liquid assets	42,381
=	**Net public sector debt**	**345,470**	=	**Net public sector debt**	**349,165**

-0.9% of GDP (a net repayment). This is well within the reference ratio, which allows for deficits of up to +3% of GDP. The box on pages 358–59 shows how changes in the United Kingdom's debt and deficit positions under the Maastricht Treaty compare with those of other EU Member States.

Analysis of central government debt by instrument

Central government gross debt (CGGD) accounts almost entirely for the public sector gross debt (see Table A). Although gross debt levels of local government and public corporations are significant (£53 billion and £27 billion respectively at end March 1999), most is held by central government and so is not included in the consolidated public sector debt.

Table A shows that CGGD consists of market holdings of national debt and a few other components, including coin in circulation and deposits with the National Debt Commissioners of funds lodged in courts. The national debt represents the liabilities of the National Loans Fund, and consists mainly of British Government Securities (gilts) and National Savings instruments (as Table D shows).

Total national debt remained largely unchanged at £414 billion during 1998/99. The slight fall in market holdings was offset by a similar increase in official

Table D
Market and official holdings of national debt

£ millions, nominal values; *percentage of market holdings in italics*

End March (a)	1998		1999	
Market holdings				
British government stocks	291,021	*76.2*	285,394	*75.1*
of which: index-linked	58,729	*15.4*	62,289	*16.4*
other	232,292	*60.8*	223,105	*58.7*
Treasury bills	2,106	*0.6*	4,721	*1.2*
National Savings	58,955	*15.4*	59,531	*15.7*
of which: index-linked	8,912	*2.3*	9,133	*2.4*
other	50,043	*13.1*	50,398	*13.3*
Certificates of tax deposit	706	*0.2*	574	*0.2*
Other	17,624	*4.6*	18,147	*4.8*
Market holdings of sterling debt	**370,412**	***97.0***	**368,367**	***96.9***
North American government loans	534	*0.1*	453	*0.1*
US$ floating-rate notes	1,194	*0.3*	1,239	*0.3*
US$ bonds	2,986	*0.8*	3,098	*0.8*
Euro Treasury bills	2,249	*0.6*	2,341	*0.6*
Euro 9¹/₈% 2001 bond	1,606	*0.4*	1,672	*0.4*
Euro Treasury notes	2,891	*0.8*	3,010	*0.8*
Debt assigned to the government	7	*0.0*	6	*0.0*
Market holdings of foreign currency debt (b)	**11,466**	***3.0***	**11,820**	***3.1***
Total market holdings of national debt	**381,878**	***100.0***	**380,187**	***100.0***
Official holdings	32,205		33,367	
Total national debt (c)	**414,083**		**413,554**	

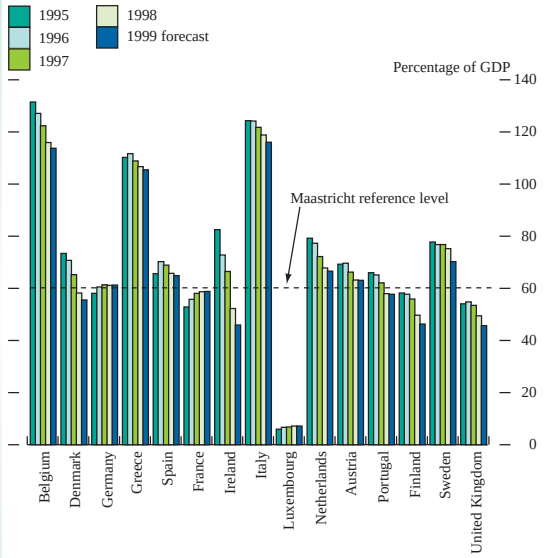
(a) Data from 1975 to 1999 are published in the *Bank of England Statistical Abstract 1999*, Part 1, Table 14.2.
(b) Sterling valuation rates:
31 March 1998: £1 = US$1.6745, Can$2.3821, ECU1.5565, DM3.0963
31 March 1999: £1 = US$1.6138, Can$2.4415, €1.4951, DM2.9242
(c) Excludes IMF interest-free notes. Although officially part of the national debt, these are not components of central government gross debt.

Public finances in the European Union

The public finances of each EU Member State are subject to close scrutiny, and Member States participating in the single currency may be subject to financial penalties if they maintain persistently excessive budget deficits. The Stability and Growth Pact requires EU members to maintain deficits (measured as general government net borrowing) below 3% of GDP, and, for those countries with debt ratios still above 60% of GDP, to achieve a declining general government consolidated gross debt in the short term. The Pact stipulates that government deficits should be close to balance, or in surplus, in the medium term.

Charts A and B show how the reported debt and deficit positions for each Member State have changed since 1995, and are forecast to change this year. The United Kingdom's debt comfortably met the criterion in March 1999; its debt is forecast to fall again during 1999, for the third consecutive year, and is expected to remain well below the 60% reference level. Except for Germany, France and Luxembourg, all Member States have reported a fall in their debt positions relative to GDP since 1995. In Germany and France the debt position has remained fairly stable at around 60%, and in Luxembourg, where there is very low public debt, the increase was minimal. In Belgium, Greece and Italy, which have exceptionally high government debt ratios, consistent falls were reported (with the exception of a slight rise in Greece's debt in 1996). However, the debt in each of these countries was forecast to remain well above 100% of GDP at end 1999. Five other member states, including Germany, Spain and the Netherlands, forecast that debt will remain in excess of the reference level in 1999. Ireland's strong economic growth and consistent budget surplus in recent years have helped it to achieve the steepest decline, from 82% in 1995 to a forecast 46% in 1999.

Chart A
General government consolidated gross debt (end year)



Source: Eurostat.

Falling debt ratios, combined with generally lower interest rates, have reduced interest burdens in most countries (see Chart B). This is reflected in improved annual deficits since 1995 in all EU Member States. UK annual net borrowing has fallen from 5.5% of GDP in 1995 to a net repayment of 0.6% in

holdings[1]—holdings by central government bodies such as the National Investment and Loans Office and central government departments. The structure of market holdings of national debt remained broadly unchanged from 1998, as did marketable debt, the proportion of debt that can be traded in a secondary market (gilts, Treasury bills and some foreign currency instruments).

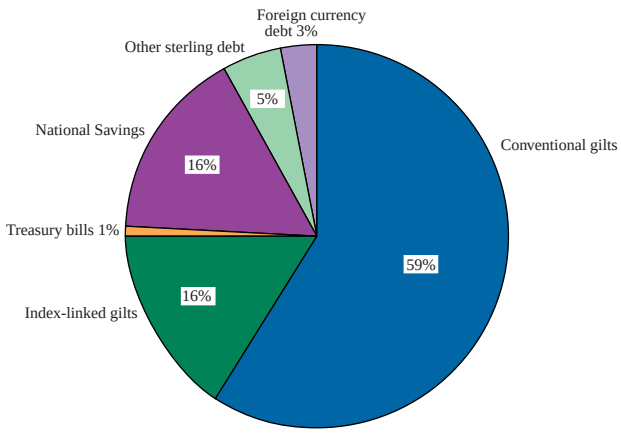
National debt instruments

The composition of market holdings of national debt is shown in Chart 4. This section gives a more detailed analysis of the major national debt instruments, explaining significant year-on-year changes.

British Government Securities (gilts)

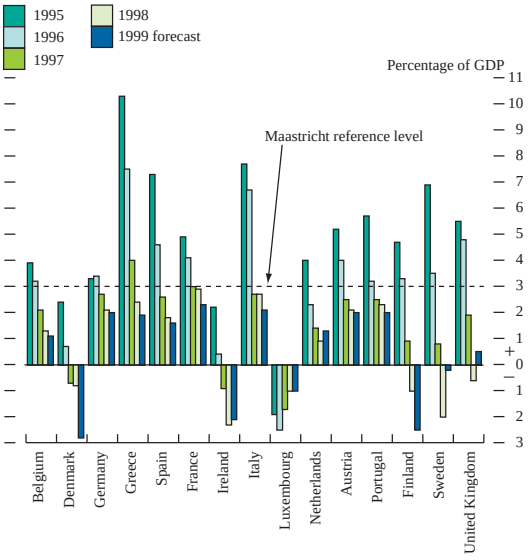
Gilts are by far the largest component of national debt. At end March 1999, market holdings of gilts[2] were £285.4 billion at nominal value, accounting for 75% of total market holdings of national debt (see Chart 4). This is £5.6 billion (and 1 percentage point) lower than the previous year, with a £9.2 billion decrease in holdings of conventional gilts only partly offset by a £3.6 billion increase in market holdings of index-linked gilts.

Chart 4
Composition of market holdings of national debt by instrument, end March 1999



(1) Note that, although a consistent picture is presented in this article, the coverage of market and official holdings was affected by the switch to ESA95 definitions since the article in the November 1998 *Quarterly Bulletin*. This is explained in the box on pages 356–57.
(2) Unless otherwise stated, all figures are in nominal terms and include capital uplift accrued on index-linked stock.

Chart B
General government net borrowing (calendar year)



Source: Eurostat.

1998, with net borrowing of 0.5% forecast for 1999. Steep falls in net borrowing were also reported by countries which had relatively high debt ratios during the early 1990s. In Greece, Spain and Italy, in particular, net borrowing fell from levels as high as 10% of GDP in 1995 to levels below the 3% requirement by 1998. Denmark, Ireland, Finland, Sweden and the United Kingdom have now joined Luxembourg in recording annual net repayments.

Many countries reported significant falls in their deficit figures for 1997, the year over which eligibility for membership of the first wave of Economic and Monetary Union (EMU) was judged. In their 1999 Public Finance Report, the European Central Bank (ECB) acknowledged that temporary measures—such as the Italian euro tax—played a significant role in reducing deficits in 1997 (by an average of 0.4% of GDP). These measures had less influence in 1998 (around 0.1%), when decisions had been taken on EMU entry. Although deficits continued to fall in 1998, assisted by historically low interest rates in the euro area, the falls were much smaller than in 1997. The ECB's report expressed disappointment that the 'opportunity to use the windfalls of buoyant growth and low interest rates to make more substantial progress in improving underlying budgetary positions was largely forgone in many Member States'. They noted that 'developments in 1998 represented a noticeable slowdown if not a standstill in fiscal consolidation'.

The ECB report also contrasted the generally more positive debt and deficit positions in 1998 for Member States not adopting the single currency (Denmark, Greece, Sweden and the United Kingdom) than for those already committed. On average, the deficit ratio for participating countries fell from 2.5% in 1997 to 2.1% in 1998, and for non-participating Member States the average fell from a deficit of 1.7% in 1997 to a surplus of 0.6% in 1998.

The ECB expects only small improvements in countries' budgetary positions in 1999 and the medium-term future. It points out that any increase in interest rates could lead to some countries having difficulty meeting the requirements of the Stability and Growth Pact, which expects net borrowing to be in balance or surplus in the medium term. Despite the generally negative outlook, the individual assessment for the United Kingdom is relatively positive. The ECB predicts that both deficit and debt for the United Kingdom will soon be comfortably within the Maastricht limits.

The nominal value of index-linked gilts held by the market at end March 1999 was £62.3 billion, a 6% annual rise. Index-linked issuance totalled £1.5 billion (excluding capital uplift) during 1998/99. This included the first auction of index-linked gilts in November 1998—all previous issues of index-linked stock had been conducted via the tap mechanism. The Debt Management Office (DMO) expects issuance of index-linked gilts via auctions to become general practice in the longer term, as it currently is for conventional gilts.

Despite the growth of index-linked stock in recent years, conventional gilts still accounted for 59% of the national debt held by the market at end March 1999 (see Table D). In total, £5.9 billion of conventional gilts were issued during 1998/99. This comprised further issues of 5¾% Treasury Stock 2009 and 6% Treasury Stock 2028, which are now regarded by the market as the 10-year and 30-year benchmarks respectively.

Several conventional gilts were redeemed during 1998/99. Major redemptions included £5.7 billion of Floating Rate Treasury Stock 1999, £3.9 billion of 12% Exchequer Stock 1998 and £3.0 billion of 12¼% Exchequer Stock 1999.

In March 1998, the DMO projected gross gilt sales of £14.2 billion in 1998/99, to contribute towards a forecast financing requirement of £15.2 billion. This target was revised downwards during the year for a number of reasons. The overfunding carried forward from 1997/98 was £3.1 billion higher than had been anticipated, and the 1998/99 central government net cash requirement (CGNCR) was revised up by £8.2 billion, from an initial forecast deficit of £3.7 billion to a £4.5 billion outturn surplus. These effects were partly offset by a £600 million reduction in the forecast net contribution from National Savings, resulting in a final gilt financing requirement of £4.0 billion. Actual sales during the year were £8.1 billion (£7.4 billion at nominal value).

The average remaining life of market holdings of gilts at end March 1999 was ten years. As Table E shows, this figure has changed little in recent years. However, through consultation with the market, the DMO has identified an increased demand for long-dated gilts. This is partly due to factors such as the minimum funding requirements applied to pension funds, and the relative competitiveness of bonds compared with equities brought about by the abolition of advance corporation tax and dividend tax credits. As a

result, the Government's issuance strategy is now biased towards long-dated stocks, which, other things being equal, will lengthen the average gilt maturity. Chart 5 shows the maturities of existing dated stocks by value in market hands.

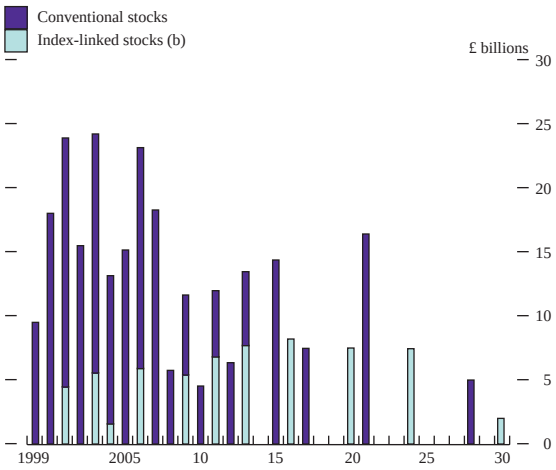
Table E
Average remaining life of dated stocks in market hands(a)

Years to maturity at 31 March

	1992	1993	1994	1995	1996	1997	1998	1999
Latest possible redemption:								
All dated stocks (b)	10.0	10.8	10.6	10.4	10.1	10.1	10.2	10.0
Excluding index-linked stocks	8.4	9.4	9.1	9.1	8.8	8.8	9.0	8.9
Earliest possible redemption date:								
All dated stocks	9.8	10.5	10.4	10.2	9.9	9.9	10.0	9.9
Excluding index-linked stocks	8.1	9.0	8.9	9.1	8.8	8.7	8.9	8.8

(a) These data are based on the nominal value of dated stocks held by the market at 31 March each year.
(b) Index-linked stocks are given a weight reflecting capital uplift accrued to 31 March.

Chart 5
Redemption dates of dated stocks in market hands(a)



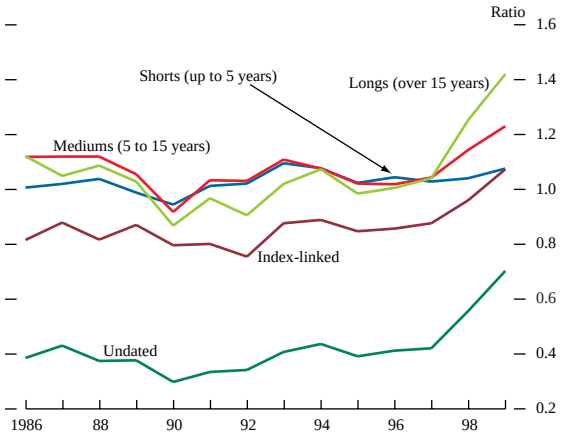
(a) As at end March 1999, using latest possible redemption dates.
(b) Figures include accrued capital uplift to 31 March 1999.

The gilt market in 1998/99

Gilt yields continued to fall in 1998/99. A decline in global stock markets precipitated by economic uncertainty in Russia and East Asia led to rising gilt prices—and falling yields—in the second quarter of the financial year. The transfer of capital from equities into government bonds in this period was seen as a 'flight to quality'. During October the fall in yields was sharply reversed because of the liquidation of holdings in response to the global economic difficulties, but this was short-lived: reductions in global interest rates caused further falls in yields. By the end of the financial year yields had begun to rise, but over the whole of 1998/99 yields fell by more than 100 basis points across all maturity bands. The fall was most marked in the five-year benchmark, which was 144 basis points lower at the end of the year.

The strength of gilt prices resulted in a sharp rise in their market to nominal ratio (see Chart 6). The market value of all gilts in market hands at end March 1999 was £335 billion, 17% higher than the nominal value (up from 9% a year earlier). The increased demand for long-dated gilts since 1997 has resulted in longs being at an average 42% premium to their nominal value at end March 1999. This reflects greater demand from pension funds, partly because of the minimum funding requirements introduced in 1997, as shown by the increased holdings of gilts by pension funds (described below).

Chart 6
Ratios of market to nominal values of stocks in market hands



Despite the increased issuance of index-linked gilts, demand, particularly from institutional investors, remained very strong, and yields fell. For the first time since their introduction, index-linked gilts were being traded at a premium to their nominal value at the end of the 1998/99 financial year. The market to nominal premium at the end of the year was 7%, compared with a discount of 4% a year earlier. Market prices of undated stocks rose in response to falling interest rates and yields. At the beginning of 1998/99, undated stocks were trading at a 44% discount; this fell to 30% by the end of the year.

The financing Remit for 1999/2000

The Government's Remit to the DMO was published in March 1999,(1) with a target for gross gilt sales in 1999/2000 of £17.3 billion. This was based on a forecast CGNCR of £6.2 billion, and takes into account gilt over-funding during 1998/99 of £2.3 billion and expected gilt redemptions in 1999/2000 of £14.9 billion. The target for index-linked issuance is £3.5 billion (20% of gross sales). Reflecting the increased demand for long-dated stock mentioned earlier in this article, the Government has set a target issuance of £5.8 billion of long conventional gilts (34%), up from £3.1 billion in 1998/99. 1999/2000 targets for short and medium conventional gilts are £5.0 billion (29%) and £3.0 billion (17%) respectively.

National Savings

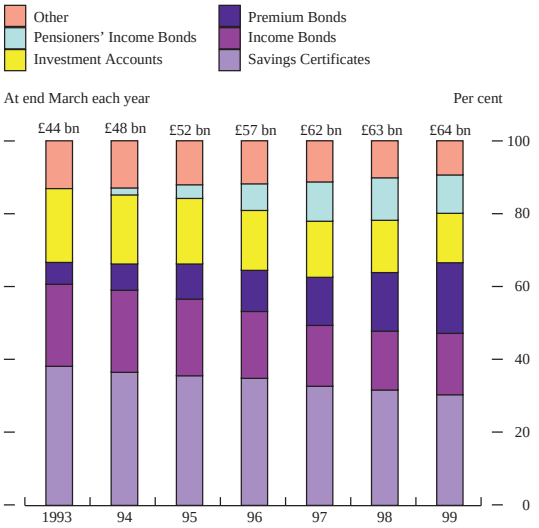
National Savings instruments accounted for 16% of market holdings of national debt at end March 1999 (see Chart 4).

(1) *Debt Management Report 1999–2000*, HM Treasury, March 1999.

Including Ordinary Account deposits and accrued interest and index-linked increments on other National Savings products, which are not part of national debt, outstanding National Savings instruments totalled £63.7 billion. The increase of £0.4 billion during the financial year constitutes the net funding contribution to the Government's financing requirement. The gross sales (ie sales and deposits including accrued interest) of National Savings products for 1998/99 was approximately £12 billion.

The proportion of National Savings held in Premium Bonds continued to grow in 1998/99, to 19% at the end of the period. This compares with 6% at end March 1993. The share of Pensioners' Income Bonds,(1) which had increased every year since their introduction in 1994, fell back slightly in 1998/99 to 11%. The growth in the proportion of National Savings held in Premium Bonds and Pensioners' Income Bonds has been at the expense of holdings of conventional Income Bonds and Investment Account deposits (see Chart 7).

Chart 7
Composition of National Savings by product



Source: Department of National Savings.

The net contribution of National Savings to the Government's financing programme for 1999/2000 is expected to be around £100 million, with gross sales of around £11 billion. This is lower than 1998/99, reflecting the high level of redemptions due on National Savings products during 1999/2000.

Sterling Treasury bills

Market holdings of sterling Treasury bills at end March 1999 stood at £4.7 billion, or 1.2% of national debt. This is markedly higher than a year earlier, when the stock was £2.1 billion (0.6%). The rise was the result of an increased three-month tender from £100 million to £200 million, and the introduction of a one-month tender of £500 million a week, during March 1999. These were necessary to offset a prospective easing in money-market conditions arising from two large gilt redemptions on 11 and 26 March, and the seasonal rise in government expenditure at the end of the financial year. This was the first offer of one-month sterling Treasury bills since end 1997. They allow more flexibility than longer-dated bills in influencing the outstanding stock of money-market refinancing.

Following the decrease in the estimated CGNCR, the DMO confirmed in the *1998/99 Gilt Review*(2) that its estimated net Treasury bill issuance during 1999/2000 had been revised downwards from an earlier estimate of £3.6 billion to £1.9 billion. The DMO also announced on 29 July its intention to assume full responsibility for Exchequer cash management by the end of the 1999/2000 financial year. Once these arrangements are in place, Treasury bills will become the primary short-term financing instrument used to meet the seasonal fluctuation of the Government's within-year cash requirements. The DMO's holdings of short-term instruments will then reflect daily changes in the net cash position, a function currently performed by the Ways and Means overdraft with the Bank of England. After this transfer of cash management responsibilities, the Ways and Means advances will no longer be used to balance the Government's overnight needs, and will be frozen.

Foreign currency debt

The sterling value of foreign currency debt outstanding increased during 1998/99, from £11.5 billion to £11.8 billion, as shown in Table D. Foreign currency debt as a proportion of total market holdings of national debt also rose slightly, from 3.0% to 3.1%, mainly because of the revaluation of existing liabilities; the sterling effective exchange rate (as measured by the Bank's exchange rate index) rose from 102.8 at the start to 106.8 at the end of 1998/99.

Sterling national debt: analysis by holder

Tables F and G show an estimated distribution by economic sector of the sterling national debt at end March 1999.(3)

Table F shows that this distribution has remained broadly unchanged from last year. Individuals' and private trusts' holdings of national debt instruments increased during 1998/99 by more than £10 billion, to £85.0 billion. Most of this sector's holdings were again in National Savings products, but growth in their holdings of gilts (to £25.3 billion at end March 1999) accounted for all of the increase.

Total sterling national debt held by non-UK residents increased during the year by £6 billion, also reflecting increased investment in gilts. As in the previous year, their net investment was concentrated on the short to

(1) Holders must be 60 years of age or over; interest rates are fixed for five years.
(2) *1998/99 Gilt Review*, Debt Management Office, July 1999.
(3) These tables are compiled from a variety of sources, including banks' aggregated balance sheets, the 1998 gilt ownership survey (Bank of England), and the ONS' quarterly and annual surveys of various financial and non-financial companies.

medium-term end of the market. This increase means that non-residents' holdings of national debt instruments accounted for just over 16.6% of total market holdings, an increase of 1½ percentage points from 1997/98. This may have been because overseas investors perceived the United Kingdom as a 'safe haven' from both EMU uncertainty and turbulence in Russia and the Far East.

Table F
Distribution of the sterling national debt: summary[a]

£ billions; *percentage of market holdings in italics*

Amounts outstanding at 31 March	1998		1999		Change in 1998/99
Market holdings					
Public sector	7.1	*1.9*	5.9	*1.6*	-1.2
Banks	28.4	*7.6*	26.9	*7.2*	-1.8
Building societies	1.0	*0.4*	0.7	*0.2*	-0.3
Institutional investors	192.4	*51.3*	183.1	*48.9*	-9.3
Individuals and private trusts	74.4	*19.8*	85.0	*22.7*	10.6
Other UK residents	15.2	*4.0*	10.5	*2.8*	-4.7
Non-residents	56.4	*15.1*	62.2	*16.6*	5.8
Total market holdings	**374.8**	***100.0***	**374.3**	***100.0***	**-0.5**
Official holdings	31.2		32.0		0.8
Total sterling debt	**406.0**		**406.4**		**0.3**

Note: Figures shown may not sum to totals because of rounding.

(a) See Table G for a more detailed analysis. Data for 1975–99 are published in the *Bank of England Statistical Abstract 1999*, Part 1, Table 14.3.

Although institutional investors remain by far the largest holders of sterling national debt, accounting for 49% of total market holdings in 1999, their holdings fell by £9 billion during the year. As Table G shows, these holdings are concentrated largely in medium and long-dated stocks, reflecting the institutions' need to match their assets with their typically longer-term liabilities. The fall during the year was almost entirely in insurance companies' holdings of gilts. Holdings by pension funds continued to grow (in particular holdings of long-term gilts), reflecting increasing demand for pensions, and following the introduction of the minimum funding requirement solvency test, which came into force in April 1997 (implementing the Pensions Act 1995).

Banks' and building societies' holdings of sterling national debt instruments fell again in 1998/99, and were £27.6 billion at end March 1999. Within this, holdings of gilts fell, but holdings of other debt instruments, such as Treasury bills, rose.

The Bank of England conducted a survey of Central Gilts Office members to ascertain the beneficial ownership of the sterling British Government Securities (gilts) held on behalf of their clients as at the end of 1998. The results, which have been used in the compilation of Table G, are contained in an article published in the Bank of England's *Monetary and Financial Statistics* (July 1999, and supplement in September 1999).

Table G
Estimated distribution of the sterling national debt: 31 March 1999

£ billions, nominal values (a)

	Total holdings of sterling debt	British government stock (b)				Treasury bills	Non-marketable debt
		Total	Up to 5 years to residual maturity	Over 5 years and up to 15 years	Over 15 years and undated		
Market holdings							
Local government	0.2	*0.2*	0.0	0.1	0.1	0.0	0.0
Public corporations	5.8	*3.0*	1.2	1.4	0.4	0.0	2.8
Total public sector	**5.9**	***3.2***	**1.2**	**1.5**	**0.4**	**0.0**	**2.8**
Banks (c)	26.9	*9.4*	4.5	3.5	1.4	1.8	15.8
Building societies	0.7	*0.7*	0.6	0.1	0.0	0.0	0.0
Institutional investors:							
Insurance companies	102.7	*102.1*	25.6	43.8	32.7	0.6	0.0
Pension funds	76.0	*75.4*	19.6	37.3	18.6	0.6	0.0
Investment and unit trusts	4.3	*4.3*	1.5	1.7	1.1	0.0	0.0
Total institutional investors	**183.1**	***181.9***	**46.7**	**82.7**	**52.4**	**1.2**	**0.0**
Individuals and private trusts	85.0	*25.3*	8.4	12.7	4.2	0.0	59.7
Other UK residents	10.5	*9.9*	6.4	2.1	1.4	0.3	0.3
of which: Industrial and commercial companies	1.2	*0.6*	0.1	0.3	0.2	0.3	0.3
Non-residents:							
International organisations	6.1	*0.5*	0.3	0.2	0.0	0.0	5.7
Central monetary institutions	16.3	*15.5*	9.3	5.1	1.2	0.8	0.0
Other	39.8	*39.2*	15.3	13.7	10.2	0.6	0.0
Total non-residents	**62.2**	***55.2***	**24.8**	**19.0**	**11.4**	**1.4**	**5.7**
Total market holdings	**374.3**	***285.4***	**92.5**	**121.6**	**71.3**	**4.7**	**84.2**
Official holdings	32.0	*6.4*	2.6	3.0	0.8	4.5	21.1
Total sterling national debt	**406.4**	***291.8***	**95.1**	**124.6**	**72.1**	**9.2**	**105.4**

Note: Figures shown may not sum to totals because of rounding.

(a) Some of these estimates are based on reported market values; certain others rely on broad nominal/market value ratios.
(b) A sectoral analysis of gilt holdings from 1975–99 is published in the *Bank of England Statistical Abstract 1999*, Part 1, Table 14.4.
(c) Includes the Issue and Banking Departments of the Bank of England.

Annex
Notes and definitions

The national debt

The *national debt* represents the total liabilities of the National Loans Fund (NLF). *Market holdings* include holdings by local government and public corporations, and, since the transition to ESA95 definitions, the Issue and Banking Departments of the Bank of England. Market holdings exclude holdings by other central government bodies (principally the funds of the National Investment and Loans Office, the Exchange Equalisation Account and government departments).

The national debt comprises:

British Government Stocks (BGS): Sterling, marketable, interest-bearing securities issued by the UK Government. The nominal value of index-linked gilt-edged stocks is increased by the amount of accrued capital uplift. The whole nominal value of all issued stocks is recorded, even where outstanding instalments are due from market holders (where this is the case, the outstanding instalments are recorded as holdings of liquid assets). This article uses the same definition of short and medium-dated gilts as the NLF accounts (under five years and five to ten years respectively). In the financing requirement, however, and in general market usage, short-dated gilts are defined as three to seven years and medium-dated as seven to fifteen years.

Treasury bills: Short-term instruments generally issued with a maturity of 91 days. The bills, which can be traded on the secondary market, are sold at a discount and redeemed at par. The amount of discount depends on the price accepted by the Bank at the tender.

National Savings securities: Non-marketable debt comprising a variety of products available to the public. The national debt excludes deposits in ordinary accounts of the National Savings Bank, as well as accrued interest and indexing on National Savings products.

IMF interest-free notes: Non-marketable non interest bearing Treasury notes, issued by the Bank of England on the authority of warrants from HM Treasury. The warrants authorise various sums to be placed at the disposal of the International Monetary Fund (IMF) as a reciprocal facility for loans received by the United Kingdom. All transactions are initiated by the IMF. Interest-free notes held by the IMF are excluded from the central government gross debt, since they represent the United Kingdom's subscription to the IMF, and any drawing down creates an equivalent UK asset (an increase in the reserve position with the IMF) or a decrease in other UK debt to the IMF.

Certificates of tax deposit: Non-marketable debt available to taxpayers generally, which may be used in payment of most taxes.

Other sterling debt: Includes *Ways and Means advances* (the method by which government departments etc lend overnight to the NLF), *NILO stocks* (non-marketable stocks, issued directly to the National Debt Commissioners, whose terms reflect those on existing BGS), and the *temporary deposit facility* (deposits by central government bodies and public corporations with the NLF).

Foreign currency debt: Converted to sterling at end-period middle-market closing rates of exchange and comprises *foreign currency bonds* (denominated in US$, DM and euro), *euro Treasury notes and bills, long-term post-war loans* from the governments of the United States and Canada and *assigned debt* (debt originally drawn under the Exchange Cover Scheme and transferred to the government following privatisations of public corporations).

Central government gross debt

Includes *market holdings of national debt* (except IMF interest-free notes) and also any market holdings of other central government gross debt, which comprises:

National Savings ordinary account, accrued interest and indexing on National Savings: Excluded from market holdings of national debt.

Coin in circulation

Deposits with the National Debt Commissioners of *funds lodged in courts*.

Other central government gross debt: Comprises market holdings of *Northern Ireland government debt* (principally Ulster Savings Certificates), *bank and building society lending, balances of certain public corporations with the Paymaster General, funds held on behalf of the European Commission, other third-party deposits* (from the Insolvency Service), and the *net liabilities, guaranteed by government, of the Guaranteed Export Finance Company (GEFCO)*, following the reclassification of its transactions to central government in 1987.

Public sector consolidated gross debt

This includes *central government gross debt*, as well as all *local government and public corporation debt*. All holdings of each other's debt by these three parts of the public sector are netted off to produce a consolidated total.

The local government sector comprises all bodies required to make returns under the various local authorities acts. Public corporations are trading bodies (including nationalised industries), which have a substantial degree of independence from the public authority that created them, including the power to borrow and maintain reserves.(1)

Public sector net debt

The *public sector net debt* is derived from the consolidated debt of the public sector by deducting the public sectors' holdings of liquid assets.

General government consolidated gross debt

This is *central government* and *local government gross debt* with holdings of each other's debt netted off to produce a consolidated total. The Maastricht measure of GGCGD—the government debt figures produced under the terms of the Stability and Growth Pact—is calculated on the ESA79 basis. In absolute terms this is the same for the United Kingdom as the ESA95 definition, but is slightly higher as a percentage of GDP (47.4% at end March 1999). Beginning with the March 2000 submission to the Commissions, all data will be on the latest, ESA95, basis.

(1) For further details, see Chapter 4 of the *Financial Statistics Explanatory Handbook*, published by the Office for National Statistics.

The external balance sheet of the United Kingdom: recent developments

This article[1] summarises the development of the international investment position of the United Kingdom between 1988 and the first half of 1999.[2] It continues an annual series begun in 1985.

The article describes how financial flows and changing asset values affect the United Kingdom's external balance sheet. It relates investment income flows and capital gains to stocks of assets and liabilities, and compares the United Kingdom's international investment position with those of other major economies. A box gives details of the UK participation in the IMF-sponsored coordinated portfolio investment survey.

Overview

The international investment position of the United Kingdom comprises the stock of UK residents' investments in the rest of the world (assets) and the stock of investments into the United Kingdom from the rest of the world (liabilities).

At end 1998, the United Kingdom's net debt to the rest of the world was £67.5 billion, down from a net liability of £82.6 billion at end 1997. The reduction resulted from a £9 billion net acquisition of assets and a £6.1 billion net revaluation of assets. By end June 1999, the net international liability had contracted further to £43 billion.

Table A shows how the net asset position changed from 1993 to mid 1999, identifying the separate contributions of actual financial flows and revaluation effects.

Table A
Changes in the United Kingdom's net asset position

£ billions

	1993	1994	1995	1996	1997	1998	1999 H1
Current account	-10.6	-1.5	-3.7	-0.6	6.6	0.1	-7.3
Capital account	0.3	0.0	0.5	0.7	0.8	0.4	0.3
Financial flows	-9.4	6.0	-0.9	-1.8	13.1	9.0	-2.1
Net errors	0.9	7.5	2.3	-1.9	5.8	8.5	5.3
Revaluations	23.3	-20.1	-13.7	-7.8	-93.9	6.1	26.6
Net assets	36.4	22.2	7.6	-1.9	-82.6	-67.5	-43.0
Change in net assets (a)	13.8	-14.1	-14.6	-9.5	-80.7	15.1	24.5

Sources: ONS and Bank of England.

(a) Financial flows + Revaluations = Change in net assets.

At the end of 1998, UK international assets stood at £2,150 billion, up by 10.7% on the end-1997 level of £1,942 billion. International liabilities were £2,218 billion, up by 9.5% on the end-1997 figure of £2,025 billion. To put these figures into perspective, international assets and liabilities at end 1998 were two and a half times nominal annual gross domestic product.

The data used in this article are taken from the latest available balance of payments statistics, published by the Office for National Statistics (ONS). Following the standard layout of the balance of payments accounts,[3] international investments are classified under four headings:

- Direct investment: interests in non-resident enterprises implying a degree of ownership or control (assessed as a holding of 10% or more of an enterprise's equity, and any subsequent transactions while the holding remains at or above 10%).
- Portfolio investment: holdings of securities (such as bonds, notes, preference and ordinary shares) of less than 10% of an enterprise's equity.
- Other investment: residual category (mainly deposits, loans and trade credits).
- Reserve assets: external assets controlled by monetary authorities.

In principle, every credit in the balance of payments should be offset by a debit. For example, the export of a good from the United Kingdom is a credit in the current account. It could be offset directly by a debit in the financial account, when a non-resident pays for the good out of a deposit at a bank in London (measured as a decrease in UK liabilities). In practice, there are 'net errors and omissions'. The ONS believes that most of these net errors are probably inflows on the financial account, such as purchases of UK firms' equities, which are not measured directly in the official surveys.[4]

(1) Prepared by Andrew Colquhoun of the Bank's Monetary and Financial Statistics Division.
(2) Using figures published in the *United Kingdom Balance of Payments (Pink Book)*, Office for National Statistics, 1999.
(3) The main international standard for compiling balance of payments accounts is the 1993 IMF *Balance of Payments Manual, fifth edition*, ('BPM5'). This is supplemented in the European Union by the *European System of National and Regional Accounts*, 1995 ('ESA95'). These standards replaced BPM4 and ESA79 as the basis for the United Kingdom's official statistics in 1998. Full details of the changeover are explained in a box in the February 1999 *Quarterly Bulletin*, page 42.
(4) See the *Pink Book 1999*, Introduction, page 7.

The coordinated portfolio investment survey

Origins

This box reports on the United Kingdom's contribution to the multilateral coordinated portfolio investment survey undertaken at the end of 1997 under the auspices of the IMF Balance of Payments Statistics Committee.(1)

International flows in the form of portfolio investment (both equities and debt securities) increased significantly in the 1980s and 1990s, attracting the attention of policy-makers, market participants, and independent researchers. However, the reliability of the statistics has been undermined by deficiencies in data compilation systems, which were highlighted by an IMF report(2) in 1992. Concerned by these deficiencies, the IMF decided in 1993 to promote the idea of a coordinated portfolio investment survey (CPIS), at the reference date of end December 1997.

The CPIS was designed to improve estimates of portfolio investment in the form of equity and long-term debt. Specifically, the objectives were:

- To collect comprehensive information, with geographical details, on the stock of cross-border equities and long-term bonds and notes, for use in the compilation or improvement of international investment position (IIP) statistics on portfolio investment capital. The IIP statistics, in turn, can provide information to check the coverage of recorded estimates of portfolio investment capital flows and associated investment income transactions recorded in the balance of payments.

- To exchange the bilateral data. By exchanging comparable data, participating countries should be able to improve their estimates of non-resident holdings of their portfolio investment liabilities, as well as associated capital flows and investment income data.

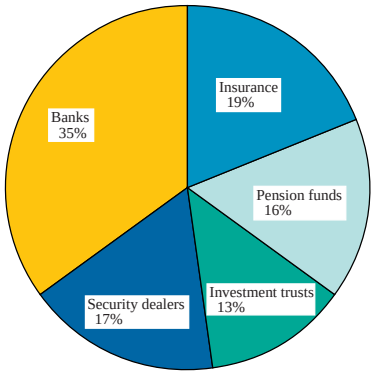
The United Kingdom participated in an IMF task force established to draw up detailed specifications for the minimum amount of information required to achieve the objectives of the CPIS, and to address various technical issues, including valuation, definition and classification to be used.

Twenty nine countries participated in the CPIS. These countries represented more than 80% of the estimated stock of global portfolio assets and liabilities. All participating countries collected the 'mandatory' data, relating to assets in equity and long-term debt securities. Some non-mandatory data were also compiled by eighteen countries, mainly relating to assets in money-market instruments, but also to liabilities in equities, long-term debt and money-market securities. Only two countries reported data on financial derivatives assets and liabilities positions.

Results

The IMF plans to publish the global results in early December 1999, together with supplementary commentary and metadata. The United Kingdom's contribution to this is shown in Charts A and B. Chart A shows that UK banks held 35% of the United Kingdom's total holding of portfolio investments issued by non-residents at the end of 1997. Other sectors held approximately equal amounts of the remaining balance. UK banks accounted for 63% of the total holding of bonds issued by non-residents but only 1% of the corresponding total for equities held as portfolio investments. The country analysis in Chart B gives an insight into the concentration of UK portfolio investment, and shows that investment in mature markets far outweighs investment in emerging market securities. The top ten countries by size of holding by UK residents accounted for 77% of the total portfolio investment assets recorded in the United Kingdom's international investment position.

Chart A
UK portfolio investment assets: share by institutional sector



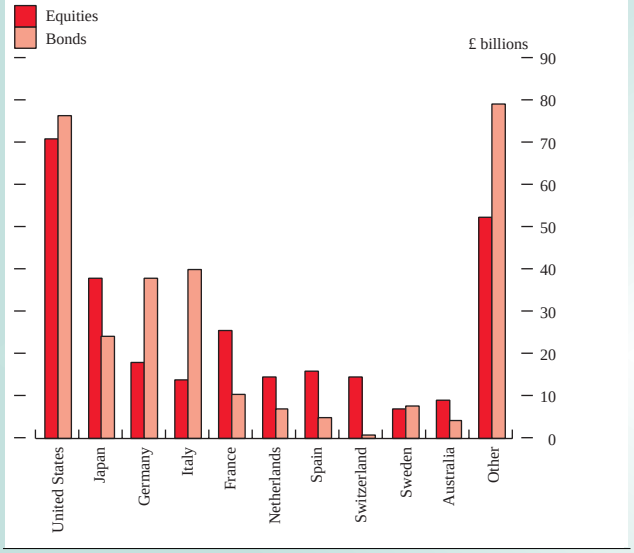
At the direction of the national compilers of the CPIS at their meeting in March 1999, it was agreed that a task force should be formed to report to the October 1999 meeting of the IMF Balance of Payments Statistics Committee. This task force will be reporting on the results of the 1997 CPIS, and on the need for, feasibility, and possible timing of subsequent surveys, and their scope.

UK data collection issues

In the United Kingdom, the Office for National Statistics (ONS) was responsible for reporting the CPIS data to the

(1) See the box on page 420 of 'The external balance sheet of the United Kingdom: recent developments', *Quarterly Bulletin*, November 1996, an earlier article in this series.
(2) 'Final report of the IMF working party on the measurement of international capital flows' ('The Godeaux Report'), IMF, September 1992.

Chart B
UK portfolio investment assets



IMF. The Bank of England was readily able to supply the ONS with the banking sector's contribution using data from new survey forms,[1] introduced in September 1997 as part of a wider Banking Statistics Review designed to bring banking statistics into line with new international guidelines.[2] The ONS had to collect the additional geographical details required from non-bank financial institutions[3] by means of an annex to their annual balance sheet inquiry forms. These forms were despatched to approximately 700 companies, but the response rate was only 61%, which was lower than expected.[4] Various estimation methods were used to gross up the results to represent 100% coverage. Non-response was not a problem for banks, and the relevant survey was completed by institutions whose business in aggregate was around 95% of the total external business of UK banks.

The United Kingdom supplied data for the mandatory items—equity and long-term debt securities. In addition, non-mandatory data on banks' holdings of short-term debt securities was supplied. This was largely because the data were readily available, and it was thought that holdings of such instruments by non-banks were minimal.

(1) Form CC (Country analysis of UK external claims).
(2) For details, please see John Thorp's article in *Monetary and Financial Statistics*, 'Outcome of the review of banking statistics, including effects on monetary and other banking statistics', September 1997.
(3) The ONS sent survey forms to institutional investors in various sectors: securities dealers, insurance companies, pension funds and unit trusts. Surveys were not sent to the household sector, on *de minimis* grounds.
(4) The ONS conducted a pilot survey in August 1997 to assess whether non-bank financial companies would be able to provide the required data. The results suggested that the actual survey response rate might be better than was actually achieved.

The ONS acknowledges that there are substantial difficulties in compiling an accurate measure of the country's international investment position. Net figures and balances should be treated with caution. Assets and liabilities are both estimated to be more than £2 trillion; the balance of £67.5 billion is probably within the margin of measurement error of either gross total.

One methodological problem is that not all asset stocks are recorded at comparable market values. Most significantly, stocks of foreign direct investment (FDI) are recorded in the accounts at book value. (The final section of this article presents the results of a study that attempted to estimate the market value of direct investment stocks.) Moreover, some asset and liability levels are estimated imperfectly, by cumulating financial flows and revaluing the result using relevant price indices. However, despite the limitations of the data, it is possible to examine trends in the gross stocks of assets and liabilities and to explain the more extreme swings in the net position.

Revaluation effects on the international investment position

Changes in international asset stocks can occur because of flows of new investment, or because existing assets are revalued. With stocks of around £2,000 billion in recent years, fluctuations in value might be expected to outweigh financial account inflows and outflows (of around £100 billion in 1998). Chart 1 shows that, in most years, this is indeed the case.

Chart 1
International investment position—flows and revaluations

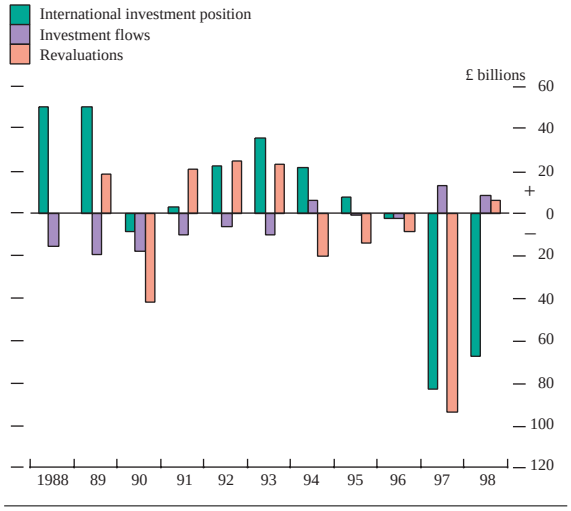


Table B decomposes changes in the international asset and liability positions, attributing the changes to (i) financial flows and (ii) currency, price, and 'other' valuation effects. Financial flows are given in the published data. Revaluations should equal the difference between the change in the stock and the flow. The apportionment of

revaluations is estimated using price indices (stock markets, bond prices and currency movements). The 'other' category is a residual; the IMF manual allows for a third category of 'other adjustments', but at the aggregate level these will be dwarfed by revaluations.

Table B
Changes in gross assets and liabilities: financial flows and revaluations

£ billions

	1993	1994	1995	1996	1997	1998	1999 H1
Assets (total)	**1,351.1**	**1,337.9**	**1,539.4**	**1,634.4**	**1,942.2**	**2,150.3**	**2,428.7**
Financial flows	153.8	30.4	115.3	219.2	256.8	114.3	234.8
Revaluation effects:	52.4	-43.6	86.2	-124.2	51.0	93.9	43.5
Currency effect	32.4	-23.8	13.2	-169.3	-32.3	32.4	7.7
Price effect	20.0	-19.8	73.0	45.1	83.3	61.4	35.8
Liabilities (a)	**1,314.8**	**1,315.6**	**1,531.8**	**1,636.3**	**2,024.8**	**2,217.9**	**2,471.8**
Financial flows	163.3	24.3	116.2	220.9	243.7	105.3	237.0
Revaluation effects:	29.2	-23.5	99.9	-116.5	144.9	87.8	16.9
Currency effect	-20.0	48.0	71.7	-43.1	-8.2	30.8	31.7
Price effect	59.6	-61.8	44.8	-58.3	78.2	54.0	21.7
Other effect	-10.5	-9.6	-16.6	-15.1	74.9	3.0	-36.6

Source: Bank of England.

(a) Increases in liabilities are shown as positive.

There are very large negative revaluations of both assets and liabilities in 1996. These were largely driven by sterling's appreciation (see Table C), which lowered the sterling value of assets and liabilities denominated in foreign currency. There are also large negative price effects on international liabilities in 1996. These were caused by a fall in the price of the benchmark UK bond used in the calculations; this partly offsets the strong price rise in 1995.

Table C
End-period sterling exchange rates 1992–99 H1

	1992	1993	1994	1995	1996	1997	1998	1999 H1
£/$	1.5150	1.4780	1.5645	1.5505	1.7120	1.6453	1.6640	1.5768
£/DM (a)	2.4520	2.5688	2.4245	2.2191	2.6373	2.9558	2.7731	2.9893
£/¥	189.072	164.974	156.012	159.826	198.678	214.086	187.649	190.723

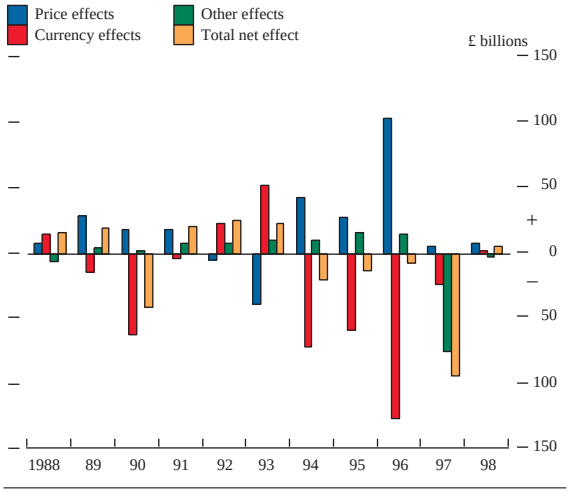
Source: Bank of England.

(a) £/DM rate for end June 1999 calculated using the Deutsche Mark's euro conversion rate and the end-June £/€ rate.

These data also show a steep increase in UK international liabilities in 1997 of some £389 billion, to £2,024 billion. Of this, about £185 billion is due to revaluations. 'Other' revaluations, not accounted for by price and currency movements, amount to £75 billion, by far the highest 'other' revaluations figure. Chart 2 shows how each category of revaluation has affected the United Kingdom's international investment position.

The ONS has confirmed that the apparent steepness of the increase and the sudden move to a high net international liability are partly misleading, owing to an undervaluation of equity liabilities in 1995 and 1996 (the 1997 figure is correct). The steep move is partly a result of how the triennial Share Register Survey is incorporated into the annual data. The 1997 survey uncovered large holdings of UK equities by non-residents that had been missed in the estimates for 1995 and 1996. This effect will unwind in

Chart 2
Revaluation effects decomposed



subsequent releases, when non-residents' holdings of UK equities in 1995 and 1996 are revised upwards in line with the ONS' revisions policy. This will increase the United Kingdom's international liability in 1995 and 1996, so increasing the overall net liability for those years (assuming that there are no offsetting revisions).

The size of the 'other' revaluation in 1997 gives some indication of the extent of the undervaluation of international liabilities in 1995–96; it represents the amount of the change in the stock of liabilities not accounted for by financial flows or price and currency moves. However, a definitive answer must await the revisions from the ONS.

The path of the currency effects is unsurprising, given movements in the sterling exchange rate. Appreciation of sterling means that assets denominated in foreign currency are worth less in sterling terms, which causes negative revaluation in sterling-denominated accounts. These figures are also based on movements in various international price indices such as stock markets and benchmark bond prices, used to estimate price movements of assets and liabilities.

Sterling's appreciation since late 1996 has led to large negative currency-effect revaluations of the United Kingdom's gross external assets. Meanwhile, buoyant equity markets have contributed to strong positive price effects (see Table D).

Table D
International equity market indices 1992–99 H1

	1992	1993	1994	1995	1996	1997	1998	1999 H1
S&P 500	435.71	466.45	459.27	615.93	740.74	970.43	1,229.23	1,373
Dax 30	1,545	2,267	2,107	2,254	2,889	4,250	5002	5,379
Nikkei	16,295	17,417	19,723	19,868	19,361	15,259	1,3842	17,530
FTSE All-Share	1,363.79	1,682.17	1,521.44	1,802.56	2,013.66	2,411	2,673.92	2,946.17

However, the strength of the UK equity market and of the economy more generally has had strong upward price effects on non-residents' investments in the United Kingdom; and this has had a negative effect on the net UK

position. The balance of revaluation effects was negative from 1994–97, with small positive balances in 1998 and 1999 H1. The 1998 balance was partly due to the pound's slight depreciation against most other currencies. In the first half of 1999, on a net basis, there were strong upward price effects on assets (+£35.8 billion), combined with large negative 'other' effects (-£37 billion) on liabilities, contributing to a positive overall revaluation total. However, the size of the 'other' effects indicates that the 1999 data may well be subject to revision soon.

Evolution of components of the international asset position

Chart 3 shows how the United Kingdom's international assets and liabilities have grown as a proportion of annual gross domestic product (GDP).

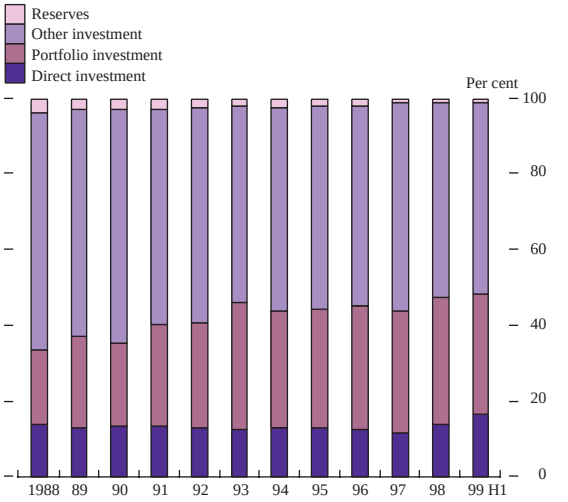
Chart 3
UK international assets and liabilities as a percentage of GDP

A striking trend is that the United Kingdom's stocks of international finance are growing as a percentage of annual GDP (measured at current market prices, for comparison with asset stocks, which are mostly also valued at market prices). Assets and liabilities were one and a half times nominal GDP in 1988; by 1998, they were two and a half times as large. International finance is becoming more important in relation to the UK economy as a whole. (See 'International comparisons', below, for a comparison with the four other biggest industrial economies, depicted in Chart 8.) However, the relative growth of international finance has not proceeded smoothly. Chart 3 shows retrenchments in 1990 and again in 1994.

Chart 4 shows the evolution of both sides of the balance sheet in terms of the proportions of different investment categories. It is clear from this chart that 'other investment' (mainly deposits and bank lending) has been in long-term decline as a proportion of both total assets and total liabilities. Other investment fell from 62% of total assets and 67% of total liabilities at end 1988, to 51% of total assets and 58% of total liabilities at end June 1999.

Portfolio investment, however, has grown proportionately within the total stocks. Portfolio investments were 20% of assets and 22% of liabilities at end 1988, up to 32% of assets and 33% of liabilities at end June 1999.

Chart 4
Asset categories as a proportion of total international assets (end-period stocks)



Liability categories as a proportion of total international liabilities (end-period stocks)

Explaining FDI is complicated by the fact that it is recorded in the accounts at book value rather than market value, as discussed above. This almost certainly means that FDI stocks are undervalued relative to other investment categories, and understates the relative importance of FDI in the accounts. (See the final section of this article for some estimates of market value FDI stocks.) This also means that the picture of FDI presented by the accounts does not square with the prominence of FDI in media comment and political debate.

Allowing for that caveat, despite the public prominence of large, single direct investments such as the BP/Amoco merger, FDI is the smallest of the three major categories of investment (official reserves, of course, are by far the smallest). Furthermore, apart from the jump in FDI assets

in the first half of 1999, FDI appears to be becoming less important.

FDI assets were the same proportion of total international assets at end 1998 as at end 1988 (14%). By end June 1999, they had risen to 16.5% of total assets. This reflects exceptionally high acquisitions activity in the first half of 1999, including Vodafone's acquisition of Airtouch and Zeneca's takeover of Astra, worth a reported £58.5 billion between them (in a stock of £400 billion). On the other side of the balance sheet, FDI declined from 11% of the United Kingdom's total international liabilities in 1988 to 9% by end 1998, and fell slightly further by end June 1999. However, the United Kingdom retains its status as one of the world's top destinations for FDI.

These figures should not obscure the rapid growth in absolute stocks of direct investment. Between 1988 and 1998 (even without considering the surge in the first half of 1999), FDI assets grew by 183%, from £104 billion to £295 billion. Over the same period, inward direct investment into the United Kingdom grew by 170%, from £77 billion to £208 billion. FDI stocks are also growing as a proportion of GDP, in common with all categories of international finance (except official reserves). International portfolio investment is growing even more quickly than FDI stocks.

Investment income, capital gains and the international investment position

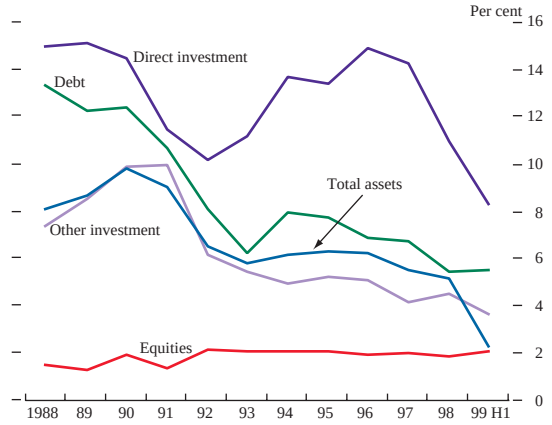
This section considers investment income and capital gains in relation to the United Kingdom's external balance sheet. Investment income, formerly known as 'IPD' (interest, profits and dividends), is conceptually distinct from capital gains. Investment income recorded in the balance of payments accounts should exclude capital gains. Capital gains arise from revaluation of assets due to asset price or exchange rate movements, or 'other' factors, and are estimated above. Although distinct from investment income, capital gains are similar, and are often treated in company accounts as income for practical purposes.

Comparing investment income credits and debits with gross assets and liabilities allows implied 'rates of return' to be calculated. These are given in Chart 5.

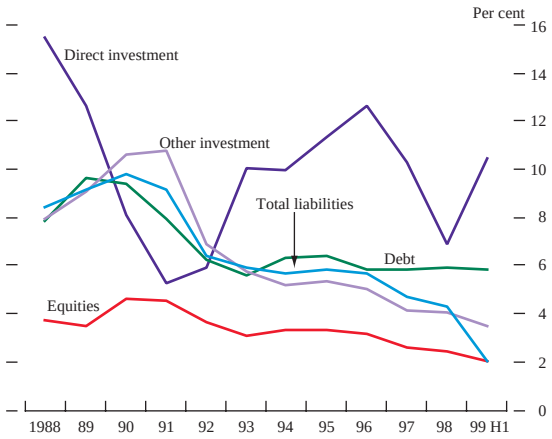
By adding estimated capital gains to pure income, another measure of the rate of return (the 'full' rate) can be derived (see Chart 6). Pure income rates of return are more helpful in interpreting the balance of payments accounts, as investment income flows in the current account exclude capital gains. Full rates of return give a better indication of the real returns facing investors, to whom, tax considerations aside, the distinction between income and capital gains may be irrelevant.

It is immediately apparent that rates of return on direct investment, both inward and outward, are far higher than on

Chart 5
International assets: pure rates of return



International liabilities: pure rates of return



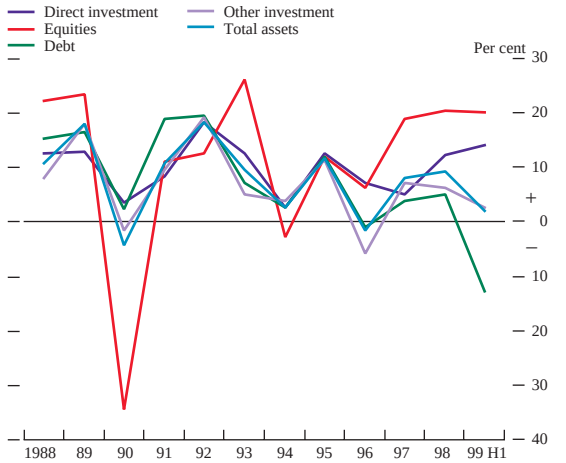
other categories of investment. This is partly because direct investments are recorded at book values, as discussed above.

Equity has a lower pure rate of return than the other categories of investment. However, the pure income rate of return on equities is particularly inadequate as a measure of equities' returns, particularly in recent years, when share markets have risen strongly and investors have enjoyed large capital gains. So it is informative to compare pure and full income rates of return from Charts 5 and 6. On the full income measure, equities have the highest rate of return in most years, and in every year since 1996; on the liabilities side, they have the highest return in every year since 1995.

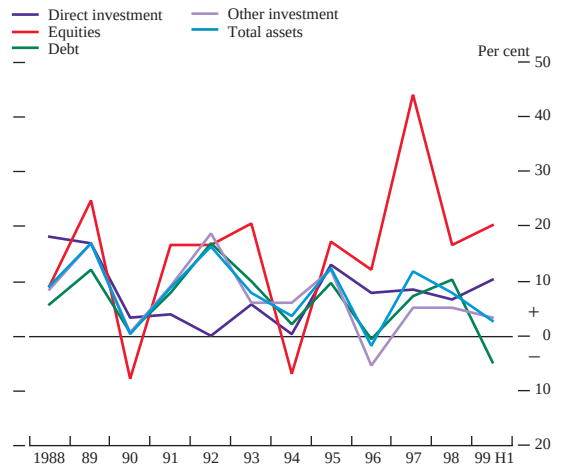
However, full rates of return are considerably more volatile than pure rates of return. In years of stock market downturns, the full rate of return on equities plunges sharply, as in 1990 (particularly on the liabilities side). There are two points to note on the rates of return on total international assets and liabilities. First, both the aggregate rates of return have declined since 1990, in line with generally falling interest rates across the industrial economies. Second, rates of return on gross assets and liabilities have changed relative positions in the past ten years. Until 1991, the rate of return on gross liabilities was generally higher than the return on assets. In 1991–93,

returns were roughly equal, but from 1994 onwards, the return on international assets has been higher than that on liabilities every year. The strongest-performing assets relative to liabilities appear to have been direct investment and portfolio debt securities. In both these categories, UK assets have earned higher returns than UK liabilities over the period.

Chart 6
International assets: full rates of return



International liabilities: full rates of return



The turnaround is due to other investment, by far the largest category of investment in gross terms. The United Kingdom paid more on its other investment liabilities than it earned on its other investment assets in every year until 1996. Then, and again in 1997, the rates of return were equal. In 1998 and 1999 H1, the United Kingdom's assets earned a higher return than its liabilities for the first time since 1990.

Possible explanations for this trend include a higher proportion of deposits than lending in UK liabilities, assuming that banks pay less interest on their deposits than UK borrowers in general pay on their loans. Conversely, there could be a higher proportion of loans relative to deposits in the United Kingdom's overseas assets, or a narrowing interest rate differential charged to UK borrowers relative to other world borrowers. The full explanation may involve all three factors.

International investment positions: comparison with other major economies

Chart 7 shows net asset positions for the United States, Japan, Germany, the United Kingdom and France. This article has suggested that it is unwise to lay too much stress on fluctuations in the net asset position when gross totals are so large. However, Chart 7 shows consistent results that are unlikely to be the result of random error.

Chart 7
Major economies' net asset positions

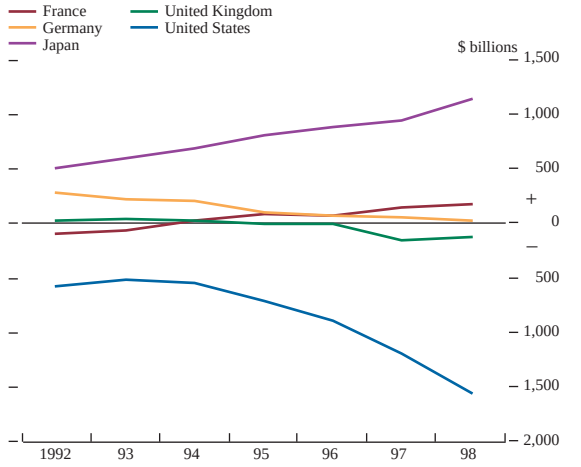


Chart 7 shows that the net international liability of the United States and the net international assets of Japan have both grown. Germany's formerly large net assets have dwindled towards balance, and France (traditionally a net international debtor) is now a net international creditor. The United Kingdom's international assets have fluctuated around balance.

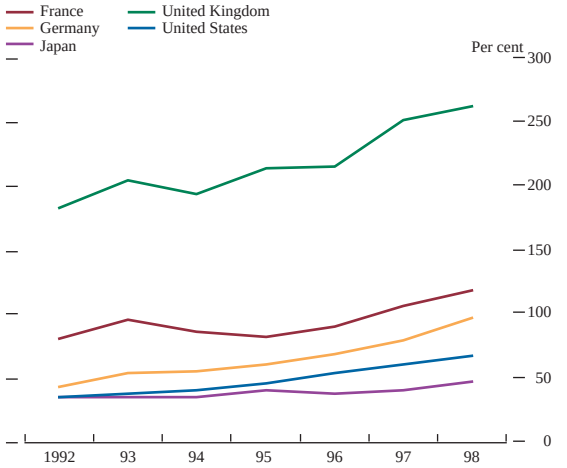
These developments are broadly consistent with the evolution of each country's current account—its balance of trade plus its net investment income and net transfers from abroad (such as migrant workers' remitted earnings). In 1992–98, Japan's cumulative current account surplus grew to more than $766 billion, with its net assets growing by around $640 billion. The United States ran a cumulative current account deficit of some $630 billion, while acquiring more than $1 trillion more debt, net, to the rest of the world. In this period, the Japanese were major investors in US government securities, and a large part of the United States' current account deficit was with Japan. The huge movements in these major countries' international investment positions can be explained at least partly in terms of these countries' bilateral trade and investment relations.

In the same period, France accumulated a current account surplus of $131 billion and became a net international creditor, a $275 billion turnaround. Germany ran a cumulative current account deficit of $83.5 billion over the same period, and shed a net $260 billion of international assets. Germany's public sector ran annual deficits (partly because of expenses incurred in unification

with East Germany); these also amounted to some $265 billion.

Chart 8 shows each country's international liabilities in relation to nominal GDP. This measure was chosen to give some indication of the relative importance of international finance in the set of countries' economies. Nominal GDP gives a fairer comparison than constant-price GDP, because asset stocks are mostly given at market value, consistent with international statistical standards.(1)

Chart 8
Major economies' international liabilities as a percentage of GDP



The data show that international finance is much more important to the United Kingdom than to any of the other four economies studied here. The United Kingdom's international liabilities were around 250% of nominal GDP in 1998. France's proportion of 120%, though the next highest, is less than half that of the United Kingdom. Germany is next with 98%, then the United States with 68%, then Japan with 48%.

The prominence of international finance in the United Kingdom is undoubtedly due to the presence of the City of London financial centre in a medium-sized economy. New York and Tokyo, for example, are in much larger domestic economies (nominal GDPs in 1998: United States $8.2 trillion, Japan $3.7 trillion, United Kingdom $1.3 trillion).

Liabilities were at least twice the percentage of nominal GDP in 1998 compared with 1992 in all the economies considered here except France and Japan, the two countries that have acquired substantial net assets. France's international assets, which have been growing more strongly, have nearly doubled as a percentage of nominal GDP (from 76% to 133%). Japan's stock of assets relative to GDP has increased by only a half, from 50% to 79%, making it the country with the slowest-growing reliance on international finance considered here.

Direct investment valuation

This section presents the results of a study of the valuation of UK FDI. The study was prompted by the United Kingdom's acquisition of an extra £80.7 billion of net international liabilities in 1997. The study's main conclusion is that a market valuation of UK FDI might boost the United Kingdom's net asset position by around £81 billion in 1997 and around £74 billion in 1998 (and by smaller amounts in previous years). The basis of the study is a paper written in 1992 for the Central Statistical Office (precursor of the ONS), which estimated the market value of the United Kingdom's FDI stocks.(2)

BPM5's guidance on valuing direct investment is ambiguous. The manual states: 'Although this manual... affirms the principle of using market price as the basis for valuation, it is recognised that, in practice, book values from the balance sheets of direct investment enterprises... often are used to determine the value of the stock of *direct investment*.'(3) The official balance of payments statistics use book valuation. The *Pink Book* states that book values are likely to correspond to historic cost minus accumulated depreciation charges, plus current assets minus current liabilities.(4)

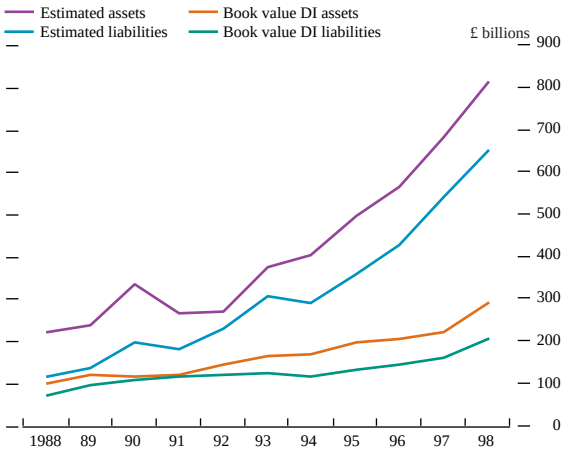
Pratten's 1992 study lists three main reasons why book values are likely to be lower than market values: inflation; conservative book valuation in order to limit future depreciation charges against profits; and market valuation of intangibles (such as market position and goodwill) that are not reflected in book values.

Pratten's study attempted to estimate the ratio between book and market valuations. He apportions the stock market values of a sample of companies between their UK and non-resident operations, using the proportions of their total profits generated by the UK and overseas units (available from corporate accounts). On this basis, Pratten found that the market value of outward direct investment (UK assets) would be 2.19 times the book value, whereas the market value of investment in the United Kingdom (UK liabilities) is 1.69 times the book value.

It is not practicable to repeat Pratten's exercise every year, as his method involved analysing the accounts of a sample of more than 160 companies. Instead, the present study used Pratten's results as a base. His market value estimates for 1991 were revalued forwards to 1998 and backwards to 1988, using stock market indices as a proxy for changes in market value (adjusting outward FDI also for exchange rate movements). The resulting market value estimates are compared with the National Accounts book values in Chart 9.

(1) Such as BPM5 and ESA95.
(2) 'The valuation of outward and inward direct investment: a report for the CSO', Pratten, C, Department of Applied Economics, University of Cambridge, 1992.
(3) BPM5, paragraph 377.
(4) *Pink Book*, page 126.

Chart 9
FDI: book value and market value estimates



UK net assets: FDI at book and market values

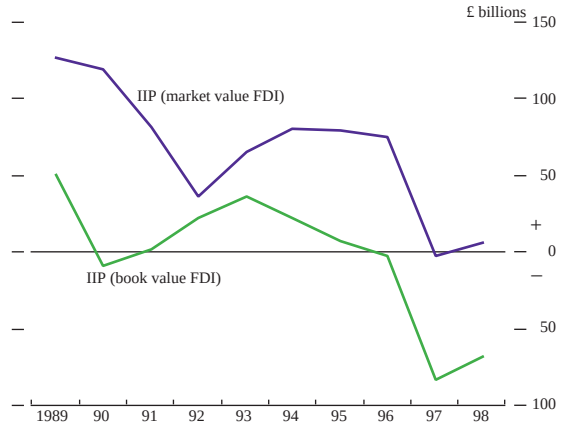
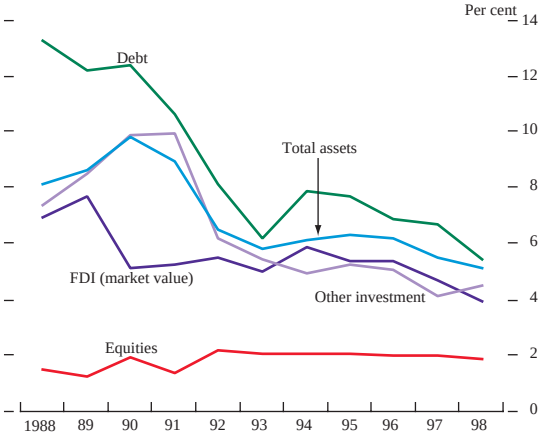
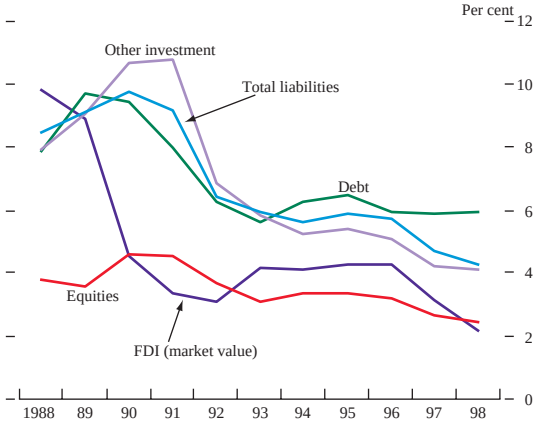


Chart 10
Assets (FDI market value): pure rates of return



Liabilities (FDI market value): pure rates of return



The next step in the study was to calculate rates of return using the market value estimates. Chart 10 presents revised pure income rates of return for direct investment, alongside rates of return for the other categories of investment. Comparison with Chart 5 shows that using the market value estimates largely removes the discrepancy between rates of return on direct and all other categories of investment.

It should be stressed that these valuations are not intended in any way as alternative ‘official’ estimates of FDI stocks. They are the product of official data and an imperfect estimation methodology. However, they do show what FDI might look like at market values, and suggest the net direction in which market revaluation might drive the United Kingdom’s international investment position.

News and the sterling markets

By Martin Brooke, Graeme Danton and Richhild Moessner of the Bank's Gilt-edged and Money Markets Division.

The Quarterly Bulletin *reports developments in financial markets in detail each quarter in the regular 'Markets and operations' article.*(1) *Day by day, items of news about the economy—in the form of data releases and news about policy—are the most significant market-moving events. This article looks over a longer time period than is usually possible in the 'Markets and operations' article to answer the following two questions:*

- *Which news items tend to move the sterling interest rate markets most?*
- *How do different parts of the sterling yield curve respond to news?*

Introduction

The prices of financial assets adjust continually in response to news. This news can either be 'regular' (ie announcements that are released at pre-determined times known to market participants) or 'irregular' (ie events which are largely, or wholly, unexpected). This article examines how different parts of the sterling yield curve react to different types of regular news. We consider daily interest rate changes for three different assets: the nearest-maturity three-month interest rate futures contract traded on the London International Financial Futures and Options Exchange (LIFFE) (a contract based on three-month sterling Libor), the same LIFFE futures contract for a three-month interbank rate 2½ years ahead, and the yield on the benchmark ten-year gilt.

According to the expectations theory of the term structure, forward interest rates are determined by expectations of the future path of short-term spot interest rates. In other words, longer-maturity interest rates embody expectations of future short rates at all dates up to the maturity of the loan. To the extent that this theory holds, the front (ie nearest-maturity) short sterling futures contract indicates the market's expectation for the level of three-month interest rates at the maturity of the contract. Similarly, the longer-dated futures contract used in our analysis provides information about the market's expectation for the level of three-month interest rates in 2½ years' time. And the yield on the ten-year benchmark gilt should reflect average interest rate expectations over the life of the gilt (ie ten years). Changes in the prices of these three assets indicate how the term structure of sterling interest rates responds to news announcements.

Many other instruments or measures of rate expectations could have been used for this investigation, such as swap rates and forward rate agreements.(2) Also, price changes can be looked at over the whole day of the news announcement or in, say, the first hour immediately following an announcement. This article considers interest rate movements that are large enough, and sustained for long enough, to be observed in day-to-day comparisons.

One extension of the results reported here would be to compare daily movements in the sterling yield curve with intraday responses, which capture the very short-term reaction to a piece of news and allow a richer analysis of trading patterns through the day. Research on this topic is in progress at the Bank of England; initial results suggest that intraday and day-to-day responses are mostly in the same direction, though the size of the responses varies.(3) This is consistent with comments made by market contacts who report that, after the initial market reaction to news, there are often additional changes later in the day (and sometimes the next morning) as traders and analysts process the information contained in the latest news.(4)

Properties of the data

Table A shows the 20 largest daily changes in interest rates at our three chosen horizons between January 1996 and April 1999. There are a number of points to note. First, the largest daily change was a fall of 42 basis points in the

(1) See 'Markets and operations' on pages 327–43.
(2) Swap rates provide an alternative measure to gilt yields of the market's longer-term interest rate expectations, and are attracting increasing market attention in view of the current low level of gilt supply and the impact of the Minimum Funding Requirement (MFR) on gilt market liquidity. On average, however, day-to-day changes in gilt yields due to MFR and supply considerations are small, and are unlikely to have affected the results in this article significantly.
(3) For the exchange rate, intraday and end-of-day responses to news tend to be more diverse, however.
(4) Existing studies have looked at both daily and intraday changes in asset prices. For instance, Almeida, Goodhart and Payne (1998) look at intraday responses; whereas Fleming and Remolona (1999), Haldane and Read (1999), and Joyce and Read (1999) all look at end-of-day responses.

Table A
Top 20 largest daily interest rate movements (basis points)

Front short sterling contract			Short sterling contract 2½ years ahead			Ten-year gilt yield		
Date	Interest rate change	Event	Date	Interest rate change	Event	Date	Yield change	Event
4/6/98	27.0	Interest	26/9/97	-42.0	Other-news (a)	9/10/98	33.1	Other-news
6/6/96	-25.0	Interest	8/3/96	36.0	Interest and US	6/5/97	-28.9	Interest (b)
6/11/97	20.0	Interest	9/10/98	32.0	Other-news	8/3/96	26.9	Interest and US
18/1/96	-19.0	Interest, RS and RPIX	13/3/96	-24.0	LMD	26/9/97	-21.0	Other-news
8/3/96	19.0	Interest and US	16/6/98	24.0	RPIX and US	2/1/97	19.2	Other-news
4/2/99	-19.0	Interest	19/2/96	23.0	Other-news	1/3/96	-18.3	Other-news
30/10/96	18.0	Interest	6/5/97	-23.0	Interest and Independence (b)	1/10/98	-17.0	Other-news
12/1/98	-18.0	IP and PPI	17/6/98	23.0	LMD	19/2/96	16.7	Other-news
3/3/99	17.5	Interest	16/9/97	-22.0	US	16/9/97	-15.7	US
19/3/97	17.0	Minutes, RS, LMD and US	11/3/96	21.0	IP	25/2/99	15.7	Other-news
16/6/98	15.5	Interest, RPIX and US	16/10/96	20.0	LMD and US	5/2/96	15.2	Other-news
3/7/97	15.0	US	20/10/97	19.0	Other-news	5/1/98	-14.3	Other-news
14/1/98	15.0	Minutes and LMD	19/3/97	19.0	Minutes, RS, LMD and US	22/5/97	14.1	RS and GDP
16/10/98	-15.0	US	7/1/99	-17.0	Interest	10/9/98	-14.0	Interest
3/12/98	15.0	Other-news	1/3/96	-17.0	Other-news	16/10/96	13.7	LMD and US
16/1/97	-15.0	Interest and RPIX	1/3/99	17.0	Other-news	30/12/97	13.4	Other-news
18/12/96	14.0	RS and LMD	18/1/96	-17.0	RS and RPIX	16/6/98	13.2	RPIX and US
9/7/98	-14.0	Interest	25/2/99	17.0	Other-news	2/5/96	13.0	Other-news
11/11/98	12.5	LMD and Inflation Report	3/10/97	-16.0	US	7/2/97	-13.0	Other-news
5/3/98	-12.0	Interest	5/1/98	-16.0	Other-news	12/2/99	13.0	Other-news

Legend:

IP	Industrial production data.
Inflation Report	Publication of the Bank of England's *Inflation Report.*
Interest	UK interest rate announcements.
LMD	Labour market data.
Minutes	Publication of the minutes of monetary policy and MPC meetings.
PPI	Producer price index.
RPIX	Retail prices index excluding mortgage interest payments.
RS	Retail sales data.
US	US consumer price index or non-farm payroll data.
Other-news	Days without any of the above data releases or monetary policy announcements.

(a) On this day, there were press reports suggesting that the United Kingdom would enter EMU earlier than had been previously thought.
(b) Interest rates were increased and the Bank of England was granted operational monetary policy independence.

longer-dated short sterling futures contract on 26 September 1997. This change was not related to any of the major data announcements included in our sample, or to a change in domestic monetary policy. Instead, it was caused by reports that the United Kingdom would join EMU earlier than had previously been expected. Second, some pieces of information appear to have had very different effects on interest rate expectations at different maturities. In other words, news may cause the yield curve to pivot, as well as to shift up or down. For instance, the EMU-entry reports on 26 September 1997 had no impact on shorter-term interest rate expectations. And third, domestic data and monetary policy announcements have been more likely to influence shorter-term than longer-term interest rate expectations.

Evidence of this last point can be seen in the fact that 19 of the 20 largest daily interest rate movements in the front short sterling contract were associated with data or monetary policy announcements, compared with only 12 for the longer-dated short sterling contract and 7 for the ten-year gilt. So longer-term interest rate expectations have been influenced by a wider array of information.(1) The largest daily gilt yield change in our sample was also unrelated to a data release or news about a change in the stance of monetary policy. Rather, it was related to sharp de-leveraging by hedge funds in international financial markets.

Many news items affect financial markets each month. In the rest of this article, we confine our analysis to regular items of news (ie released on pre-determined dates known to market participants). We subdivide this news into two groups. The first consists of those monthly macroeconomic data releases that we think are most likely to have moved sterling interest rate expectations over the sample period. These are primarily UK data for: average earnings and employment, GDP, industrial production, producer output prices, retail sales, and the official target measure of inflation—retail prices less mortgage interest payments (RPIX).(2) We also look at the effect of two key US data releases—consumer prices and non-farm payrolls—to test the hypothesis that US developments influence sterling markets significantly. We use the data released at the time of the announcement and make no allowance for subsequent data revisions. The second group consists of monetary policy news in the form of interest rate announcements, publication of the minutes of MPC meetings (and the monthly Chancellor-Governor monetary meetings before that), and publication of the Bank of England's *Inflation Report*.

Table B shows the distribution of daily changes in short-term interest rate expectations implied by the front short sterling futures contract between January 1996 and April 1999.(3) The table shows the distribution of daily changes in rate expectations on:

(i) days when there were no significant regular domestic economic releases ('no-news days');

(1) These findings are consistent with the framework outlined in Haldane and Read (1999).
(2) We also looked at the effect of broad money and the CGNCR/PSNCR, and found that neither had a predictable or significant effect on interest rate expectations.
(3) Futures contracts mature on the third Wednesday of March, June, September and December. Because contracts tend to lose liquidity before they mature, we have chosen to switch contracts at the beginning of the final month of the shortest contract. For example, we take the September contract to be the front contract from June.

(ii) days when significant macroeconomic data were released (see above); and

(iii) days when there was news about monetary policy in the form of interest rate announcements, publication of the minutes of monetary policy meetings, or the release of the *Inflation Report*.

Table B
Percentage distribution of daily changes in interest rates implied by nearest short sterling contract

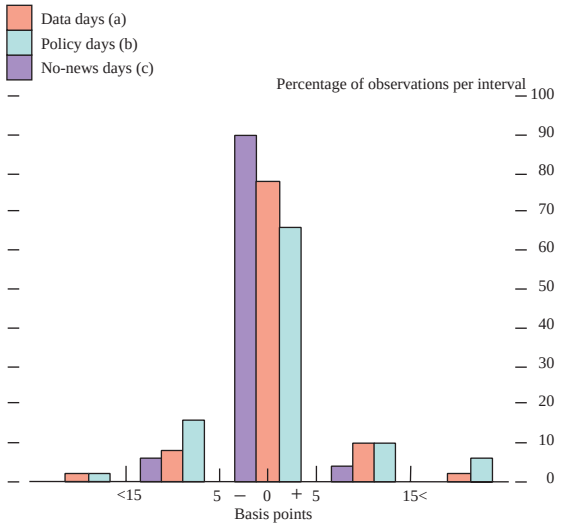
Per cent

	No-news days	Selected data days (a)	Policy days
Rate rose by 15 basis points or more	0.2	1.4	7.8
Rate rose by between 5 and 15 basis points	3.0	8.3	8.9
Rate moved within plus or minus 5 basis points	91.3	82.1	62.2
Rate fell by between 5 and 15 basis points	5.2	7.3	17.8
Rate fell by 15 basis points or more	0.4	0.9	3.3
Number of days in sample	*574*	*218*	*90*

(a) Data releases covered: average earnings and unemployment, GDP, industrial production, PPI, retail sales, and RPIX.

On around 90% of the days when there were no significant data releases or policy announcements, changes in near-term interest rate expectations were confined within a band of +/-5 basis points. This gives us a benchmark against which to judge the impact of news. The second and third columns of the table indicate that rate changes were confined within a band of +/-5 basis points on 82% of the days when selected data were released and on only 62% of days when there was policy news. Chart 1 plots these data in a histogram. The chart shows that daily changes in the interest rate on the front short sterling futures contract tend to be larger on days when there is news about data or policy than on days when there is no such news.

Chart 1
Distribution of daily changes in implied interest rates (nearest short sterling contract)



(a) Data days are when average earnings and unemployment, GDP, industrial production, PPI, retail sales and RPIX data are released.
(b) Policy days are when interest rate announcements occur or when *Inflation Reports* and minutes of MPC/monetary meetings are published.
(c) No-news days are all other days.

Table C and Chart 2 show the distribution of daily changes for the expectation of interest rates in 2½ years' time, as implied by the longer-dated futures contract. Two things are apparent. First, daily changes in interest rates implied by this contract have also tended to be greater on days when there was news about data or policy than on no-news days. And second, daily changes in longer-term interest rate expectations have been more frequently outside the +/-5 basis points margin than for short-term rate expectations (ie the peak of the distribution in Chart 2 is lower than in Chart 1, and the tails of the distribution in Chart 2 are broader). In other words, daily changes in the expectation of interest rates 2½ years ahead were typically larger than changes in short-term expectations, on both news and no-news days (a similar picture emerges from the information provided in Table A).(1)

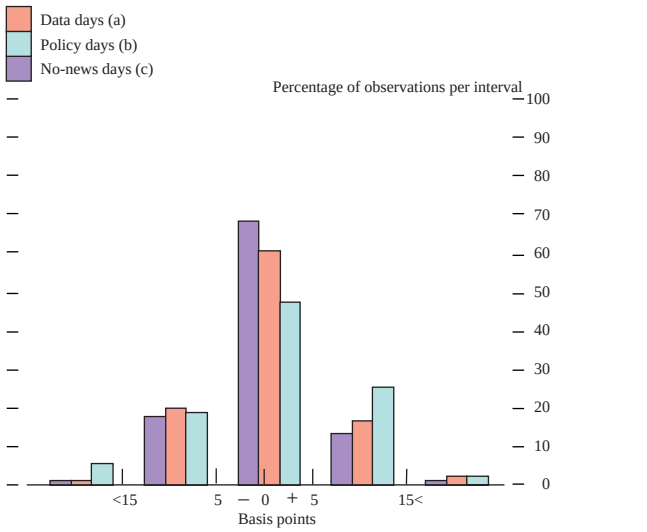
Table C
Percentage distribution of daily changes in interest rates implied by short sterling contract 2½ years ahead

Per cent

	No-news days	Selected data days (a)	Policy days
Rate rose by 15 basis points or more	1.1	2.3	2.2
Rate rose by between 5 and 15 basis points	12.7	17.0	25.6
Rate moved within plus or minus 5 basis points	68.3	60.6	47.8
Rate fell by between 5 and 15 basis points	17.1	19.3	18.9
Rate fell by 15 basis points or more	0.9	0.9	5.6
Number of days in sample	*574*	*218*	*90*

(a) Data releases covered: average earnings and unemployment, GDP, industrial production, PPI, retail sales, and RPIX.

Chart 2
Distribution of daily changes in implied interest rates (short sterling contract 2½ years ahead)



(a) Data days are when average earnings and unemployment, GDP, industrial production, PPI, retail sales and RPIX data are released.
(b) Policy days are when interest rate announcements occur or when *Inflation Reports* and minutes of MPC/monetary meetings are published.
(c) No-news days are all other days.

Two factors help to explain the larger daily changes in the 2½ year ahead interest rate expectation. First, movements in the front contract are constrained by the shorter time to maturity, whereas the longer contract period allows for a

(1) For the no-news days, the standard deviations of the daily interest rate movements in the front and longer-dated short sterling contracts were 3.0 and 5.9 basis points respectively.

larger and more sustained interest rate response to news (there is also likely to be greater uncertainty about the level of rates two to three years ahead). Second, the greater response of longer-maturity contracts could also reflect their lower liquidity. Turnover and open interest (outstanding amounts) in the longer contracts are typically much lower than for short maturities. Lower liquidity can lead to larger jumps in prices on relatively thin volume.

Table D and Chart 3 show the daily distribution of changes in the ten-year gilt yield on news and no-news days. It is harder to discern whether gilt yields tend to change more on days when there is news than when there is no news. This is perhaps not surprising. Given that the ten-year gilt yield measures average interest rate expectations over the next ten years, news about the current state of the economy will be of less relevance than for short sterling. Instead, the key determinants of longer-term interest rates will be inflation expectations and factors that influence the economy's long-run equilibrium real interest rate. (The long rate is also likely to include a varying risk premium.)

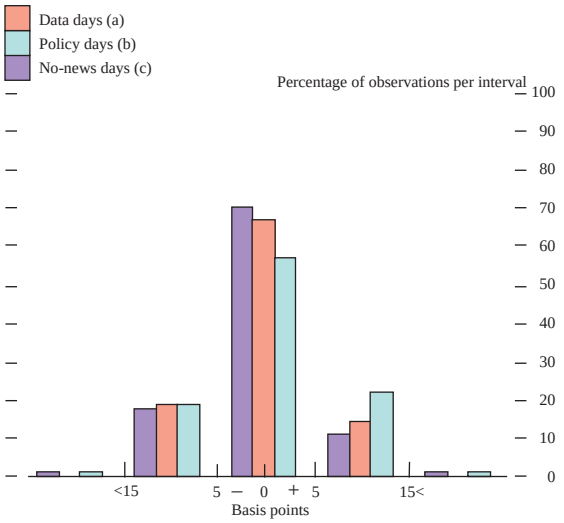
Table D
Percentage distribution of daily changes in ten-year gilt yield

Per cent

	No-news days	Selected data days (a)	Policy days
Yield rose by 15 basis points or more	0.9	0.0	1.1
Yield rose by between 5 and 15 basis points	11.2	14.7	22.2
Yield moved within plus or minus 5 basis points	70.2	66.5	56.7
Yield fell by between 5 and 15 basis points	17.1	18.8	18.9
Yield fell by 15 basis points or more	0.7	0.0	1.1
Number of days in sample	*574*	*218*	*90*

(a) Data releases covered: average earnings and unemployment, GDP, industrial production, PPI, retail sales, and RPIX.

Chart 3
Distribution of daily changes in ten-year gilt yield



(a) Data days are when average earnings and unemployment, GDP, industrial production, PPI, retail sales and RPIX data are released.
(b) Policy days are when interest rate announcements occur or when *Inflation Reports* and minutes of MPC/monetary meetings are published.
(c) No-news days are all other days.

It is possible to test whether the measured sample responses for the no-news, data, and policy days are significantly different from one another using a statistical test (a chi-squared test). The details of this method are described briefly in the Appendix. The technique tests whether the distributions (per interval of interest rate changes) for the data and policy days are the same as the distributions for the no-news days, against the alternative hypothesis that they differ. The results, summarised in Table E, imply that, for the nearest short sterling contract, the probability distributions of interest rate changes for the data and policy days are statistically significantly different from the no-news days. For the longer-dated short sterling contract and the ten-year gilt yield, policy days are statistically distinct from no-news days (at the 1% and 5% significance levels respectively); but data days are not distinct from no-news days for either the longer-dated short sterling contract or the ten-year gilt. These statistics confirm the earlier findings.(1)

Table E
Chi-squared test statistic

	Data days	Policy days
Nearest short sterling contract	14.5 (a)	21.2 (a)
$2^1/_2$ years ahead short sterling contract	6.6	24.7 (a)
Ten-year gilt yield	3.8	11.5 (b)

Note: Test is relative to no-news days.

(a) Significant at 1% level.
(b) Significant at 5% level.

Market surprises

Market participants form expectations about the future, especially news announcements that occur on pre-determined dates. Events that turn out as expected should not, therefore, have any effect on interest rate expectations. So when looking at the effect of news on financial markets, we need to take account of these expectations. To do this, we compare the outturns of our selected data series with survey measures of market participants' forecasts for the respective data. The difference between the two is a measure of the extent to which the data were a surprise, against which the market response can be calibrated. A number of reported surveys of market expectations are collated and published by the electronic news services. These surveys are usually conducted weekly, on a Thursday or Friday, and cover the data releases for the following week. The surveys are sometimes updated if there has been a major surprise that might have led market participants to revise their views of subsequent data releases. In practice, however, it is rare for published expectations to change much during a particular week, even when market participants are re-surveyed.

The various surveys all cover the same, or a largely overlapping set of, investment banks, consultancy firms, and other financial institutions. So the 'median market expectation' from the surveys—generally the most widely quoted measure—is often the same, or very similar, across

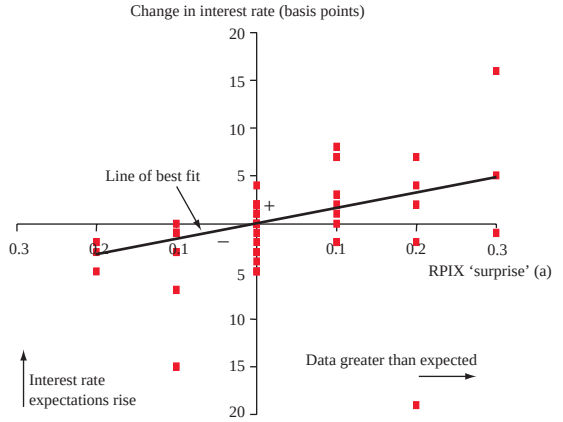
(1) The test statistic could not be applied to the intervals used in Tables B–D and Charts 1–3 because the expected numbers in the outer interval bands were too small to make the test statistically valid. So, for the purpose of the test, we used different intervals (see Appendix for details).

different surveys. For the purpose of this article, we have used the median market expectation published by Bloomberg News.[1]

The markets' response to data surprises

When inflation or activity indicators are higher than expected, interest rate expectations would normally be expected to rise, and *vice versa*. Chart 4 plots the twelve-month change in RPIX minus the market median expectation against the daily change in interest rates implied by the front short sterling contract. Points to the right of the origin show when inflation turned out higher than the market had expected. Points in the top half of the chart indicate that the implied rate on the short sterling contract rose on the day of the inflation announcement. Most observations lie in the southwest and northeast quadrants of the chart, as expected; the positive slope of the line of best fit confirms the view that, over the sample period, interest rate expectations have tended to rise when inflation outturns exceeded expectations. Throughout the rest of this article, data surprises are measured in the same way: 'positive surprises' indicate that data turned out to be higher than expected.

Chart 4
Effect of RPIX surprises on interest rate expectations: nearest short sterling contract



(a) Measured as actual minus expected; units are percentage points.

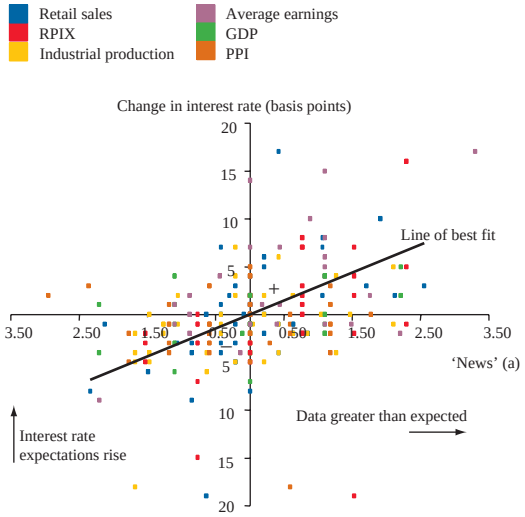
Chart 4 does not, however, allow comparison of different data releases on a like-for-like basis. A forecast error of, say, 0.2 percentage points would be more significant when forecasting twelve-month RPIX inflation than a similar-size error when forecasting a more volatile series such as monthly changes in industrial production.[2] To illustrate, Table F shows the standard deviation of past forecast errors for the data series considered in this article. We have therefore divided each forecast error by the standard deviation of past forecast errors. Surprises are then measured in units of standard deviation, making different data surprises comparable. Charts 5, 6 and 7 show how our three interest rate measures have reacted to all the domestic

Table F
Standard deviation of past surprises[a] in forecasting data releases (1996–99)

Industrial production (monthly change)	0.48
Retail sales (monthly change)	0.48
Average earnings (twelve-month rate)	0.23
PPI (twelve-month rate)	0.17
RPIX (twelve-month rate)	0.13
GDP (quarterly change)	0.09

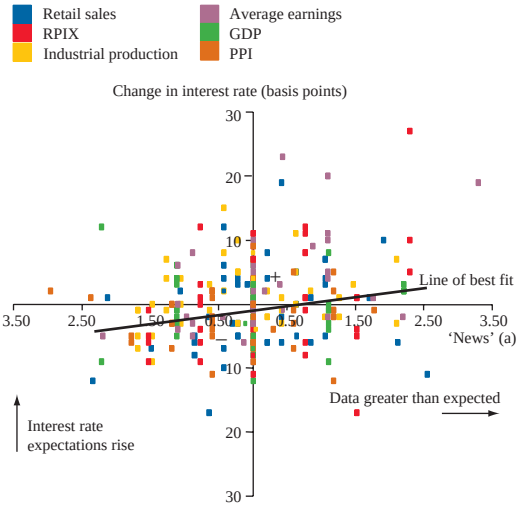
(a) Surprise measured as actual outturn minus expectations.

Chart 5
Effect of data surprises on interest rate expectations: nearest short sterling contract



(a) Actual minus expectation, divided by standard deviation of past forecast errors.

Chart 6
Effect of data surprises on interest rate expectations: short sterling contract 2½ years ahead

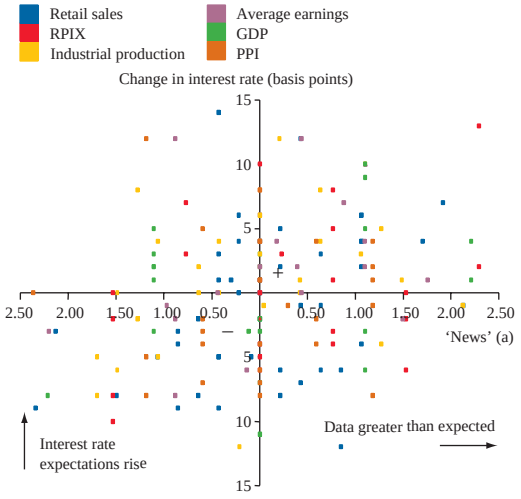


(a) Actual minus expectation, divided by standard deviation of past forecast errors.

data releases since January 1996 (compared on the same basis). Short-term interest rate expectations (as measured by the front short sterling futures contract) show the strongest positive relationship: interest rates tend to rise when data outturns are stronger than expected and fall when

(1) Joyce and Read (1999) used market expectations measured by Money Market Services (MMS). They found these expectations to be unbiased, ie the forecast errors have a mean not significantly different from zero. They also found no serial correlation in the forecast errors.
(2) For each of the data items considered in this article, forecasts of monthly, quarterly or annual changes could be used. In each case, our choice was determined by which series the market typically focuses most attention on.

Chart 7
Effect of data surprises on ten-year gilt yields



(a) Actual minus expectation, divided by standard deviation of past forecast errors.

data turn out weaker than forecast. Although the relationship is also positive for the longer-dated futures contract, the strength of the relationship (indicated by how closely the data points cluster around the line of best fit) is weaker.(1) Furthermore, no clear relationship is evident between the data surprises and the observed movements in ten-year average interest rate expectations (as measured by the benchmark gilt).

Which data items move the sterling yield curve most?

Tables G, H, and I report results from a series of simple regressions based on the following equation:

$$\Delta i^e = \alpha + \beta S \qquad \textbf{(1)}$$

where:

Δi^e is the change in interest rate expectations, as measured by interest rate movements for each of our three horizons, between close of business on the day before a data announcement and close of business on the day of the announcement;

α is a constant;

β is the slope coefficient; and

S is our measure of the data surprise (data outturn less market expectation, divided by standard deviation of past forecast errors).

We can use the regression results to test a number of hypotheses. First, events that were expected should, on average, have no impact on interest rate expectations (or, put another way, market participants' expectations should be unbiased). This implies that in all of the equations, α should be equal to zero. Second, as noted earlier, stronger-than-expected inflation and activity indicators should cause market participants to revise their interest rate expectations upwards. This implies that the β coefficients should be positive and significantly different from zero. And third, short-term interest rate expectations should be more responsive to indicators of current economic conditions, while gilt yield movements should be more responsive to factors that influence long-term inflation expectations and the economy's equilibrium real rate of interest. By comparing the sizes of the different β values we also obtain some indication of which data surprises moved interest rate expectations most over our sample period: the larger the value of β, the more interest rate expectations are revised for any given surprise.

The results provide some evidence to support all three hypotheses. First, in nearly all of the regressions, the constant term, α, is insignificantly different from zero. Second, in every case where the surprise variables are found to have a significant effect on interest rate expectations, the

Table G
Regression results—nearest short sterling futures contract

	Slope coefficient, β	Significance level of: β	Constant, α
Average earnings	0.030	1%	5%
Retail sales	0.027	1%	n.s.
RPIX	0.020	1%	n.s.
US CPI	0.019	1%	n.s.
Industrial production	0.017	1%	n.s.
US NFP	0.015	5%	n.s.
GDP	0.009	5%	n.s.
Unemployment	0.004	n.s.	n.s.
PPI	-0.002	n.s.	n.s.

Note: n.s. = not significant.

Table H
Regression results—short sterling futures contract 2½ years ahead

	Slope coefficient, β	Significance level of: β	Constant, α
Average earnings	0.037	1%	n.s.
US NFP	0.030	5%	n.s.
RPIX	0.025	5%	n.s.
US CPI	0.025	5%	5%
Retail sales	0.013	n.s.	n.s.
Industrial production	0.005	n.s.	n.s.
PPI	0.003	n.s.	n.s.
GDP	-0.002	n.s.	n.s.
Unemployment	-0.005	n.s.	n.s.

Note: n.s. = not significant.

Table I
Regression results—ten-year benchmark gilt yield

	Slope coefficient, β	Significance level of: β	Constant, α
US NFP	0.029	5%	n.s.
US CPI	0.021	5%	n.s.
Retail sales	0.020	5%	n.s.
RPIX	0.013	n.s.	n.s.
Average earnings	0.012	n.s.	n.s.
Industrial production	0.008	n.s.	n.s.
PPI	0.002	n.s.	n.s.
GDP	0.001	n.s.	n.s.
Unemployment	-0.010	n.s.	n.s.

Note: n.s. = not significant.

(1) The lines of best fit shown in Charts 5, 6, and 7 are all derived using the simple least squares regression technique outlined below.

sign of the slope coefficient, β, is appropriate (ie positive). And third, the front short sterling contract responds to a wider array of data surprises than either of the two other interest rate instruments. There is also evidence that the two US data releases included here (consumer prices and non-farm payrolls) have a greater influence on longer-term sterling interest rate expectations than most domestic data. The large size of the US economy means that it is likely to be a significant influence on world interest rates. So the UK markets' reaction to US data surprises is compatible with the view that domestic market participants may believe that US activity and inflation developments are key determinants of world inflationary pressures and hence world (and UK) long-run interest rates.

A comparison of the slope coefficients in Tables G, H, and I also gives some indication of which data have tended to move sterling interest rate expectations most. Both the short sterling contracts seem to be most responsive to average earnings and inflation data (for the United Kingdom and the United States). Retail sales data have also had a strong effect on interest rate expectations, although this relationship was not found to be statistically significant for the longer-dated short sterling contract. GDP and industrial production releases have had a smaller impact on short-term interest rate expectations, and unemployment and producer price data were not found to be significant influences at all.(1)

To summarise, our findings for the period January 1996 to April 1999 are:

(i) Near-term interest rate expectations responded predictably to a wide array of activity and inflation surprises.

(ii) Surprises in average earnings and RPIX inflation affected short-term interest rate expectations most.

(iii) Interest rate expectations two to three years ahead were more volatile than three-month expectations, and reacted to a smaller set of data surprises.

(iv) Ten-year interest rate expectations were less responsive to surprises about current domestic economic conditions, but reacted to two US indicators.

Conclusions

The very short end of the sterling yield curve—as measured by the nearest short sterling contract—tends to change more on data and policy news days than on days when there is no significant news. That is also true, though to a lesser extent, for the short sterling contract two to three years ahead. Movements at the longer end of the yield curve—measured here by the change in the ten-year gilt yield—tend to be less closely tied to domestic news. Among individual domestic data releases, average earnings, RPIX and retail sales are the most significant market-moving events. Two key US data releases, consumer prices and non-farm payrolls, significantly affected the longer end of the UK yield curve.

(1) Unemployment data are released as part of a package with average earnings (and employment) data. The empirical results suggested that the average earnings data had a significant effect on the yield curve, but that the unemployment data did not.

Appendix: Chi-squared test for differences in probabilities

The aim of the chi-squared test statistic is to quantify whether the probability distribution of changes in interest rates is statistically significantly different on policy days and data days from the distribution on no-news days. In the case of data days, this is done by testing the null hypothesis that the distributions of rate changes (for suitably chosen intervals) are the same for data days and no-news days, against the alternative hypothesis that the distributions are not the same. The chi-squared test is based on a contingency table of size 2 times c, where c is the number of intervals chosen (see the contingency table for an example where $c = 3$).

Contingency table

	Interval 1	Interval 2	Interval 3	Totals
No-news days	O_{11}	O_{12}	O_{13}	$n_1 = O_{11} + O_{12} + O_{13}$
Data days	O_{21}	O_{22}	O_{23}	$n_2 = O_{21} + O_{22} + O_{23}$
Totals	$C_1 = O_{11} + O_{21}$	$C_2 = O_{12} + O_{22}$	$C_3 = O_{13} + O_{23}$	$N = n_1 + n_2$

The test statistic is defined as:

$$T = \sum_{i=1}^{2} \sum_{j=1}^{c} \left(O_{ij} - E_{ij} \right)^2 / E_{ij} \qquad \textbf{(1)}$$

Here O_{1j} are the observed numbers of rate changes in interval j for no-news days ($i = 1$), and O_{2j} are the observed numbers of rate changes in interval j for data days ($i = 2$). The expected number of rate changes for each interval j, if the null hypothesis is true, is given by:

$$E_{ij} = n_i \, C_j / (n_1 + n_2) \qquad \textbf{(2)}$$

with n_i being the number of observations in sample i, and with C_j defined as in the example in the table.

If the null hypothesis is true, and if the sample size is large enough, the test statistic is distributed as a chi-squared random variable with $(c - 1)$ degrees of freedom. The null hypothesis that all probabilities are the same on no-news days and data days is rejected at significance level s if the test statistic T is larger than a critical value, namely the $(1 - s)$ quantile of the chi-squared distribution with $(c - 1)$ degrees of freedom.

The test requires that the expected values for each interval E_{ij} are not too small. As a general guide, the size of each interval should be sufficiently large to ensure that there are at least five expected values within each interval.[1] So it would be inappropriate to calculate the test statistic using the intervals shown in Charts 1 to 3, since the expected numbers in the outer intervals would be too small to draw reliable inferences. To address this problem, we chose interval sizes such that the expected number of observations in each interval was greater than ten. Reflecting this, our intervals (in basis points) for the front short sterling futures contract were: $x \leq -3$; $-3 < x \leq -1$; $-1 < x < 1$; $1 \leq x < 3$; and $x \geq 3$. For the longer-dated futures contract and the ten-year gilt yield, the five intervals were: $x < -4.5$; $-4.5 \leq x < -1.5$; $-1.5 \leq x \leq 1.5$; $1.5 < x \leq 4.5$; and $x > 4.5$.

(1) See Cochran (1952).

Data sources

Data releases: We use data released at the time of the announcement and do not, therefore, make an allowance for subsequent revisions to data (since the market response on the day will be to the published data).

Front short sterling futures contract: The underlying data are from prices traded on the London International Financial Futures and Options Exchange (LIFFE); we took data from Bloomberg. Contracts mature on the third Wednesday of March, June, September and December. Because contracts tend to lose liquidity before they mature, we switched contracts at the beginning of the final month. For example, we take the September contract to be the front contract from June.

Longer-maturity short sterling futures contract: This is the LIFFE contract that matures 2½ years hence; data taken from Bloomberg.

Median market expectation: Taken from Bloomberg's survey of market expectations.

Ten-year gilt yield: We used the generic ten-year bond yield quoted by Bloomberg. Bloomberg defines this as the bond that the market judges to be the current ten-year benchmark. Over our sample period, the benchmark ten-year bond changed five times.

Sample period: January 1996–April 1999 (except for Charts 4–7 which include data to September 1999).

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New estimates of the UK real and nominal yield curves

By Nicola Anderson and John Sleath of the Bank's Monetary Instruments and Markets Division.

This article presents some new improved estimates of the UK yield curve, both nominal and real. It describes the rationale for changing the estimation techniques that we have previously used, in the light of our own experience and developments in the academic literature. The article also illustrates the use of data from the general collateral repo market to derive estimates of the nominal yield curve at short maturities.

Introduction

Nominal yield curves have been estimated in the Bank for more than 30 years. For the past five years, in common with many other central banks, we have used the estimation method proposed by Svensson (1994, 1995). This is a parametric method, with the entire curve described by a single set of parameters representing the long-run level of interest rates, the slope of the curve and humps in the curve. Previously we used an in-house non-parametric method described by Mastronikola (1991). And before that we used another parametric approach, with the parameters reflecting, among other things, segmentation in the market and the planning horizons of different investors.

Estimation of the real yield curve is a more recent innovation, made possible by the introduction of index-linked bonds in the United Kingdom in 1981. As these bonds are indexed only imperfectly to the price level, we have to use information from the nominal yield curve to extract the real risk-free rates of interest embodied in their prices. Until now we have been using an iterative technique developed by Deacon and Derry (1994), in which the real yield curve is described by a restricted version of Svensson's model.

As discussed by Breedon (1995), the Svensson method was preferred both to the earlier in-house method and the range of alternative options available at the time, on the basis of three key criteria. Specifically:

- the technique should aim to fit implied forward rates (rather than, for example, yields), since the final objective is to derive implied forward rates;
- it should give relatively smooth forward curves, rather than trying to fit every data point, since the aim is to supply a market expectation for monetary policy purposes, rather than a precise pricing of all bonds in the market; and
- it should allow as many economic restrictions as possible to be imposed.

For maturities of less than two years, estimates of both the real and nominal yield curves have not been thought to be reliable, and as a result have not been used by the Bank's Monetary Policy Committee, nor published in the *Inflation Report* or *Quarterly Bulletin*. This is partly because there are few gilts at the short end of the yield curve (ie with terms to maturity of two years or less), where expectations may be relatively precise and where the curve may be expected to have quite a lot of curvature. More recently, experience has led us to question whether the Svensson estimates, even at the longer maturities, are the best guide to monetary conditions in the United Kingdom.

The opportunity to shed new light on the performance of these models has arisen, partly through the relatively recent arrival of additional information from the gilt market (in the form of strips prices), and partly through the development of new techniques for estimating the yield curve. In the latter case, we find that a new model developed by Waggoner (1997) offers a number of improvements on the parametric methods currently used to estimate both the real and nominal yield curves. In addition, improvements in extracting the real yield curve from index-linked bond prices can be found using the non-iterative technique developed by Evans (1998).

The following two sections describe the problem of extracting information from the bond market and the choice of techniques currently available. We then examine some estimates of the Svensson nominal yield curve. In the light of these observations, we describe a number of criteria for comparing different methods of estimating the yield curve, and discuss how these relate to four different models. The final two sections present estimates of the yield curve using our preferred model, first extended to include general collateral (GC) repo data at the short end, and then applied to index-linked gilts.

Extracting information from the bond market

The most useful information that can be derived from the government bond market is implied forward interest rates. These are important in their own right as they reflect, albeit

imperfectly, the market's expectations about the future path of interest rates. But they also provide the building-blocks for other types of information, including zero-coupon yields and the synthetic bond prices we create to derive credit spreads from corporate bonds.

Implied forward rates are the marginal rates of return that investors require in order to hold bonds of different maturities. Ideally, we would like to measure 'instantaneous' forward rates, which are related to the price of a bond as follows:

$$B(\tau) = \exp\left[-\int_0^{\tau} f(m)dm\right] \qquad \textbf{(1)}$$

where f is the forward rate, B is the price of a zero-coupon bond and τ is its maturity. Given these forward rates, it is straightforward to derive the implied forward rate of interest between any two dates in the future, and at any point in time.(1)

To measure the set of instantaneous forward rates directly from the market requires a set of observable zero-coupon bond prices across a continuum of maturities (the 'discount function'). In practice, however, as we can only observe the prices of coupon-bearing bonds,(2) the discount function is not directly observable. All we can do is to write the price of each observable bond as follows:

$$P(c,\tau) = \sum_{i=0}^{n-1} cB(\tau - i) + 100B(\tau) \qquad \textbf{(2)}$$

where τ denotes the maturity of the bond, c is the coupon payment made in each period, and n refers to the number of such payments outstanding. A more fundamental problem is that these bonds are issued across only a finite set of maturities. We therefore need a method of disentangling the discount function and 'filling in the gaps' to give a continuous curve.

Parametric versus spline-based methods

The simplest method is to define the forward rate curve, $f(m)$, as a function, $f(m,\beta)$, of a set of unknown parameters, β. This is the approach taken both by Nelson and Siegel (1987) and by Svensson (1994, 1995). In these models, the parameters are related to the long-run level of interest rates, the short rate, the slope of the yield curve and humps in the curve. Svensson's model can be regarded as an extended version of Nelson and Siegel's model, with an additional hump to help fit bond prices in the market. The precise specification of each of these models is described in the Appendix.

In each case, via equations **(1)** and **(2)**, the functional form can be used to derive a fitted value for each bond price, given the set of underlying parameters. The parameters are estimated to minimise an objective function that compares these fitted values with observations from the gilt market. A variety of objective functions are available to us; over N bonds, we choose to minimise:

$$X_P = \sum_{i=1}^{N}\left[\frac{P_i - \Pi_i(\beta)}{D_i}\right]^2 \qquad \textbf{(3)}$$

where P_i is the observed price of the ith bond, D_i is its modified duration, and $\Pi_i(\beta)$ is the fitted price. This is approximately equal to minimising the sum of squared yield residuals (although it is much quicker to calculate), and so implies roughly equal yield errors, irrespective of maturity.

Rather than specifying a single functional form to describe instantaneous forward rates, spline-based techniques fit a curve to the data that is composed of many segments, with constraints imposed to ensure that the overall curve is continuous and smooth. This is the principle advantage of spline-based techniques over parametric forms since, subject to the continuity constraints, individual segments can move almost independently of one another.

This is clearly illustrated in Charts 1a and 1b, which shows an example of a simple non-linear least squares regression to a set of arbitrary data points, using both the Svensson functional form and a cubic spline.(3) When a single data point is changed at the *long* end, the Svensson curve changes dramatically, particularly at the *short* end, whereas the spline moves only slightly to accommodate the new data, and only at the long end. Methods for fitting cubic splines to the data differ in a number of ways, including the objective function used. The effect that this has on the resulting yield curve estimates is discussed in later sections.

UK nominal interest rates estimated using Svensson

At the long end of the yield curve, the Svensson model is constrained to converge to a constant level. The rationale for this constraint is based on the assumption that forward rates reflect expectations about future short interest rates, or equivalently that the unbiased expectations hypothesis holds. Assuming that this is true, it seems implausible that agents will perceive a different path for the future short rate in 30 years time compared with, say, 25 years. So we should expect to see constant expectations and forward rates at the long end.

But how does this compare with data from the strips market? In theory, the observed strips' yields should provide a direct reading on the underlying term structure that the Svensson method is attempting to describe. Chart 2 compares the estimated yield curve with the yields on strips

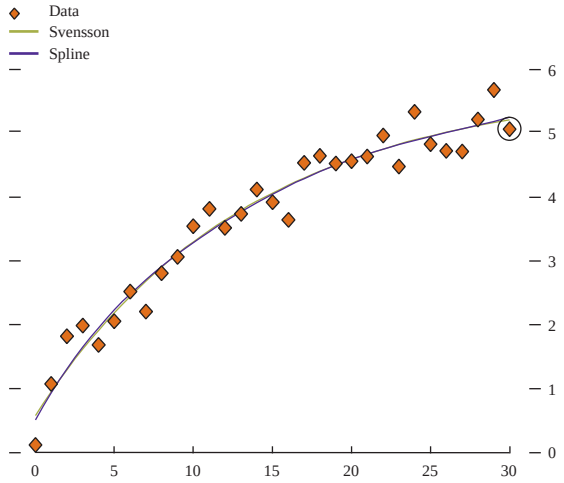
(1) The implied forward rate at time 0 between s and τ, for example, is given by $\int_s^{\tau} f(m)dm$.

(2) In fact, zero-coupon gilts have existed since the introduction of the strips market in December 1997. These separate the two components of a coupon-bearing gilt to give a principal strip with maturity equal to its redemption date and a series of coupon strips related to each payment date. The market in strips is, however, still small relative to coupon-bearing gilts. We therefore do not use strips prices to estimate the yield curve.

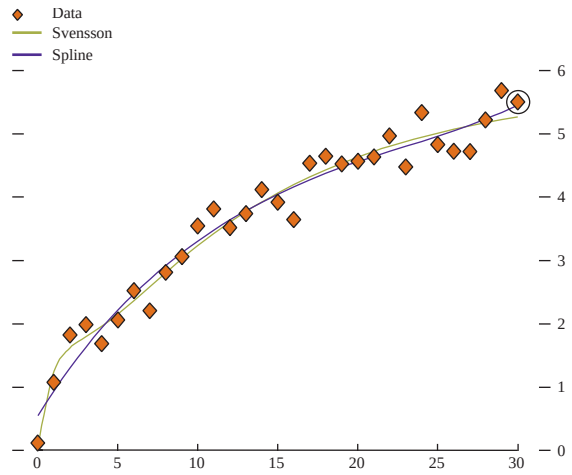
(3) The spline has been chosen to have the same number of degrees of freedom as the Svensson curve.

Chart 1 Svensson method versus cubic spline

(a) Original set of data points

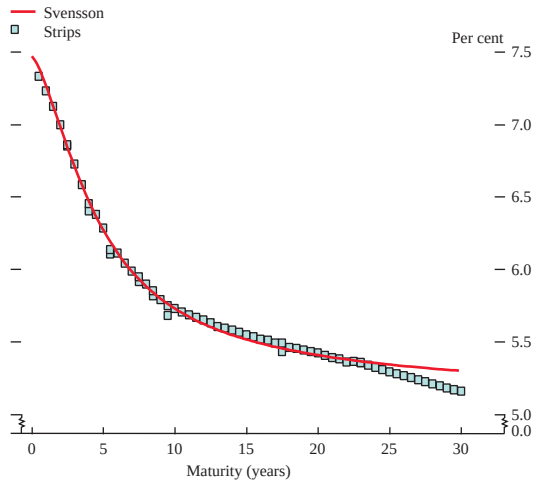


(b) Change of single data point



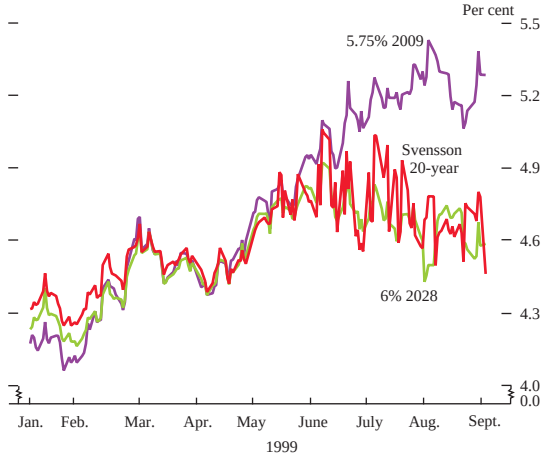
on a day chosen at random, 19 June 1998. The strips prices clearly display a downward-sloping term structure at the long end, compared with the constant level imposed by the Svensson yield curve. Assuming that expectations do converge at longer maturities, this implies that there are other factors driving strips' prices (for example, risk premia and convexity terms), so that the unbiased expectations hypothesis does not hold.

Chart 2
Estimated yield curve on 19 June 1998—Svensson versus strips



Of course, the strips may be mispriced.(1) Direct evidence from the gilt market, however, suggests that a downward-sloping yield curve may be justified, at least over the maturity range that we consider. Moreover, forcing the long end of the curve to converge to a constant level can produce a significant amount of instability in the estimated yield curve. This is shown in Chart 3, where we plot the redemption yields on the 10-year benchmark bond and the longest-maturity bond (with maturity of 29 years), together with 20-year zero-coupon yield estimates derived using Svensson.

Chart 3
Time series of redemption yields at the long end



This illustrates that, as the *observed* bond yields have diverged more and more, the yield curve *estimates* have been increasingly unstable. We attribute this to the parameterised nature of the Svensson curve. Estimates at all maturities rely on a single set of parameters, of which one is the long-run level, determined largely by the yield on the longest bond. But the increasing divergence of the two redemption yield series suggests that the level of this asymptote is not well defined, at least in this maturity range. As a result, the asymptote itself is likely to be unstable, and this volatility will be transmitted into estimates of the yield curve as in Chart 1.

A comparison of techniques

In the light of this experience, we examined a number of alternative methods of yield curve estimation. In particular, we compared the performance of the Nelson and Siegel and Svensson methods with two spline-based models due to Fisher, Nychka and Zervos (1995) and Waggoner (1997). (See Appendix for details of these models.)

Our preferred model is a modification of the spline-based technique developed by Waggoner (1997), which he refers

(1) There is some concern about the reliability of strips prices in practice. This is because the market is relatively new (introduced in December 1997), and trading in strips is quite thin compared with conventional coupon gilts.

Summary of key criteria and properties of the VRP model

Criteria	Properties of the VRP model
Smoothness	
The technique should give relatively smooth forward curves, rather than trying to fit every data point, since the aim is to supply a market expectation for monetary policy purposes rather than a precise pricing of all bonds in the market.	Forward rates are estimated to maximise the fit of the model to observed bond prices while penalising curvature in the forward curve.
Flexibility	
The technique should be sufficiently flexible to capture movements in the underlying term structure. It should also be relatively less flexible at the long end than at shorter maturities, but should not necessarily asymptote within the range of maturities defined by the market.	The extent to which curvature in the forward curve is penalised—the value of the penalty parameter—depends on maturity; the shorter the maturity, the more structure is allowed in the curve. The penalty parameters are chosen to maximise the out-of-sample(1) goodness-of-fit of the model estimates.
Stability	
Estimates of the yield curve at any particular maturity should be stable, in the sense that small changes in data at one maturity (such as at the very long end) do not have a disproportionate effect on forward rates at other maturities.	Forward rates are described by a number of segments joined together. This in effect localises the influence of maturity idiosyncratic price movements to a specific portion of the curve.

(1) The term 'out-of-sample' here refers to the fit obtained for a bond excluded from the estimation. To estimate the overall out-of-sample goodness of fit we leave out each bond in turn, estimate the yield curve, and calculate the average fitting error of the omitted bonds, a procedure known as cross-validation (Davison and Hinkley (1997)).

to as the 'variable roughness penalty' (VRP) method. This model was chosen on the basis of a number of key criteria, and on its performance relative to the alternative models in a number of tests. For the sake of brevity, the results of these tests are not reported here.(1) Instead, we describe the intuition for our choice of yield curve model. The box above describes the main features of our preferred model, alongside our criteria.

In the Nelson and Siegel and Svensson methods, the yield curve estimates are guaranteed to be smooth by the parsimonious nature of the functional form—the curves are simply not flexible enough to capture the idiosyncratic price movements of every bond in the market. But this raises the question as to whether or not these methods are sufficiently flexible to capture movements in the underlying term structure. We conducted an out-of-sample test.(2) Each estimation method will produce a high in-sample goodness of fit, but this may not be indicative of the underlying term structure. The important test is whether the estimated curve can accurately price a bond that has not been used to estimate the curve.

Comparing results for the Nelson and Siegel and Svensson methods confirms Svensson's view that additional flexibility may be needed to capture variation in the underlying data. Both methods give qualitatively smooth forward curves, but the out-of-sample performance of the Nelson and Siegel method is inferior to the Svensson model.

So how do the spline-based methods compare? These techniques are specifically designed to be more flexible than the parametric forms. However, when fitting a cubic spline, we can control the smoothness of the curve by means of a roughness penalty. The objective function described in equation **(3)** is modified, so that we now minimise X_S, where:

$$X_S = X_P + \int_0^M \lambda_t(m)\left[f''(m)\right]^2 dm \qquad \textbf{(4)}$$

$f''(m)$ is the second derivative of the fitted forward curve (and so is a measure of its curvature) and M is the maturity of the longest bond. The choice of roughness penalty, $\lambda_t(m)$, marks the main distinction between the two spline-based models we investigated. Fisher, Nychka and Zervos ('FNZ')(3) chose $\lambda_t(m)$ to be constant across all maturities, but variable from day to day.(4) In contrast, Waggoner (1997) allowed $\lambda_t(m)$ to vary across maturity, but kept it constant from day to day.

Waggoner chose a three-tiered step function for his smoothing parameter, with steps at one and ten years to maturity. This was based on the segmentation of the US market into bills, notes and bonds. The UK market cannot

(1) A forthcoming *Bank of England Working Paper* will discuss the results in full.
(2) See footnote (1) in the box above for a description of this test.
(3) Fisher, Nychka and Zervos (1995).
(4) The value of the smoothing parameter is chosen using a procedure known as generalised cross-validation. This attempts to find the optimum value based on the trade-off between goodness of fit and parsimony.

be naturally divided in the same way. We chose instead to define $\lambda(m)$ as a continuous function of only three parameters.(1) Following Waggoner, the main criterion for choosing these parameters was to maximise the out-of-sample goodness of fit averaged over our sample period.(2)

Intuitively, there are a number of reasons to suspect that the VRP method will provide us with more reliable estimates of the yield curve. First, by constraining the smoothing parameter to be maturity-invariant, FNZ assume that there is the same degree of curvature along the length of the term structure. But there are strong reasons to believe that this is not the case. In particular, investors are likely to be more informed about the precise path of interest rates at short and medium maturities (when interest rates are determined by monetary policy and business cycle conditions) than at longer maturities. Hence FNZ's curve may be too stiff at the short end (and so unable to capture the true shape of the underlying term structure) and/or too flexible at the long end (and so over-fit the data).

Comparing the goodness of fit of the two spline-based techniques supports these observations. In particular, the VRP curve outperforms the FNZ curve, which in fact does worse than both parametric forms. Intuitively, this is because it suffers from the same lack of flexibility at the short end as Nelson and Siegel. At the same time, the long end of the curve appears to be too flexible, fitting too closely to bonds included within the sample. Results for the VRP method, on the other hand, are very similar to those obtained with the Svensson model.

The main differences between the VRP and Svensson models relate to the stability criterion (see the box on previous page) and the constraints imposed at the long end. As mentioned above, the Svensson model is constrained to converge to a constant at long maturities, a property that appears to contradict evidence from the strips market. The VRP curve, on the other hand, is constrained only to be very smooth at these maturities. Chart 4 illustrates the effect that this difference has on the estimated yield curves.

Chart 4 shows that the spline-based curve is better able to capture the shape of the underlying term structure implied by strips, particularly at the long end. Note that data from the strips market were not used to derive these estimates.(3) The effect that this has on the stability of our estimates is shown in Chart 5. This compares the 20-year zero-coupon yields estimated using the new technique with those derived from the Svensson model, and shows clearly that the former are more stable.

More generally, the fact that the new model is non-parametric suggests that it is less likely to display the sort of instability highlighted above. To formalise this property and the effect that it has on the stability of the resulting yield curve estimates, we conducted a stability test. All bond prices are subject to a measurement error, because of the finite minimum price change (the 'tick size'). So we require the estimated curve to be virtually unchanged if bond prices are perturbed by an amount smaller than a half of the tick size, and this forms the basis for the test. As expected, the two spline-based methods outperformed the parametric models in this test. The VRP method also outperformed the FNZ method, probably reflecting the fact that at longer maturities, the FNZ model is able to fit too closely to individual bonds.

Chart 4
Estimated yield curve on 19 June 1998—VRP model versus Svensson versus strips

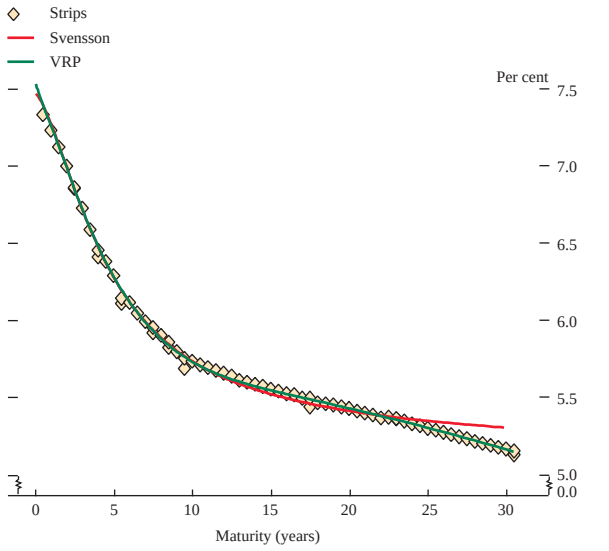
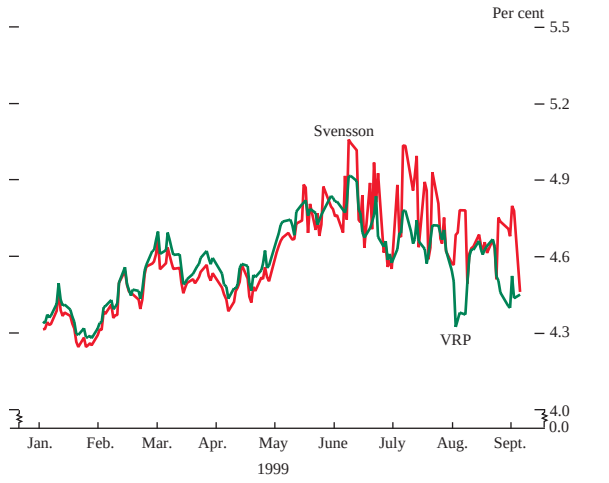


Chart 5
Comparison of 20-year yields since January 1999



The short end of the yield curve

At the short end of the yield curve, there are relatively few data from which estimates can be derived. An alternative approach is to introduce data from the money market. But

(1) We specify the following function: $\log \lambda(m) = L - (L - S)\exp(-m/\mu)$, where L, S and μ are the three parameters to be estimated.
(2) In practice, many combinations of these parameters gave similar out-of-sample goodness-of-fit measures. Within this set of combinations, we chose the set of parameters that corresponded to the highest level of smoothing.
(3) Market participants may use a similar yield curve to price non-trading strips from the gilts curve. If so, this reinforces our belief that the VRP curve captures the market's views.

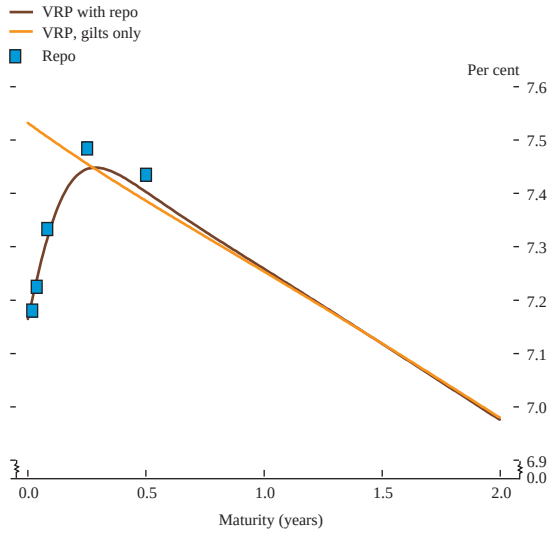
since we aim to measure the risk-free (or default-free) term structure of interest rates, the choice of data is limited. Although many short-term instruments are traded on the UK money market, their prices are not generally consistent with gilt prices, because they include a credit-risk premium. This leaves a choice of only two instruments: Treasury bills (T-bills) and GC repo rates.

T-bills are short-term zero-coupon bonds issued by the government, and so have the same risk-free characteristics as gilts. The outstanding stock of T-bills is, however, quite small, and because commercial banks use them for cash management purposes, their prices are widely accepted as being unrepresentative of the underlying fundamental rate determined by expectations.

A GC repo agreement is equivalent to a secured loan, and so the credit risk is much lower than on unsecured Libor. In addition, the repo is marked to market daily, thereby limiting the exposure of either party to large moves in the value of the collateral. The risk premium is further reduced because the collateral comprises gilts or similar instruments, for which there is virtually no chance that the issuer will default during the term of the repo. GC repo therefore provides us with the only widely traded, virtually risk-free short-term instrument.(1)

Chart 6 compares the yield curve estimates (based on the VRP method) with and without the inclusion of GC repo data, and the repo rates themselves. The difference between the two curves is striking. When the GC repo data are included, the curve exhibits a significantly different shape at the short end. At the same time, however, the two sets of estimates are virtually identical at maturities longer than one year. This is important as it indicates that, even if there is reason to doubt the reliability of the GC repo data or if these are not available, we can still have confidence in estimates at longer maturities.

Chart 6
VRP model: short-end yield estimates with and without repo rates (19 June 1998)



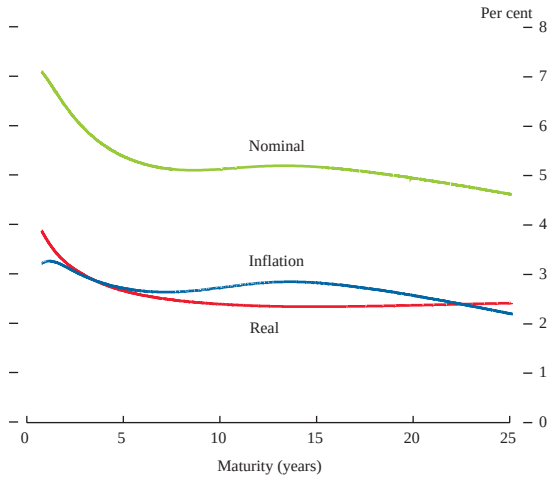
Estimation of the real term structure

The estimation of the real term structure from the prices of index-linked gilts (IGs) is considerably more complex than deriving the nominal yield curve from conventional bond prices. This is mainly because IG coupon payments are indexed to the level of RPI eight months before the cash flow occurs; for the last eight months of its life, an IG offers no inflation protection at all, and it therefore trades as a purely nominal bond. As a result, IG prices generally reflect a mixture of both the real and nominal term structures.

The approach we have been using up to now is described by Deacon and Derry (1994). By making an initial assumption about the expected future path of inflation, the real forward rate can be fitted (using a truncated Svensson curve). The difference between the real and nominal yield curves is then calculated where, assuming zero inflation-risk premia, this is determined by the market's inflation expectations. The real curve is then re-estimated using this new inflation assumption, and the process is repeated until convergence is obtained.

Evans (1998) introduced a new framework for dealing with the problems outlined above, avoiding the use of an iterative procedure. He derives a relationship between the nominal and real term structures and the term structure of (incompletely) indexed bonds,(2) allowing an interest rate curve to be fitted directly to IG prices. We have extended his work to account explicitly for the variation of the effective indexation lag for each IG's constituent cash flows, and also to deal with the delay in publication of the retail price index. A major advantage of this approach is that it is significantly more transparent than the iterative procedure.

Chart 7
Nominal, real and inflation forward curves (19 June 1998)



(1) On the other hand, we should be aware that GC repo rates can be affected by other factors. One example is gilt collateral shortages, although this effect may be diminished now that eligible collateral to be used in the Bank's operations has been extended to include many euro-denominated bonds (see *Quarterly Bulletin*, August 1999, pages 249–50).
(2) The index-linked term structure is a mathematical construct that simply allows us to price IGs using the standard discounted present value formula. It is not in itself an interesting term structure, since it is a mixture of the real and nominal curves.

Chart 7 presents preliminary estimates of the real and nominal yield curves using the VRP curve within this framework. It also shows the set of implied inflation expectations, calculated as the difference between these two curves. The real yield estimates do not differ markedly from those derived using the iterative technique. Instead, any differences in the nominal curve tend to be reflected by the set of inflation expectations. Work is still in progress to assess the relative performance of the two techniques.

Conclusion

In recent years, the Bank has used a model put forward by Svensson to estimate the UK nominal yield curve, and currently employs a similar parametric approach to derive the real yield curve. Experience of using these models has highlighted a number of problems. We have shown in this article that these problems can be resolved by using a spline-based technique. Moreover, this technique can be extended to provide estimates at the short end of the nominal yield curve, by including GC repo data. Further improvements relating to estimates of the real yield curve may by found by applying the spline technique to the theoretical framework put forward by Evans (1998).

In this article and in the November 1999 *Inflation Report*, we have presented our improved estimates of the nominal yield curve using the VRP technique. As work is still ongoing in relation to the real yield curve and inflation term structure, estimates presented continue to be based on Deacon and Derry's (1994) iterative technique. We intend to replace these with our new estimates of the real yield curve and inflation term structure in future editions of the *Quarterly Bulletin* and *Inflation Report*.

Appendix

This Appendix outlines the four methods for estimating the instantaneous forward rate curve discussed in the main text. The two parametric models were proposed by Nelson and Siegel (1987) and Svensson (1994, 1995). One of the spline-based models is the preferred choice of Fisher, Nychka and Zervos (1995), and the other is a modification (for the UK market) of the technique proposed by Waggoner (1997).

Parametric models

Nelson and Siegel proposed that the instantaneous forward rate curve could be parsimoniously modelled at all maturities by a parametric function of the form:

$$f(m,\beta) = \beta_0 + \beta_1 \exp\left(\frac{-m}{\tau_1}\right) + \beta_2\left(\frac{m}{\tau_1}\right)\exp\left(\frac{-m}{\tau_1}\right)$$

where $\beta = (\beta_0, \beta_1, \beta_2, \tau_1)'$ is the vector of parameters describing the curve, and m is the maturity at which the forward rate is evaluated. The functional form has three components: a constant term, an exponential decay term, and a 'hump-shaped' term. The curve asymptotes to a constant value of β_0 at the long end, and has a value of $(\beta_0 + \beta_1)$ at the short end.

To allow for additional flexibility in fitting the yield curve, Svensson proposed an extension to Nelson and Siegel's model, adding an extra hump term to give:

$$f(m,\beta) = \beta_0 + \beta_1 \exp\left(\frac{-m}{\tau_1}\right) + \beta_2\left(\frac{m}{\tau_1}\right)\exp\left(\frac{-m}{\tau_1}\right) + \beta_3\left(\frac{m}{\tau_2}\right)\exp\left(\frac{-m}{\tau_2}\right)$$

The curve is now described by six parameters: $\beta = (\beta_0, \beta_1, \beta_2, \beta_3, \tau_1, \tau_2)'$. Once again, the curve asymptotes to a constant value of β_0 at the long end, and has a value of $(\beta_0 + \beta_1)$ at the short end.

Smoothing cubic spline models

A generic spline is a piecewise polynomial, ie a curve constructed from individual polynomial segments joined at 'knot points', with coefficients chosen such that the curve and its first derivative are continuous at all points. The most commonly used polynomials are cubic functions, giving a cubic spline. The continuity constraints mean that any cubic spline can be written in the form:

$$S(x) = \alpha x^3 + \beta x^2 + \gamma x + \delta + \sum_{i=1}^{N-1} \eta_i \left| x - k_i \right|^3$$

for some constants, $\alpha, \beta, \gamma, \delta, \eta_i$, where k_i, $i = [0,N]$ is the set of knot points.

Though this is the simplest expression for a cubic spline, it is numerically unstable,(1) and so instead we prefer to represent our splines as a linear combination of cubic B-splines. This is a completely general transformation (any spline can be written as such a combination of B-splines of the appropriate order), which cures the numerical problems. B-splines of order n are most simply represented by the following recurrence relation:

$$B_{i,n}(x) = \frac{x - k_i}{k_{i+n-1} - k_i} B_{i,n-1}(x) + \frac{k_{i+n} - x}{k_{i+n} - k_{i+1}} B_{i+1,n-1}(x)$$

with $B_{i,1}(x) = 1$ if $k_i \le x < k_{i+1}$, and $B_{i,1}(x) = 0$ otherwise. For further details see Lancaster and Šalkauskas (1986).

With a sufficiently large number of knot points, a cubic spline can be used for interpolation. If this approach were adopted when fitting yield curves, the resulting term structures would be very different from the smooth curve that we require for monetary policy purposes. To reduce the flexibility of the spline, we can either reduce the number of knot points or impose a penalty on 'excessive' curvature (or non-smoothness). In both our spline-based models we use the latter approach, and the difference between the two methods lies in the different specifications of the penalty.

As described briefly in the main text, Fisher, Nychka and Zervos (1995) specify a roughness penalty that is constant across maturities, but which varies from day to day. So the objective function can be written:

$$X_{FNZ} = X_P + \lambda_t \int_0^M \left[f''(m) \right]^2 dm$$

where X_P is the duration-weighted sum of squared price residuals, and $f''(m)$ is the second derivative of the forward curve, and so a measure of its curvature. The constant λ_t is chosen for each day. If a large value is used, the curve is very smooth, and the effective number of parameters is reduced. Alternatively, a small value results in a very flexible curve, increasing the (in-sample) goodness of fit. The 'generalised cross-validation' technique is used to derive the optimum value of λ_t based on this trade-off between parsimony and goodness of fit, using the estimated curve and the observed bond prices.

Waggoner's VRP method (and our modification) uses a roughness penalty that is constant from day to day, but depends on maturity. The objective function can be written:

(1) Computers have only finite accuracy, and the calculation of a spline using this expression typically involves subtracting very large, similar numbers, resulting in (potentially) large errors.

$$X_{VRP} = X_P + \int_0^M \lambda(m)\left[f''(m)\right]^2 dm$$

In this case, we need to specify a functional form for the smoothing function. We use:

$$\log \lambda(m) = L - (L - S) \exp(-m / \mu)$$

where, L, S and μ are parameters to be estimated. The smoothing parameters were chosen to maximise the out-of-sample goodness of fit, with a preference for higher smoothing when (as was found to be the case in practice) several combinations of the parameters gave similar out-of-sample goodness of fit measures.

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Government debt structure and monetary conditions

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In June 1998 the Bank of England organised a conference on 'Government debt structure and monetary conditions'. The aim of the conference was to discuss the interactions between the size and structure of government debt and the concerns of monetary policy. The proceedings of the conference will be published shortly.[1] *This article summarises the issues discussed.*

Governments usually play a large role in the money and capital markets, so the needs of government finance often influence conditions in these markets. Until 1997, the Bank of England was responsible, as agent for the government, for both the implementation of monetary policy and the management of the government's debt; hence the Bank had to be aware of any overlaps or conflicts between these two functions. The official responsibilities for debt and monetary policy within the United Kingdom changed after May 1997. The Monetary Policy Committee (MPC) was established within the Bank of England to set the official interest rate, and the Debt Management Office was established by HM Treasury to take over the management of government debt. Despite the removal of the responsibility for debt management from the Bank, it was thought that an understanding of the links between government debt and monetary conditions remained relevant to the monetary policy objectives of the Bank.

There are three main channels through which government debt structure might influence monetary conditions. These are the potential effects of:

- the quantity of debt;
- the composition of debt (eg short versus long-maturity, index-linked versus conventional); and
- the ownership of debt (eg by banks or non-banks).

We discuss each of these in turn.

Does the quantity of debt matter for the operation of monetary policy?

In a paper presented to the conference, Charles Goodhart[2] argued that practitioners' concerns about the effect of debt on monetary policy need to be judged in a historical context. The absolute size of the government debt in the years immediately after the two world wars—together with the lack of liquidity of financial markets at that time—was the main cause of concern about whether debt management problems could lead to inflationary expansion in the money stock. In the United Kingdom at least, there had been times in the post-war period when it had proved difficult to fund the debt at long maturities on the scale desired, and with sufficient assuredness of timing and volume. Recourse to short-maturity financing was thought at the time to loosen monetary conditions.

But the steady erosion of the debt as a share of GDP and the emergence of a new structure for capital markets after Big Bang[3] reduced the relevance of many of these concerns. New instruments (such as index-linked gilts), new issuing techniques (such as auctions), and new capital market structures all helped to reduce practical concerns about how debt management might impinge on monetary control, to a point where, for the first time since 1913, the two issues are now seen by some as almost entirely distinct.

A different approach was adopted in a paper by Michael Woodford.[4] He attempted to establish theoretically why there might be a link between the quantity of government debt and monetary policy. In his model, the path of the real primary surplus was assumed to be determined exogenously by the government. In this case, he argued, fiscal developments could affect the equilibrium price level through a wealth effect on private consumption. A tax cut not balanced by any expectation of future tax increases would make households perceive themselves to be able to afford more lifetime consumption (if neither prices nor interest rates were to change from their original equilibrium values). The excess demand caused by the tax cut would drive up prices, until the consequent fall in the real value of household wealth reduced demand.

In Woodford's model, the composition of the public debt affects monetary conditions. The shorter the average

(1) '*Government debt structure and monetary conditions*', K. Alec Chrystal (ed), Bank of England, December 1999. This publication will be available from Publications Group, Bank of England; telephone 020–7601 4030.
(2) London School of Economics and MPC member, Bank of England.
(3) Reforms of the London securities markets in 1986 that changed the trading systems and market access rules. See, for example, 'City regulation after Big Bang', *Bank of England Quarterly Bulletin*, March 1986, pages 71–73.
(4) Princeton University.

duration of nominal debt or the greater the degree of indexation of the government portfolio, the more inflation would need to increase by to reduce the value of the public debt enough to restore equilibrium following an expansionary fiscal shock.

But this analysis proved controversial. At a theoretical level, Willem Buiter[1] argued that equilibria of the type discussed by Woodford were logically impossible. And Matt Canzoneri[2] offered empirical evidence aimed at distinguishing between the world in which Woodford's analysis might apply and one where more conventional monetary forces would operate. Mervyn King[3] argued that there was no way of distinguishing empirically between an equilibrium where a tax cut was not balanced by any expectation of future tax increases and an equilibrium where a tax cut was balanced by the expectation of a tax increase in the distant future.

Does the composition of debt matter for monetary policy?

Two aspects of this question were discussed.

First, what incentives for monetary policy arise from the maturity structure of the debt? One existing view is that the monetary authorities have an incentive to keep interest rates low when there is a large stock of short-maturity debt, in order to reduce roll-over costs (ie the costs of refinancing the debt). However, Alessandro Missale[4] provided some evidence to support the view that monetary authorities sometimes react more aggressively to inflationary shocks when the maturity structure is short. His theoretical rationalisation for this result was that, when inflation is persistent, the monetary authorities need to react more aggressively in order to minimise the future roll-over costs resulting from higher expected inflation and higher future nominal interest rates.

Second, does the government's decision to issue short versus long-maturity debt, or conventional versus index-linked debt, affect real yields and thus interest rate sensitive sectors of the economy? The magnitude of such effects depends on how closely different types of government debt instruments can be substituted for one another. Gregory Hess[5] addressed this issue. His findings for the United Kingdom showed that the government's public debt management had a statistically significant effect on expected rates of return on different types of government security. These effects were found to be small, but this could be because there were no substantial changes in debt composition in the sample period. His results suggested, however, that these effects could be larger during periods when there was more uncertainty about the direction of monetary policy.

Does it matter if banks hold government debt?

The central policy question in this session was whether the impact of debt sales on monetary conditions was different if debt was held by banks or non-banks. Ken Kuttner and Cara Lown[6] addressed this question in an empirical paper using mainly US data. Their results suggested that increased debt issuance could lead to an increase in bank holdings of debt. In addition, they found evidence that bank holdings of debt displaced lending to the non-bank private sector, and that banks with larger debt holdings tended to continue lending at a faster rate following a policy tightening than banks with smaller debt holdings.

According to Kuttner and Lown, new issues of debt taken up by banks were a substitute for loans to the private sector, and therefore reduced the supply of bank credit to the private sector. So the debt held by banks had a buffer stock function. Large holdings of debt affected the transmission mechanism of monetary policy, because banks could continue lending in the face of monetary tightening by running down their holdings of debt. However, this was not the effect that might have been expected from one traditional UK perspective, which is that debt sales to banks lead to an increase in (broad) money and are, therefore, expansionary.[7]

It was unclear whether the US evidence was relevant to the United Kingdom, as it was derived from a cross-section of banks in the United States. Alec Chrystal provided some empirical evidence for the United Kingdom, which was consistent with the view that neither debt sales in general, nor debt sales to banks, had had any detectable positive impact on either money supply growth or bank lending. Such evidence as there was seemed to point to debt sales to banks having a negative effect on the money stock. This may be explained, however, by the pre-1993 government funding rules by which sales of gilts to banks were not counted as 'funding' (so further debt issues, of equivalent value to banks' purchases, would be sold to the non-bank private sector in order to meet annual funding targets).

Anil Kashyap[8] argued that for debt structure to matter there would have to be some imperfection in financial markets that violated the Modigliani-Miller theorem for banks themselves, and hence created demand from banks for government debt to act as a buffer stock against unforeseen deposit withdrawals. But the empirical evidence presented would be unconvincing until economists had a clearer theoretical insight into why government debt might be a

(1) Cambridge University and MPC member, Bank of England.
(2) Georgetown University.
(3) Deputy Governor, Bank of England.
(4) University of Brescia.
(5) Cambridge University.
(6) Federal Reserve Bank of New York.
(7) The change in M4 is identically equal to the public sector net cash requirement, minus debt sales to non-banks, plus sterling lending to the non-bank private sector, plus net externals, minus net non-deposit liabilities of banks. Debt sales to banks increase M4 one-for-one, only if all other items in this identity remain unchanged. If, for example, bank lending to the non-bank private sector falls by an amount equal to the rise in debt sales to banks, then M4 will remain unchanged.
(8) University of Chicago.

better buffer stock than private debt, and why the maturity of the debt affected its value as a buffer stock.

Panel discussion

Ben Friedman[1] suggested drawing together the range of ideas discussed at the conference into three broad sets of issues. The first—associated with, for example, the work of Michael Woodford—concerned government solvency and the extent to which the aggregate government debt could be thought of as having net value. While this set of issues was interesting analytically, Friedman argued that it was not of particular relevance to economic policy makers now in either the United States or the United Kingdom, given the improvement in the fiscal position observed in both countries over the past few years.

The second set of issues was whether the composition of the debt could affect the central bank's ability to control money. This could occur for one of two reasons. First, a large fraction of the debt in the form of short-term liquid instruments might impair the central bank's ability to restrict money supply growth. Second, if highly liquid debt were a good substitute for money, a large fraction of the debt held short term could, everything else constant, reduce the demand for money. If the monetary growth target were non-inflationary in a world where debt was not liquid, this reduction in the demand for money would imply positive inflation, even if the central bank managed to limit money growth to its target.

Both reasons implied that an increase in the proportion of short-maturity debt could have inflationary consequences if the central bank were following a monetary targeting rule. Even if the central bank were not operating an explicit money growth rule, it was important to take account of both effects to optimise money's role as a possible leading indicator.

The third question was whether, in an interest rate setting regime, debt management policy might affect the level of the interest rate consistent with achieving the central bank's monetary policy objectives. Friedman argued that, qualitatively, the answer was that it might do so. One result of the standard theory of behaviour under risk was that the entire range of expected asset yields depended on the supplies of all the assets that together make up the market portfolio. And many elements of macroeconomic activity depended on these asset returns.

Friedman argued that the size of such effects was larger than was supposed by many others, but accepted that the consensus was that these effects were not, in practice, large. So while the optimal level of short-term interest rates was affected by debt management policy, the strength of this relationship was probably dwarfed by the scale of movements in short rates that most central banks implement in the course of a typical business cycle, or in response to a normal range of shocks.

Finally, Friedman raised another question that he believed the monetary authorities should consider: what implications did changes in debt management policy have for monetary policy via their impact on the microstructure of financial markets? For example, the growth since the 1970s of the volume outstanding of long-maturity US government bonds had been closely matched by the evolution of futures and options markets on those bonds. This evolution in market structure had in turn promoted the development of more sophisticated risk-management techniques. Similarly, the development of the US index-linked bond market might herald the development in the United States of index-linked pension and life-assurance policies, which may eventually have important implications for long-run consumption and savings decisions.

Philippe Moutot[2] discussed some of the implications of debt management policy for the European Central Bank (ECB), and drew out three main themes. The first was institutional. As was clear from, for example, Charles Goodhart's paper, the relevance of public debt policy to monetary policy depended partly on the institutional framework and level of development of financial markets. So to what extent did the institutional framework for monetary and fiscal policy within EMU deal with the interactions discussed at the conference? Moutot pointed to three potentially important institutional features. First, Article 104 of the Maastricht Treaty prohibited monetary financing of national authorities' fiscal deficits. Second, the Growth and Stability Pact placed limits on the size of fiscal deficits. And third, the independence of the ECB and its objective of price stability gave it a first-mover advantage in its dealings with national debt management authorities.

The second question was the extent to which debt management might affect monetary conditions within the euro area. Moutot agreed with Friedman that there would probably be some, albeit small, effect, but that this would need further research by ECB staff.

The third question was whether preparations were adequate for implementing an ECB monetary strategy. At the time, both monetary targeting and inflation targeting were being considered. But whatever strategy was adopted would be applied flexibly in the short term. The ECB was also aiming to be in a position to offer an independent assessment of fiscal deficits and public debt, and it recognised the importance of developing adequate statistics on financial conditions within the euro area.

Mervyn King agreed with Ben Friedman that one of the main themes to have arisen from the papers presented at the conference was that, in today's liquid markets, monetary policy can largely be separated from debt management. But to what extent did this judgment depend upon current theoretical considerations? There may be many aspects of both the transmission mechanism and optimal debt management that were not yet well understood by economists. Charles Goodhart's paper clearly described the

(1) Harvard University.
(2) European Central Bank.

concern of anyone within a central bank that policy should be robust to a variety of assumptions or models about the way the world worked. That was why, in practice, central bankers felt nervous if they observed rapid growth in monetary aggregates following changes in debt management policy, even if they were not following a money targeting regime. So there was a need to monitor monetary aggregates carefully.

In addition, King pointed out that a complete theoretical framework for determining optimal debt management does not exist. Debt management should consider the trade-off between the cost and risk of the debt structure. However, much work remained to be done in modelling these risks and how the structure of the debt affects them. For example, it was not clear why, in practice, index-linked debt does not play a more substantial role in the debt management policies of developed countries. Even in the United Kingdom—home to the most developed index-linked debt market—index-linked debt had not been the most important source of debt issuance. This suggested that there remains a gap between the theory and practice of debt issuance. If theory were to catch up with the practical questions faced by policy-makers, there would perhaps be implications for monetary policy which were not yet evident from the theory.

Another issue arising from the academic literature was the validity of empirical testing. King pointed out that most of the papers discussed at the conference raised problems of identification. It might never be possible to distinguish between the different types of equilibria discussed in Michael Woodford's paper. It was not clear if firm conclusions could be drawn from the empirical results discussed by Alessandro Missale: the inflation process could affect the maturity of the debt that the public was willing to hold. But in turn, the size and structure of the debt could affect the inflation process that the government chose to implement.

Finally, Mervyn King noted how curious it was that there had been little discussion of debt management and monetary conditions after the start of EMU. Maybe this was because it simply will not matter for the ECB. And yet it was clear that it represented a risk, because debt management was a policy for national governments on which the ECB had no role. The recognition of the potential interaction between monetary policy and debt management had led to the introduction of restrictions on governments' fiscal positions via the Stability and Growth Pact. But these restrictions do not apply to either the maturity structure of the debt or the degree of its indexation.

Conclusions

What conclusions could be drawn about the effects of government debt structure on monetary conditions? Taking in turn each of the three channels through which government debt structure might influence monetary conditions:

- *Effects of the quantity of debt*. The consensus at the conference was that the insights of Michael Woodford were interesting but controversial and, as pointed out by Ben Friedman, were not of great current relevance to the UK conjuncture. Rather, as Charles Goodhart argued, new financial instruments, new issuing techniques and new capital market structures since the 1980s have all helped to reduce concerns about how the quantity of debt impinges on monetary control, to the point where the two issues could now be seen as almost distinct.

- *Effects of the composition of the debt*. Changes in the composition of debt might affect expected asset returns and the incentives facing the central bank. But the consensus at the conference appeared to be that the size of these effects was small, at least in response to marginal shifts in government portfolios. There was nevertheless a need for monetary policy makers to monitor changes in the composition in the debt portfolio carefully, to be alert to possible effects on the monetary aggregates.

- *Effects from the ownership of debt*. Most of the work on this topic has been done on the United States, where there were suggestions (for instance in the work of Kuttner and Lown) that government debt taken up by banks was a substitute for loans to the private sector. For the United Kingdom, the available evidence was consistent with the view that debt sales to banks had only a small impact on either money supply growth or bank lending. But little detailed empirical work has been done to support this result. So that view can, at most, be tentative.

Overall, therefore, the economic research discussed at the conference suggested that changes in debt management policy at the margin were unlikely to have first-order effects upon monetary conditions in normal circumstances. But two important caveats are needed. First, many aspects of the transmission mechanism and optimal debt management are not well understood, and policy should aim to be robust to a variety of different assumptions and models. Second, there are few, if any, examples of extreme changes by governments in debt management policy. So it is less clear that large changes in the quantity or composition of the debt will not have implications for monetary conditions. For these reasons, the effects of changes in debt management policy on monetary aggregates need to be monitored and interpreted with care.

Challenges for monetary policy: new and old

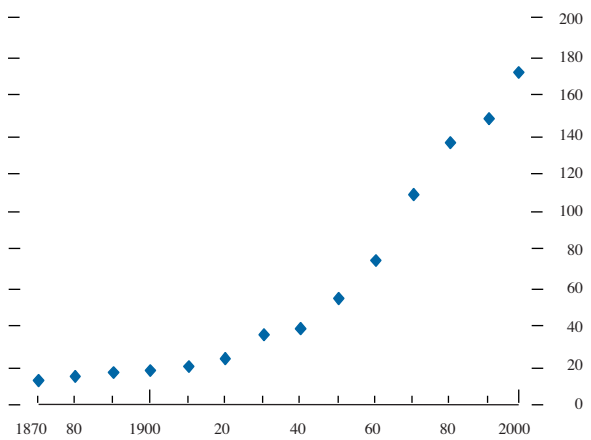
***Deputy Governor**, Mervyn King[1] argues that central banks have reached a record high in terms of their power and reputation. But to retain that position, they have to face two major challenges in a low inflation environment. The first is to decide on the objective for monetary policy. He considers the appropriate definition of price stability and the degree to which central banks should aim to stabilise output. The second challenge is to improve central banks' understanding of the transmission mechanism. Mervyn King concludes by speculating about the future of central banks.*

1 Introduction

The turn of the Millennium seems an appropriate moment to assess the role of central banks in the modern world. On second thoughts, perhaps a Millennium is not the correct unit, for it is the past century which has seen the rise and rise of central banks. One hundred years ago there was no Federal Reserve System. Indeed, in 1900 there were only 18 countries with central banks. Today that number is 172. How many will there be one hundred years from now? Will central banks exist at all?

At the beginning of this century, outside continental Europe only Japan and Indonesia had central banks. The number—and status—of central banks rose throughout the century, and has risen to the point where well over 90% of the countries represented at the United Nations have central banks (see Chart 1). Part of this rise resulted from the conversion of colonial currency boards into central banks of independent countries. But a further impetus was given by the creation of new central banks in eastern and central Europe in the 1990s. And only this year the latest, and arguably the most important, of the new central banks was created with the establishment of the European Central Bank.

Chart 1
Number of central banks, 1870–1999



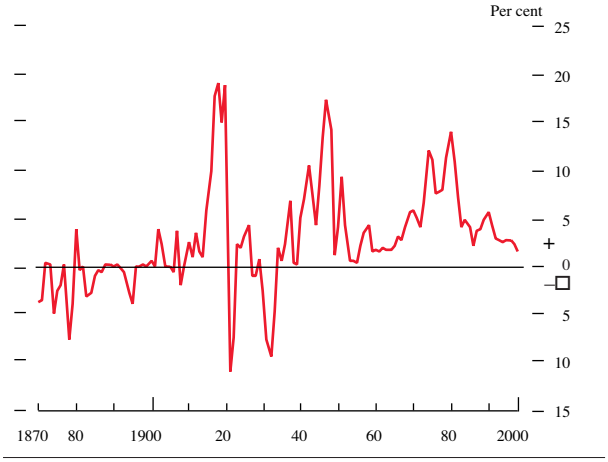
It is not just the number of central banks that has increased steadily throughout the century. Their power and independence has also increased substantially, especially over the past decade. Although the definition of 'independence' is as much a matter of practice as of legal status, ten years ago it was possible to argue that the only large countries with independent central banks were the United States, Germany and Switzerland. Since then, in all three principal time zones there have been significant moves towards independence of central banks. In the Americas, independence was granted in varying degrees to central banks in Argentina, Brazil, Chile and Mexico. In Asia, the Bank of Japan was made independent. And in Europe, not only was the European Central Bank set up, but the Old Lady of Threadneedle Street herself acquired independence in 1997. The result is that after a century of expansion, central banks now find themselves in a position of power and responsibility unrivalled in their history.

Today, central banks are rarely out of the headlines. Monetary policy is news. It is news in the G7, where newspapers continually speculate about future policy moves, and it is news in emerging markets, where the very stability of a country sometimes seems to depend on a resolution of its currency and financial problems.

But this is no time for hubris. For much of the century discretionary monetary policy, freed from the constraints of, first, the gold standard and subsequently the Bretton Woods system of pegged exchange rates, produced inflation (see Chart 2). Unfettered discretion has not been a success. It is no accident that the inflation target approach to monetary policy, so popular in the 1990s, has been described as 'constrained discretion' (Bernanke and Mishkin (1997), King (1997a)). Mechanical policy rules are not credible—in the literal sense that no one will believe that a central bank will adhere rigidly to such a rule irrespective of circumstances. No rule could be written down that describes how policy would be set in all possible outcomes. Some discretion is inevitable. But that discretion must be constrained by a clear objective to which policy is directed

(1) Paper prepared for the Symposium on 'New challenges for monetary policy' sponsored by the Federal Reserve Bank of Kansas City at Jackson Hole, Wyoming, on 27 August 1999. This paper may also be found on the Bank's web site at www.bankofengland.co.uk/speeches/speech51.pdf.
I am very grateful to Ravi Balakrishnan, Nicoletta Batini, Mark Cornelius, Spencer Dale, Ben Martin, Ed Nelson, John Vickers and Anthony Yates of the Bank of England, who not only made helpful comments and suggestions but also contributed most of the ideas to this paper.

Chart 2
Global inflation, 1870–1999



and by which performance against the objective can be assessed.

Giving a central bank a clear remit of maintaining price stability, and holding it accountable for achieving that, is seen as a *sine qua non* of a credible monetary policy regime. The language in which that remit is embodied varies from country to country. But the view that price stability is the overriding objective of monetary policy is now common to both industrialised countries and emerging markets. In part that reflects the intellectual revolution which 'rediscovered' the absence of a trade-off in the long run between inflation and output. But it also reflects the experience of the past 30 years in which high and unstable inflation led to greater fluctuations in output and employment than accompanied periods of low and stable inflation. A commitment to price stability is now seen as the key to achieving broader economic stability. Indeed, John Taylor has described the past 15 years, which contained the two longest post-war expansions, in the United States as the 'Long Boom'. In Europe, the past 15 years might be more accurately described as the 'Long March' to stability.

There is now a widespread intellectual consensus—almost a conventional wisdom—about the objectives which central banks should pursue, and the means by which they should pursue them. This is a very dangerous position. Could it be that 1999 is the apogee of the power of central banks? I believe that if central banks are to retain their central position in economic policy making, they must face up to the intellectual and technological challenges that lie ahead. Unless they do so, popularity will turn to disillusion.

Those challenges are in two main areas of monetary policy. They are: (a) the objectives of monetary policy, and (b) the transmission mechanism through which monetary policy affects those objectives. I discuss these issues in Sections 2 and 3, respectively. Section 4 discusses, more briefly, the international arena in which central banks operate. I return to the future of central banks in Section 5.

2 Monetary policy in a low inflation world: objectives

It may seem strange to identify the objectives of monetary policy as a challenge to central banks. Surely, there is a consensus that price stability is the overriding objective of monetary policy. A decade ago, when Alan Greenspan (1989) defined price stability as—'price levels sufficiently stable so that expectations of change do not become major factors in key economic decisions'—many industrial countries were some way from price stability. A more precise definition was unnecessary. It was clear along which path policy should proceed. But now that inflation has fallen in the main OECD countries, from 12.4% in 1980, to 5.2% in 1990 and 1.6% in 1998, the fact of price stability raises a number of challenges for both the formulation and explanation of the objectives of monetary policy.(1)

Irrespective of the words used to describe it, any monetary policy can be thought of as a combination of an *ex ante* inflation target and a strategy for responding *ex post* to unanticipated shocks (King (1996), (1997b)). The relevant shocks are those to which the central bank can respond before the private sector is able to adjust nominal wages and prices. In a world of low inflation, the private sector will want to know three things about the corresponding monetary policy reaction function. First, how 'low' is the inflation rate at which the central bank is aiming? Second, what precisely does the central bank mean by the exercise of its 'constrained discretion' to respond to shocks in order to stabilise inflation and output? Third, does the central bank intend to bring the price level back towards some desired longer-term path? The efficiency of monetary policy increases when central banks are open about all three aspects of their policy. Consider them in turn.

2(i) The optimal inflation rate

What is the optimal rate of inflation? As inflation has fallen from earlier high levels towards something approaching price stability, the question of what is the optimal inflation rate has become more important. Indeed a growing number of central banks have adopted an explicit and numerical target for inflation. Milton Friedman (1969) argued that anticipated inflation should, on average, be negative. Steady deflation—at a rate equal to the real rate of interest—is optimal because only at a zero nominal interest rate is the marginal opportunity cost of holding cash equal to its marginal production cost (close to zero in practice).

Other considerations suggest that a changing price level—whether inflation or deflation—creates costs. These include the distortionary effects of an unindexed tax system, especially on capital income, and increased menu costs as prices have to be adjusted more frequently. As a result, many have argued for the objective of pure price stability, that is zero measured inflation (for example, Feldstein (1996)). One problem with the objective of zero inflation is that the official indices used to measure inflation are subject

(1) The countries excluded from these comparisons are Greece, Hungary, Mexico, Poland and Turkey.

to biases of several kinds. Most studies suggest that these measures overstate the 'true' rate of inflation by an amount that could lie in a range from 0.5% to 2% a year. The Boskin Commission (1996) produced a central estimate of the overstatement of inflation in the US consumer price index of 1.1% a year.(1)

Such estimates are not uncontroversial and there is no reason to presume that the bias remains constant from year to year. Moreover, there is no unique price index to measure general inflation in a world in which relative prices move around. When average inflation is high, the differences in inflation recorded by different indices are small. But when overall inflation is low, differences between indices are more apparent. For example, Johnson, Small and Tryon (1999) found sizable discrepancies between alternative inflation measures in the United States since 1975. The Bank of England discusses a number of measures of inflation in its quarterly *Inflation Report*. No one measure fully captures all of the information that is relevant to the setting of monetary policy. A single measure, and a single target, for inflation are useful in terms of the transparency of the objectives of policy and the accountability of those responsible for decisions. But the need to examine different measures of inflation highlights the difficulty of identifying precisely an 'optimal' rate of inflation. Nevertheless, concern about the measurement bias problem has led to suggestions that the optimal measured rate of inflation is positive.

Yet other economists have argued that an inflation rate well above zero is desirable because it leads to higher output and employment. Krugman (1996), for example, proposed a long-run inflation target of 3%–4%. Two reasons, in particular, have been advanced for aiming at a positive inflation rate. The first concerns the significance of downward nominal rigidities in wages and prices. If nominal wages and prices are inflexible downwards, then a higher rate of inflation might enable a faster adjustment of real relative wages and prices which would improve efficiency. Second, the fact that nominal interest rates cannot fall below zero may constrain monetary policy in a time of recession. Both arguments have attracted some support recently, and I consider them in turn.

2(i) a Downward nominal rigidities

In a provocative and much-cited paper, Akerlof, Dickens and Perry (1996) claimed that 'targeting zero inflation will lead to a large inefficiency in the allocation of resources, as reflected in a sustainable rate of unemployment that is unnecessarily high'. They studied how downward nominal wage rigidity affects the optimal inflation rate. Their contribution was twofold. First, they reported the empirical evidence on the frequency of nominal wage cuts in the United States. Second, they argued that the existence of downward nominal wage rigidity implied that, at low rates of inflation, there is a permanent trade-off between inflation and unemployment—a trade-off whose existence many of us expend a great deal of energy denying.

It is not surprising that downward nominal rigidity in wages and prices means that zero inflation will be costly for unemployment. But is such rigidity theoretically plausible? And does theory imply that inflation would be a cure? The assumptions required to generate downward nominal rigidities, for which inflation would be a cure, are complex. For example, it is commonly thought that if wage earners were subject to 'money illusion' then positive inflation would provide room for periodic real wage cuts without necessitating cuts in nominal wages or undesirable increases in unemployment. There is indeed some evidence that supports the existence of money illusion. For example, Shiller (1996) found that 59% of his respondents stated that they would be happier with higher money wages though unchanged real wages. Even 10% of economists displayed this kind of money illusion! However, money illusion is not by itself sufficient to generate downward nominal rigidities whose effects could be mitigated by inflation (see Yates (1998)). Money illusion means that people care about nominal wages in addition to real wages. But it does not explain why people care more about a fall in nominal wage growth from 0% to -3% than a change from 3% to 0%.

Akerlof, Dickens and Perry argued that the proportion of salary earners accepting nominal pay cuts could be as low as 2%–3%. The evidence on the frequency of nominal wage cuts is not so clear-cut if we look at other studies.(2) Product markets also exhibit a prevalence of nominal price cuts. For example, towards the end of 1998, more than 25% of the components of the US CPI were falling. Broadly the same was true for the RPI index in the United Kingdom.

Moreover, it is difficult to believe that any downward inflexibility of nominal wages would be unaffected by changes in inflation. As low inflation becomes the norm, resistance to nominal wage cuts could well disappear. In Japan, money wages have been falling since the beginning of 1998. And trend increases in productivity leave scope for changes in relative real wages, without reductions in the level of nominal wages. For example, an inflation target of 2% a year and productivity growth also of 2% a year, mean that nominal wages would rise at an average rate of 4% a year, leaving scope for reductions in relative real wages without cuts in nominal wages.

It is important to focus not only on the frequency of price or wage cuts at any one time, but also on how the distribution of prices and wages evolves over time. If the world were characterised by downward nominal rigidities we would expect to find that the skewness of price changes increases, with more zero changes, as the inflation rate falls. Charts 3 and 4 suggest that this does not happen: as inflation falls, so the proportion of the index that is falling goes up. The evidence from more formal regression studies is also

(1) Broadly similar estimates were produced for the United Kingdom by Cunningham (1996).
(2) Crawford and Harrison (1998) found that between 9%–20% of employees experienced nominal wage cuts in Canada between 1995 and 1996.

Chart 3
US CPI and the proportion of price cuts in the index, 1988–99

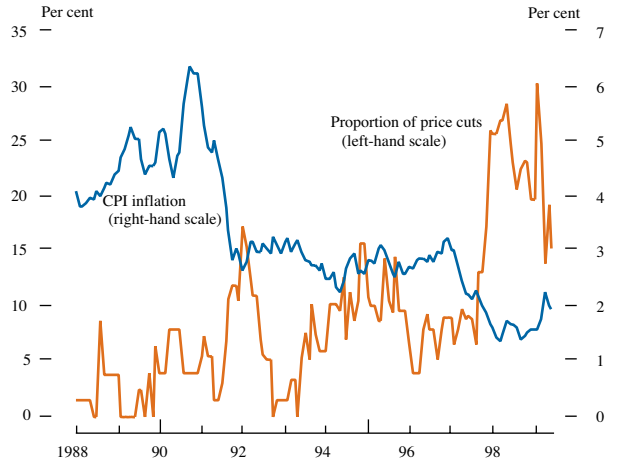
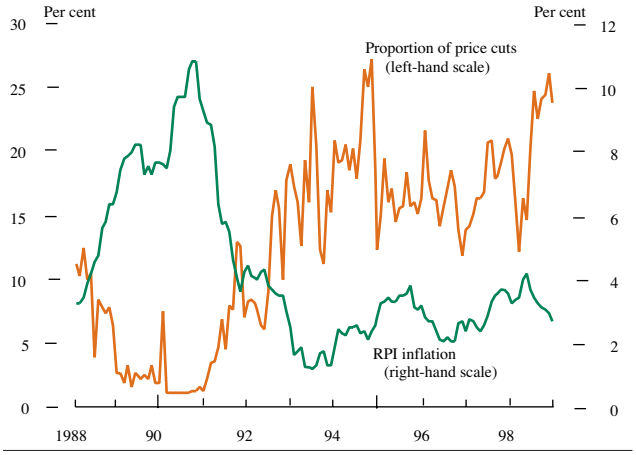


Chart 4
UK RPI and the proportion of price cuts in the index, 1988–99



broadly unsupportive of the downward nominal rigidity theory (see Yates (1998)).

Finally, the most casual, but at the same time the most striking, piece of evidence relates to recent experience. Akerlof *et al* argued that, at inflation rates below 3%, the existence of a permanent trade-off meant that unemployment would rise. In fact, since their paper was presented to a Brookings Panel in March 1996 there have been only four months when the recorded annual inflation rate in the United States was above 3%, yet during that period unemployment has continued to fall. No doubt there are many reasons why this might have happened, but at least one of them is that any downward nominal rigidity is too small for the Fed to worry about. A new Akerlof *et al* study is in the pipeline, to be presented in the autumn. Until that is available, I remain unconvinced that nominal rigidities mean we should abandon the pursuit of price stability.

2(i) b Zero bound on nominal interest rates

A second argument for targeting moderate inflation rather than price stability is that nominal interest rates cannot fall below zero. Given the existence of this lower bound, the ability to reduce interest rates in response to large and persistent negative demand shocks is likely to be constrained if the average level of interest rates, and hence inflation, is low. This is no theoretical curiosum. In Japan, official interest rates have now been below 1% since September 1995 and have been virtually zero since February 1999. And in Europe, where the average inflation rate is at present close to 1% a year, interest rates have been reduced to 2.5%, a level not seen even in Germany for over 20 years. The experience of Japan, in particular, poses a serious challenge to central bankers and economists alike in how to think about monetary policy in a world of low inflation.

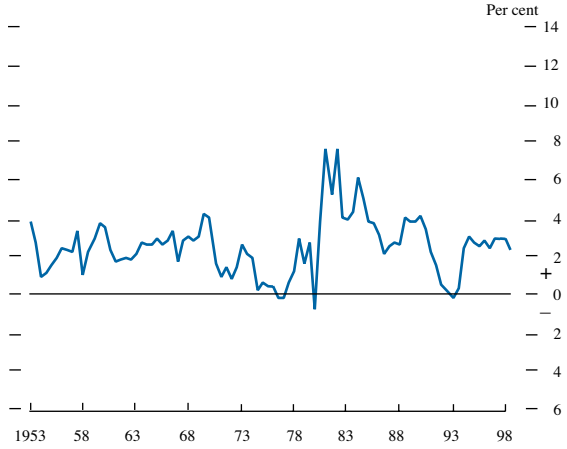
The proposition that the inability to reduce interest rates below zero might create problems for monetary policy was emphasised by Keynes (1936) in the 1930s, later by Vickrey (1955), and, more recently, by Phelps (1972), Summers (1991) and Fischer (1996). For most of the post-war period, those problems seemed to belong to the past. But the return to price stability raises the question of whether such concerns may be more pressing in future. The significance of the zero lower limit on nominal short-term interest rates hinges on whether monetary policy becomes impotent at the point when the constraint begins to bind. In other words, can a 'liquidity trap' render monetary policy ineffective? I return to this question in Section 3.

The welfare analysis of the optimal inflation target depends on both (i) the probability that nominal interest rates will be constrained at zero, and (ii) the cost of that constraint should it bind. In the rest of this section I focus on (i), because if the constraint is unlikely to bind then (ii) is redundant. The cost of the constraint depends critically upon whether monetary policy is impotent at that point and is discussed in Section 3.

There are few historical episodes that throw light on the question. In the 1930s, nominal short-term interest rates were close to zero in a number of countries, including the United States, for a decade or more; and the same was true of Switzerland in the 1970s. History can, however, shed light on the frequency of negative real interest rates in past cycles. Is it common for real rates to be negative? That is of interest because the lower limit on nominal interest rates implies a bound on real interest rates equal to minus the expected rate of inflation. The lower the expected rate of inflation, the higher the lower bound on real interest rates. In the limit, if prices are expected to be stable, then real interest rates too cannot become negative.

So how likely is it that negative real interest rates will be needed? Summers (1991) suggested that 'the real interest rate [in the United States] has been negative in about a third of the years since World War II'. He did not specify the details of exactly which real interest rate had been negative. Defining the real rate as the one-year Treasury constant maturity rate less the actual CPI inflation rate, the *ex post* rate was negative for about 20% of the period since 1950. But the relevant concept is the *ex ante* expected short-term

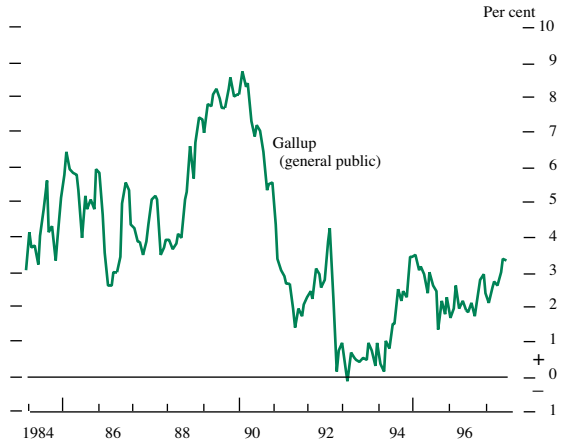
Chart 5
***Ex ante* one-year real interest rate,[a] United States 1953–98**



(a) Based on Livingston survey. See Appendix 1 for definition.

real interest rate. That rate cannot be observed directly. Estimates using survey-based measures of inflation expectations produce much lower frequencies of negative real rates than for *ex post* rates. Chart 5 shows the *ex ante* real rate of interest in the United States from 1953 to 1998 H2 defined as the one-year Treasury constant maturity rate less the expected inflation rate from the Livingston survey. There are only three brief episodes of negative real rates. These are 1976 H2–1977 H1, 1980 H1 and 1993 H1. So *ex ante* real interest rates have been negative only rarely in the post-war period. A similar finding holds for the United Kingdom (see Chart 6).[1]

Chart 6
***Ex ante* one-year real interest rate,[a] United Kingdom 1984–97**



(a) Based on Gallup survey. See Appendix 1 for definition.

Data on the past behaviour of real interest rates, even *ex ante* rates, are not conclusive. Low inflation, and the associated change of monetary policy regime, is likely to have altered the cyclical profile of interest rates. So theoretical models of monetary policy may throw further light on the potential importance of the lower limit on nominal interest rates. There has in the past two or three years been an explosion of interesting and imaginative technical research on exactly this question.[2]

It is helpful to start, however, by considering a back of the envelope calculation, based on the assumption that the central bank follows a 'Taylor rule' under which interest rates are raised or lowered according to whether output is above or below trend and inflation is above or below its target level. That rule may be represented by the following equation for nominal short-term interest rates:

$$i_t = i^* + \lambda_1 (y_t - y^*) + \lambda_2 (\pi_t - \pi^*) \qquad \textbf{(1)}$$

where i is the short-term nominal interest rate, i^* is the 'neutral' nominal interest rate, y and y^* are the logarithms of the levels of actual and trend output respectively, π is the inflation rate and π^* the target inflation rate. The two parameters λ_1 and λ_2 represent how active monetary policy is in responding to deviations of output from trend and inflation from its target level.

Negative demand shocks mean that output can temporarily be below trend and inflation fall below its target. Suppose that the inflation target was 2% a year, and the 'neutral' real interest rate was 3% a year. Then the 'neutral' nominal interest rate would be 5% a year. Imagine a large negative demand shock which led output to fall some 4% below its trend level, and inflation to fall from its target level of 2% a year to zero. Suppose that before the shock output and inflation were at their desired levels and interest rates were at their neutral level. The impact of the shock would require a reduction in interest rates. But by how much? That would depend on the coefficients in the Taylor rule. Typical estimated values for the coefficients λ_1 and λ_2 on output and inflation, respectively, are 0.5 and 1.5. The latter coefficient must exceed unity in order that the policy response to an inflationary shock is a rise in real interest rates. In our example, interest rates would fall by 2 percentage points because of the shortfall of output from trend, and by 3 percentage points because of the shortfall of inflation below its target. Hence interest rates would fall from 5% to zero if policy followed the simple rule.

What does this tell us about the likelihood that interest rates would hit zero? Only shocks which had a large impact on either output or inflation would create a problem. Such shocks are not inconceivable, but are unusual. The example suggests that policy would most likely be constrained when demand shocks were persistent, so that a negative shock to output and inflation occurred when output and inflation were already below their normal levels. Suppose that output was 2% below trend and inflation 1% below target when a negative demand shock occurred. Then interest rates would already be 2.5 percentage points below their normal level, and a shock of only 2% to output and another 1% to

(1) Details of the construction of the *ex ante* real interest rate are given in Appendix 1. Chart 6 uses data from Gallup. *Ex ante* real interest rates for the United Kingdom were also calculated using the Basix survey. According to measures of inflation expectations from this survey, UK *ex ante* real rates have not been negative since 1986, when the survey began.
(2) Among this work are papers by Fuhrer and Madigan (1997), Krugman (1998), Orphanides and Wieland (1998), Rotemberg and Woodford (1997), Wolman (1998), and a recent conference volume edited by Taylor (1999). The literature is surveyed by Johnson *et al* (1999).

inflation would be sufficient to reduce interest rates to zero. That suggests that in practice the constraint is likely to bind primarily when either shocks are persistent or policy-makers have failed to react quickly to demand shocks in the first place, and find themselves with slow growth and inflation below target when another negative shock occurs. A pre-emptive policy that is symmetric around the inflation target will help to make less likely the need for extremely low interest rates.

The idea that monetary policy does or should follow a Taylor rule has been extremely influential. Like most good ideas, its virtue is simplicity. It is not a mechanical rule to guide policy, but a vehicle to clarify issues. The calculation above is extremely simple. To analyse the frequency of interest rates being close to zero requires a more careful analysis of the shocks hitting the economy. The more recent technical literature (see footnote 2 on page 401) has tried to do exactly that.

More sophisticated policy rules have been developed. These imply that it may be better to act more 'aggressively' in response to shocks to inflation or output than in the above example of the Taylor rule. Changing interest rates quickly and sharply in response to news reduces the volatility of inflation and output. This is the case for pre-emptive monetary policy action in which interest rates should move in anticipation of likely prospects for inflation.

At first sight, one might think that interest rates would hit the zero bound more often with a pre-emptive strategy than with less aggressive policies. There is, indeed, some truth in this proposition. But matters are more complicated. And it is instructive to see why. Look at the simple Taylor rule described by equation **(1)**. It is tempting to think that the larger are the coefficients, λ_1 and λ_2, which describe the response of interest rates to output and inflation respectively, the greater will be the movement in interest rates over the cycle. But equation **(1)** alone does not determine the path of interest rates over time. That depends on how inflation and output themselves respond to earlier movements in interest rates. In technical jargon, inflation and output are endogenous variables, and equation **(1)** is a policy reaction function, not a reduced form describing the time path followed by interest rates. If a more aggressive policy response reduced the volatility of output and inflation, then interest rates might actually be less volatile over the cycle as a whole than under a less aggressive strategy. Hence pre-emptive monetary policy does not necessarily mean that interest rates are volatile over the cycle.

The benefits of a pre-emptive policy depend upon the transmission mechanism. That lesson comes from exploring modifications of the simple Taylor rule. One such, which I shall call the extended Taylor rule, takes the form:

$$i_t = i^* + \lambda_1 (y_t - y^*) + \lambda_2 (\pi_t - \pi^*) + \lambda_3 i_{t-1} \qquad \textbf{(2)}$$

where not only are the coefficients λ_1 and λ_2 typically larger than in the simple Taylor rule, reflecting a bigger response to current deviations of output from trend and inflation from its target, but interest rates also depend on their previous level.

The table shows the probability that interest rates might hit the zero bound implied by four different models of the transmission mechanism published recently in the conference volume entitled 'Monetary Policy Rules' edited by John Taylor (1999). Each model simulated the behaviour of interest rates for two different policy reaction functions. The first was a simple Taylor rule with coefficients $\lambda_1 = 0.5$ and $\lambda_2 = 1.5$, as in equation **(1)**. The second was the extended Taylor rule, as in equation **(2)**, with coefficients $\lambda_1 = 0.8$, $\lambda_2 = 3.0$ and $\lambda_3 = 1.0$. For two of the models, the simple rule is sufficient to reduce to negligible proportions the risk of zero interest rates. But the extended rule significantly increases the risk that interest rates might hit the zero bound. Indeed, for those two models the risk of zero interest rates is between one quarter and one third under the extended rule. These models are traditional macroeconomic models where private sector behaviour is more backward-looking than forward-looking.

Probability of zero interest rates in different economic models

Per cent

Model	Simple Taylor Rule	Aggressive Taylor Rule
Batini-Haldane	1	31
Levin-Wieland-Williams	2	24
McCallum-Nelson	11	16
Rotemberg-Woodford	12	2

Note: The probabilities are calculated on the assumption that the exogenous shocks are normally distributed using the reported standard deviation of interest rates under the two policy rules, and that the average nominal interest rate is 5.0%.

In the other two models, private sector expectations play a key role. This forward-looking element to behaviour changes the conclusions quite dramatically. The simple rule generates a higher, though not large, probability that interest rates might need to fall to zero. But the extended rule does not, in one case, lead to a significant rise in that probability, and, in the other, actually leads to a very substantial fall in the risk of zero interest rates. The reason is that in those models aggregate demand is sensitive to long-term interest rates. With the extended Taylor rule, a rise in interest rates is expected to persist. This will increase the leverage of monetary policy. Hence a small rise in interest rates today may induce quite large changes in private sector demand, followed by equally rapid responses of output and inflation. In turn that makes it less likely that nominal interest rates will have to fall towards zero.

So the relationship between the simple and the extended forms of the Taylor rule is sensitive to assumptions about the nature of the transmission mechanism of monetary policy. These models are not yet sufficiently robust for strong conclusions about policy to be drawn. But they do have one interesting implication for the interpretation of central bank behaviour. Much of the academic literature tends to describe extended Taylor rules which contain a

lagged interest rate as interest rate smoothing: interest rates have a tendency to stay at their current level. Such smoothing is often described as evidence of an inherent central bank degree of caution, or 'gradualism'. This is often contrasted with more 'activist' policies. Yet, as we have seen, the presence of lagged interest rates in a policy reaction function could, depending on the transmission mechanism, be evidence of an aggressive or pre-emptive policy stance. Moreover, the lagged interest rate in **(2)** could also be an appropriate response to the fact that future inflation depends on lagged values of output and inflation. A central bank that followed the extended Taylor rule, could be described as either 'activist' or 'gradualist'. Hence such words should be used with enormous care. Their meaning is not at all obvious outside a well-defined economic model.

The insight that a prompt response to shocks may prevent the need for larger subsequent movements ('a stitch in time saves nine'), and hence a less volatile path for interest rates is general. The lessons of recent research provide many insights into the way monetary policy should be set. But they do not provide an accurate quantitative guide to the risk that interest rates may need to fall to zero. In part, this reflects our incomplete understanding of the way the economy behaves. But it also reflects the fact that the probability of zero interest rates depends on the likelihood of extreme shocks. That is very hard to assess from historical experience when the frequency of such shocks is small. Econometricians require a large number of observations before their conclusions can be firm. So, as ever, central banks will need to keep an open mind. They must be prepared not only to act quickly but to think quickly.

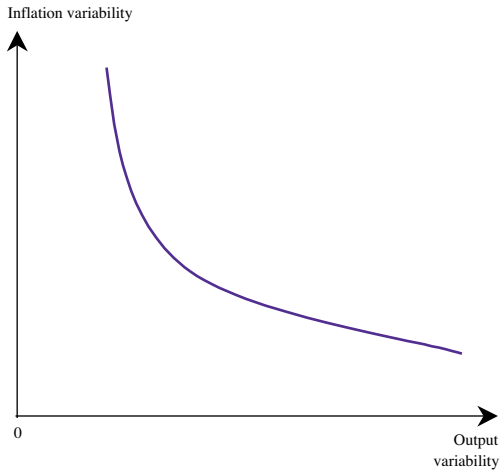
All in all, the observations that there may be downward nominal rigidities in wages and prices and that there is a zero lower limit on nominal interest rates, do not appear to justify a policy of deliberately targeting a higher rate of inflation than is currently pursued by most central banks. Summers (1991) concluded that 'the optimal inflation rate is surely positive, perhaps as high as 2 or 3%'. In his latest book, Krugman (1999) argued that the United States and Europe should 'make sure that inflation does not get too low when times are good: to set a target rate of at least 2%, so that real interest rates can be reduced to minus 2 rather than merely to zero if the situation demands' (*op cit* pages 161–62). Although the evidence for such propositions does not seem to me conclusive, the practical difference between the inflation targets recommended by Summers and Krugman and the inflation targets pursued by central banks is in practice small. The inflation target agreed by the Reserve Bank of New Zealand and its government is a range of 0% to 3%; the Bank of England has been given an inflation target of 2.5% a year; and the European Central Bank has a quantitative target for inflation of 'a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%'. Academic economists and central bankers—and an increasing number are both—are perhaps closer to each other than their rhetoric sometimes suggests.

2(ii) Stabilising output and employment

What can and should central banks do to stabilise output and employment? There are two overriding constraints on the ability of central banks to target real variables. First, in the long run, when the lags in the monetary policy transmission mechanism have worked themselves out, monetary policy affects the price level, not output or employment. Second, in the short run, before policy has fully worked through, the effect of monetary policy on real variables is extremely uncertain because the transmission mechanism is neither sufficiently well understood nor sufficiently stable over time for policy easily to target real variables. Nevertheless, monetary policy does have real effects in the short run. As Benjamin Friedman (1998 page viii) has pointed out, 'the tension created by the joint effect of central bank actions on inflation and on aggregate output, or employment, is usually of the essence whenever public policy discussion turns to monetary policy'.

Faced with shocks that tend to shift output and inflation in opposite directions, central banks have a choice. They can try either to bring inflation back to its target level as soon as possible, which might exacerbate the initial impact of the shock on output, or they can accommodate the change in inflation, bringing inflation back to the target more slowly and so reducing the impact on output. Although there is no stable trade-off between inflation and output, there is a trade-off between the variability of inflation and the variability of output. Such a trade-off is known as a—yes, you've guessed it—Taylor curve (Taylor (1979)). Chart 7 shows the Taylor curve. The position of the curve is determined by the structure of the economy (in particular by the variances of the shocks hitting the economy) and the behaviour of monetary policy. The Taylor curve plots the locus of combinations of inflation and output variability that can be attained by appropriate monetary policies. It is traced out by changing the relative weights on inflation and output variability in the central bank's 'loss function', or, in other words, by changing the implicit horizon for the inflation target. Moving down the curve from left to right is equivalent to choosing a shorter horizon over which to bring

Chart 7
The Taylor curve



inflation back to target, thus lowering the variability of inflation and increasing the variability of output.

So a central bank has 'constrained discretion' about the horizon over which to bring inflation back to target; that is, a choice about how to trade off variability of output against variability of inflation. This choice has no implications for the average level of either output or inflation, but reflects a choice about whether inflation or output should bear the strain of the initial impact of any shock. And it is at the heart of public debate over monetary policy.

Is it possible in practice to exploit the trade-off described by the Taylor curve? The curve is a useful expositional device to explain the choices facing central banks. But its empirical value is limited for two reasons.

First, the curve is a 'volatility possibility frontier' which can be identified from actual data only if the central bank is pursuing the best of all possible monetary policies. That cannot be independently verified. Second, the curve is likely to shift over time as the variances of the shocks hitting the economy themselves move around. Empirical estimates of Taylor curves are highly model specific, and can be estimated in practice only by the use of model simulation. Research by Bean (1998) and Batini (1999) suggests that the Taylor curve appears to bend sharply around the point where the standard deviation of fluctuations in GDP relative to trend is equal to the standard of deviation of inflation. Hence policy-makers with different preferences might well generate very similar outcomes for inflation and output variability. This, however, is conjecture. The Taylor curve is a useful conceptual tool, but is difficult to use empirically.

There are further reasons for supposing that monetary policy should focus on keeping inflation close to its target and not on fine-tuning output. The particular difficulty with implementing policy rules of the Taylor kind is that, as formulated, they presume a knowledge of output relative to its trend level. Estimates of the output gap, or the difference between unemployment and the current NAIRU, not only vary greatly from one method to another, but are often of opposite signs. Ignorance not only of the transmission mechanism of monetary policy but also of underlying productive potential, means that basing monetary policy on short-term movements in output can be hazardous. In a recent study of US monetary policy in the post-war period, Orphanides (1999) found that simple policy rules behaved extremely well when interest rates were set with the benefit of hindsight—using retrospective knowledge about movements in output that identified the trend path for productivity. But when they were based on information available to policy-makers at the time, they performed much less well. Orphanides concluded that there were risks in responding too aggressively to estimates of deviations of output from trend, and that 'the stabilisation promise suggested by these activist policy rules is indeed illusory'.

Changing interest rates in response to movements in inflation appears to be a relatively robust policy rule. Moving interest rates in response to changes in output, however, is much more sensitive to a knowledge of both the structure of the economy and, in particular, the forces determining the long-run growth of productive potential. To illustrate this, Christiano and Gust (1999) found that in a rather different model of the transmission mechanism than the conventional sticky price model used by many, the only robust policy rule was one which targeted inflation.

So although there are, in principle, reasons for using constrained discretion to respond to shocks, central banks would do well to have modest ambitions about the scope for output stabilisation. A keen appreciation of how limited is our present knowledge of the economy should be central to the policy-making process. It is precisely that lack of knowledge which makes mechanical policy rules incredible. The use of constrained discretion is sensible. But, as Orphanides pointed out, such a strategy 'requires continued vigilance against mechanical attempts to exploit historical relationships to fine-tune the performance of the economy'. Beware of (non-Greek) econometricians bearing false relationships. Perhaps one of the strongest arguments for delegating decisions on interest rates to an independent central bank is that, whereas democratically elected politicians do not often receive praise when they say 'I don't know', those words should be ever present on the tongues of central bankers. And, in a state of ignorance, it is important for the central bank to be transparent about both what it thinks it understands and what it knows it does not understand. In so doing, it may reduce the scale of wasted resources devoted to discovering the secrets of central bank thinking, and reduce the numbers of players in financial markets who fear that others have inside information.

2(iii) Targeting prices or inflation

The third challenge to the objectives of central banks is whether monetary policy should be directed to meeting a target inflation rate or a target price level. The case for price stability suggests that it is the stability of the long-run price level which creates confidence in the monetary standard and enables nominal contracts to play an important role in the economy. The long-term lender knows what her return will be in real terms, and equally the long-term borrower knows what he will pay. Yet the arguments presented in section 2(i) imply that a positive average measured inflation rate, might be desirable. Can price stability be reconciled with low inflation? The choice between price-level targeting and inflation targeting has attracted some interest recently.(1) The proponents of price-level targeting point out that under inflation targeting the variance of the price level increases without limit as deviations of inflation from the target level are treated as bygones. This is analogous to base level drift with monetary targeting. Proponents of inflation targeting point out that to return prices to their previous level might imply significant volatility of output.

(1) See Hall (1984), Bank of Canada (1994), Svensson (1999), McCallum (1990), McCulloch (1991), and Dittmar, Gavin and Kydland (1999).

I find this contrast somewhat artificial. The reason is that the dichotomy between the two approaches is analysed in models in which the target variable, whether inflation or the price level, is returned to its desired level in the following period. Earlier, I suggested that it was useful to think in terms of the horizon over which inflation was brought back to its target level in the context of an inflation target strategy. Equally, one can think in terms of the horizon over which policy-makers wish to bring the price level back to some desired pre-determined path.

To make this clearer, consider the current framework for UK monetary policy. The Bank of England's Monetary Policy Committee (MPC) has been given an inflation target of 2.5% a year by the Government. Members of the Committee will be held accountable for their actions in achieving that target. Imagine that the parliamentary committee to which the MPC is accountable holds hearings in 2007 to discover whether the new arrangements had been successful in meeting the inflation target. They might well ask what the average inflation rate was over the first ten years of the Committee's existence. Most commentators would regard that as a framework for inflation targeting. But asking whether the Committee had achieved an average inflation rate over that period would in fact be equivalent to price level targeting, in the sense that the Committee would be asking whether the price level after ten years was close to its desired pre-determined path implied by the objective that prices should rise by 2.5% a year. Hence an average inflation rate target is equivalent in many ways to price-level targeting. Although that is not the objective of the MPC—which is to aim continuously to meet the 2.5% target irrespective of past inflation outturns—it is worth exploring the implications of an average inflation rate target.

Just as the pursuit of an inflation target requires a judgment about the horizon over which inflation should be brought back to its target level following a shock, there is a second question that arises in the context of price-level or average inflation rate targeting. That concerns the horizon over which the price level should be brought back to its desired pre-determined path. Suppose that the average inflation target is π^*. That defines the desired price level path over time, P^*_t, which rises at the rate π^*. Policy might respond not only to deviations of output from trend and inflation from the target level, but also to deviations of the price level from its desired path. A key policy choice is the horizon over which the price level is brought back to that path. To avoid sharp changes in the current operational inflation target this horizon (denoted by H) could be a decade or more. The operational inflation target each period would be equal to the constant π^*, adjusted for the fact that prices had deviated from their desired path. The current operational inflation target is then given by:

$$\pi_t^{**} = \pi^* - \frac{1}{H}\left(\frac{P_t - P^*_t}{P^*_t}\right) \qquad \textbf{(3)}$$

Substituting this expression into equation **(1)** for the Taylor rule gives the average inflation rate targeting rule as:

$$i_t = i^* + \lambda_1\left(y_t - y^*\right) + \lambda_2\left(\pi_t - \pi^*\right) + \lambda_3\left(\frac{P_t - P^*_t}{P^*_t}\right) \qquad \textbf{(4)}$$

where $\lambda_3 = \lambda_2/H$.

Equation **(4)** shows that the difference between inflation and price-level targeting is a matter of degree and not a qualitatively different choice. At one extreme, where the horizon H increases without limit, then 'pure' inflation targeting means that policy follows a simple Taylor rule and the variance of the future price level increases without limit. At the other extreme, where the horizon $H = 0$, policy brings the price level back to its pre-determined path as quickly as possible. That implies greater volatility of output. Both in theory and in practice, policy-makers are likely to choose an intermediate horizon. To reduce short-run volatility in output and employment, central banks will bring inflation back to target gradually. But if central banks target an average inflation rate, then policy will aim also to return the price level to its pre-determined path. In this way, a policy rule such as **(4)** combines the advantages of the nineteenth century achievement of maintaining stability and predictability of the price level in the long run, with the twentieth century achievement of reducing short-run fluctuations in inflation and output. That would be an appropriate policy rule to take into the twenty-first century.

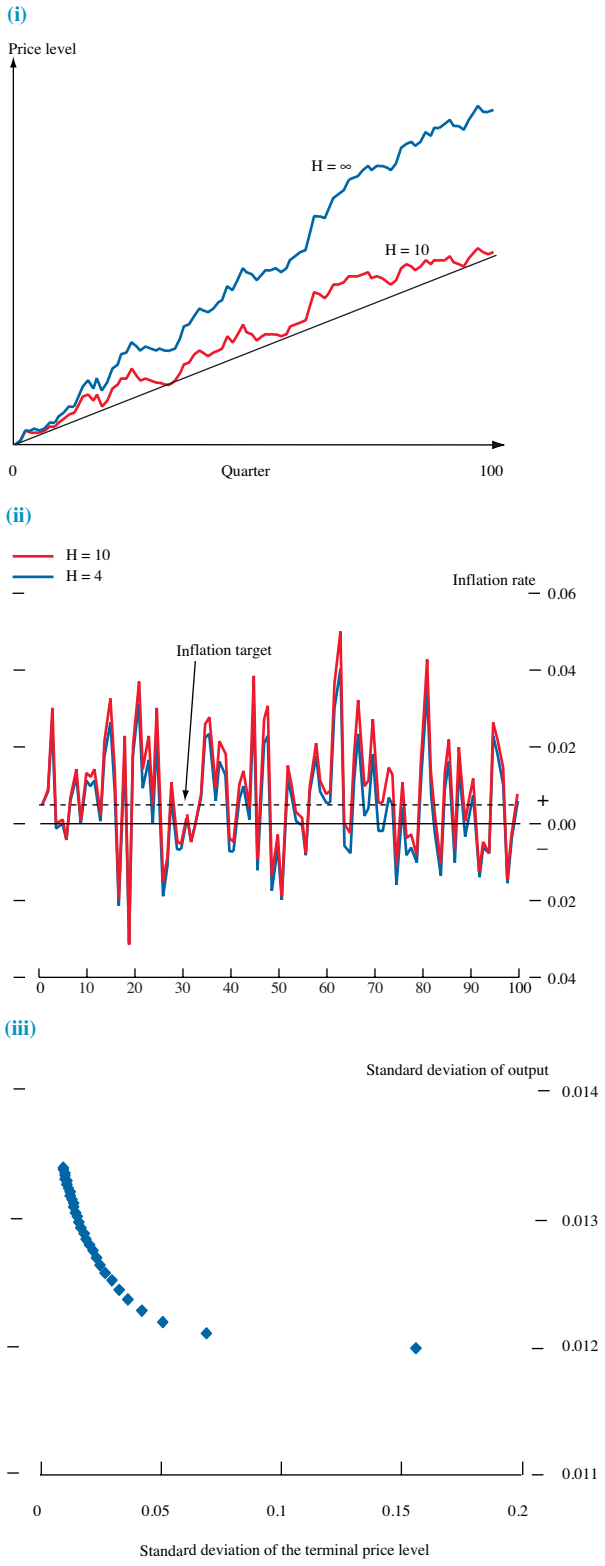
In practice, the operational inflation target could be adjusted either at discrete intervals, such as five years, or when the deviation of the price level from its desired deterministic path exceeded some critical level, rather than continuously, so that the target could be expressed as a round(ish) number.

A concern with the predictability of the long-run price level does not necessarily imply greater volatility of output and inflation in the short run. Dittmar, Gavin and Kydland (1999) and Svensson (1999) have shown that if there is persistence in shocks to output (that is, persistence in the short-run Phillips curve), then price-level targeting may actually imply lower volatility of output and inflation. Again, the optimal policy rule is sensitive to the behaviour of the economy, about which there is great uncertainty (see also Batini and Yates (1999)).

Simulations of macroeconomic models which incorporate policy rules such as **(4)** show that significant reductions in the variance of the future price level can be achieved at small cost in terms of increases in the volatility of output. This should not be surprising. The commitment to predictability of the long-run price level does not mean sharp changes in the inflation target from year to year. Small changes, even at discrete intervals, are sufficient to maintain predictability of the long-run price level without much change in either the average inflation rate targeted over a decade or so, or the response of output to changes in interest rates. Simulations suggest that there may be a rather small sacrifice in terms of output volatility for significant reductions in future price level volatility. Chart 8 shows simulation results from a three-equation macroeconomic

model calibrated to quarterly data for the United Kingdom. They illustrate the qualitative properties of mixed inflation-price level targeting. The three equations describe aggregate demand as a function of the real interest rate, aggregate supply as a function of price 'surprises' and a stochastic supply shock, and interest rates by the policy reaction function **(4)**. The first two panels of Chart 8 show the paths for the price level and inflation, respectively, for a particular sequence of shocks over 100 quarters. Two lines are plotted, in addition to a line corresponding to the long-run inflation target of 2% a year, one corresponding to pure inflation targeting (H = ∞) and the other to mixed inflation-price level targeting (H = 10). The long-run price level is much more predictable with the mixed strategy than with pure inflation targeting and there is rather little difference in terms of the inflation profile. The trade-off between variability of the price level and the variability of output around its trend is shown in the third panel. In terms of standard deviations, this shows that significant reductions in price level uncertainty can be achieved at relatively low cost in terms of output variability, but that beyond a certain point further reductions are costly or difficult to attain.

Chart 8
Comparison of inflation and price level targeting



3 Monetary policy in a low inflation world: transmission mechanism

In Section 2, several questions arose to which the answers depended crucially on the transmission mechanism of monetary policy. Do central banks have the power to stabilise output in the short run, and is this objective jeopardised by the pursuit of long-run price stability? Differences of view certainly exist, but there is broad agreement on the conceptual framework within which these questions should be answered. Before joining the FOMC, William Poole (1998) wrote that,

> 'macroeconomists share a common core model, and most are well aware of the uncertainty over estimates of key parameters in the model. Some lean a bit one way, some another way. This fact makes a debate less exciting than in earlier days but is a sign of real progress in macroeconomics.'

That is, I think, a fair description of the way economists see themselves. But is the current state of economic knowledge similar to that of nineteenth century physics, when many theories appeared to be settled but were soon shown to be inadequate in important cases? Certainly, there is much that we do not understand. The recent experience of Japan has reopened the question of whether a 'liquidity trap' can exist and how best to respond to it. In the United States, and elsewhere, asset prices have risen to levels that make it difficult for even the most sober central banker to avoid speaking of 'asset price bubbles'. Although there are many aspects of the transmission mechanism about which central banks would like to know more, I focus in this section on the following question. Is monetary policy impotent when nominal interest rates are close to zero?

The issue of how monetary policy works when interest rates are at or close to zero has been contentious since the possibility of a 'liquidity trap' was suggested by Keynes (1936) formalised by Hicks (1937) and revived by Krugman (1998). But it is only the recent experience of Japan, where interest rates have been virtually zero since February 1999, that the subject has again acquired immediate policy relevance. There are two views:

(i) When interest rates are zero, households and firms have an infinitely elastic demand for money balances. An increase in the money supply is absorbed passively in higher balances, and there are no implications for broader measures of money or demand and output. Monetary policy is impotent; there is a liquidity trap.[1]

(ii) When interest rates are zero, households and firms become satiated with money balances, and any increase in the money supply leads to changes in household portfolios with consequent changes in relative yields on different financial and real assets, and direct and indirect effects on spending.

The policy implications of the two views are clearly very different, but which one is the more attractive theoretically and empirically? In part, this depends on the demand for money. The response of the short-term nominal interest rate (a price variable) and of the monetary base (a quantity variable) to central bank operations are opposite sides of the same coin (or is it note?). The preferences of households and firms for money balances can be described in terms of either their demand for quantities of money or their response to interest rates. What happens when the nominal interest rate goes to zero—effectively making money and short-term securities perfect substitutes? If the demand for money balances tended to infinity, as the interest rate tended to zero, then monetary policy would have no effect on real demand and output because any additional money created would simply be absorbed passively in money holdings. But if preferences for money balances exhibit satiation such that the demand is finite at a zero price, then the creation of money beyond that amount would be translated into demand for other assets and ultimately—via effects on relative yields—into nominal spending. So, in principle, empirical estimates of the demand for money should help us to resolve the issue. These two possible views of the money demand curve are shown in Chart 9. Of course, there is rather little evidence on the demand for money at zero interest rates.[2]

In principle, all relevant relative prices should enter the demand for money. With a myriad of financial assets, and unobservable shadow interest rates on different consumer durables, there are many candidates for the prices or interest rates to include in a model of money demand. Both in theory and in practice, it is sensible to try to limit these. But that choice leaves room for disagreement about whether the relevant rates have been included, and it is precisely that scope for disagreement which continues to divide Keynesians and monetarists. (These differences are explored in detail in the symposium on the Monetary Transmission Mechanism published in the *Journal of Economic Perspectives* in 1995.)

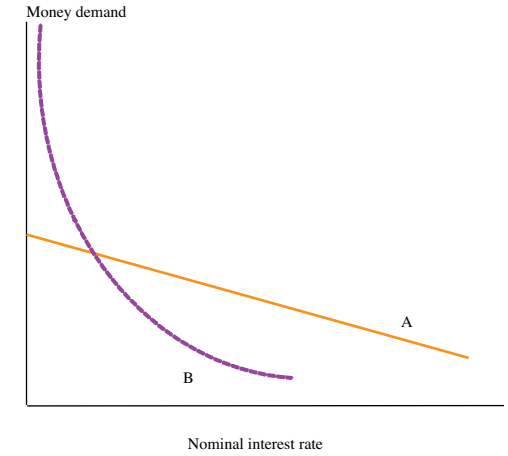
Keynes himself realised that other assets had to be included in the model for a satisfactory account of the demand for money. He focused on long-term government bonds. When short-term interest rates were extremely low, long-term bond yields would also be low, albeit above zero. But at such low rates the prices of long-term bonds would become extremely volatile with respect to small changes in the interest rate. For example, a consol with a yield of 5% would fall in price by almost 5% if the long-term interest rate were to rise by 25 basis points, whereas it would fall by 20% for the same absolute rise in interest rates if the yield were only 1%. Hence, as has been seen in Japan over the past two years, bond prices become extremely volatile at low interest rates. That might lead to a significant risk premium on long-term bonds which, in turn, would place a floor under the long-term interest rate. As Keynes argued,

> 'Circumstances can develop in which even a large increase in the quantity of money may exert a comparatively small influence on the rate of interest. For a large increase in the quantity of money may cause so much uncertainty about the future that liquidity-preferences due to the precautionary-motive may be strengthened; whilst opinion about the future of the rate of interest may be so unanimous that a small change in present rates may cause a mass movement into cash'. (Keynes (1936), page 172.)

At low interest rates, holding bonds was unattractive because they presented almost a one-way option—the interest rate could only go up. Stability in such circumstances required differences of opinion about the future direction of interest rates. Only then would control of the money supply be a potent weapon in the hands of central banks.

The alternative view is that monetary policy retains its potency even when short-term interest rates are zero. The demand for money depends upon the yields of a wide variety of assets. It is not infinitely elastic at extremely low

Chart 9
Demand for money



(1) The Keynesian response to a liquidity trap is either to expand fiscal policy or to find ways to tax cash balances. The former became the staple diet of policy-makers in the immediate post-war period, before the difficulties of stabilisation policy became apparent, and the latter is rarely suggested as a serious option (although it is discussed by Buiter and Panigirtzoglou (1999)).
(2) It is interesting that the Lucas (1994) logarithmic money demand function is equivalent to the Keynesian infinitely elastic demand for money at a zero interest rate.

interest rates, and so an increase in the money supply will lead to changes in portfolio behaviour, changes in relative asset prices across a spectrum of assets, and, in turn, an increase in nominal demand and output. Expansionary monetary policy can take the form of open market operations in which the central bank purchases a wide variety of assets, not just short-term government securities. In this way, changes in base money feed through to changes in broader measures of money. For there to be a liquidity trap, base money must be a perfect substitute for all other assets. In open economies, the exchange rate is one of the important relative prices that may respond to an increase in the monetary base. The essence of this 'monetarist' model of the transmission mechanism is the impact of a change in money supply on the quantities and yields of a wide range of financial and real assets (Meltzer (1995)). In that model, an increase in the monetary base would not lower the interest rate below the zero bound, but would affect the yields on other assets. Asset prices in general would rise, and would have an impact on spending. There would be no liquidity trap.

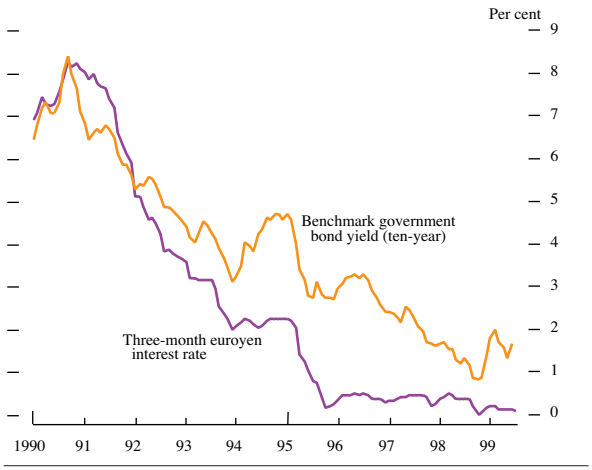
To support this view, Meltzer (1999) has argued that there are three episodes in US monetary history between 1914 and 1950 in which the monetary base was a better empirical indicator of the policy stance than measures of short-term interest rates. In two of those three episodes (1937–38 and 1948–49) short-term interest rates were close to zero. Meltzer finds a significant impact of money base growth on consumption, even after taking into account the effect of interest rates and lagged consumption growth. Nelson (1999b) has replicated these results for the United Kingdom, and finds sizable effects of real base money growth on growth in output, over and above effects via real interest rates. The orders of magnitude of the US and UK responses appear similar, although, if anything, the impact is larger in the United Kingdom than in the United States.

What is the mechanism by which increases in base money affect demand and output when short-term interest rates are zero? It is hard to believe that an increase in real money balances induces a sizable wealth effect—they are too small relative to other forms of wealth. Their impact must come, at least in part, from a change in the yields on other assets. In turn that is likely to reflect changes in risk premia. With short rates stuck at zero, the pure expectations theory of the term structure of interest rates and the uncovered interest parity arbitrage theory of exchange rates provide no way for monetary policy to affect other yields. Those theories ignore risk premia. A full explanation of the transmission mechanism of monetary policy at zero interest rates will require a general equilibrium theory of risk premia and how those risk premia are affected by monetary policy. Neither the Keynesian idea of a liquidity trap nor the monetarist rejection of such a concept are based on a rigorous and fully articulated theory of risk premia. How risk premia are determined is the key question for future research on the impact of monetary policy on asset prices. Perhaps such a theory will be the equivalent in economics of the special and general theories of relativity in physics.

So the question of whether monetary policy is impotent when short-term interest rates are zero remains, for the present, largely open. A rapid expansion of the monetary base in Japan might be an experiment from which we would learn much. But central banks are not in the business of engaging in experiments. In qualitative terms, it seems implausible that a sustained increase in money supply would simply lead to an addition to holdings of cash. But the quantitative impact on spending remains unclear.

The Japanese economy has been in recession for some time; interest rates have been low for several years, and virtually zero for much of 1999 (see Chart 10). Many commentators have urged the Bank of Japan to expand the monetary base. Since short-term government instruments have now become almost perfect substitutes for cash, open market operations should, so it is argued, concentrate on purchases of long-term government bonds, private sector financial assets and foreign currency. Such purchases would change relative

Chart 10
Interest rates in Japan, 1990–99



asset yields, including the exchange rate, and produce a rise in private sector demand. In contrast, the Bank of Japan has argued against such a strategy on three grounds (Okina (1999)). First, an increase in base money would be unlikely to produce corresponding increases in broader measures of money because banks do not wish to expand their assets by lending to the private sector. Second, it is unlikely that long-term interest rates could fall further because of a risk premium reflecting the price volatility of bonds when interest rates are low. Third, there may be political obstacles to a significant depreciation of the yen—namely, opposition from the United States and in Asia itself. Although there has, indeed, been substantial foreign exchange intervention by Japan over the past year, that has been directed to stabilising the yen-dollar exchange rate, and the intervention has been sterilised.

Support for the rejection of money base expansion as a way out comes from McKinnon and Ohno (1999). They pointed out that, in an open economy with no capital controls, long-term interest rates in Japan should reflect expectations of future currency appreciation. Bond yields could have

fallen to their present levels only if the market believed that the yen would continue to appreciate in future as it has over the past 20 years. They regard the expectation of further yen appreciation as given, which leads to an externally generated liquidity trap. Attempts to weaken the yen would, they argue, fail because investors believe that any depreciation would be only temporary. Quite why expectations of future yen appreciation cannot be influenced by monetary policy is unclear. The announcement of a medium-term commitment to an inflation target comparable with those elsewhere should eliminate expectations of perpetual yen appreciation.

In future, economists will surely learn much about monetary policy at low interest rates from the current experience of Japan. There is no doubt that monetary policy becomes more complicated when nominal interest rates are very low. There may be institutional or political objections to the consequences of a policy of base money expansion. Nevertheless, it is hard to believe that monetary policy is completely impotent.

4 The international monetary system

No central bank can be an island of stability. Interdependence among countries is a feature of modern economic life. For most countries their exchange rate is one of the most important relative prices in the economy, and some countries have gone further and either delegated monetary policy to another country—as with a currency board—or have determined to decide monetary policy collectively—as in a monetary union.

Over the past ten to fifteen years, since freely floating exchange rates and unrestricted capital movements characterised the world financial system, two 'stylised facts' have emerged. First, with floating exchange rates the volatility of real exchange rates has risen significantly compared with earlier regimes of various types of fixed exchange rate. Second, the size and volatility of international capital flows has often made fixed but adjustable exchange rate pegs hard to sustain.

This experience poses three questions for the design of the international monetary system. First, should currency arrangements take one of two extreme forms, either (a) a floating regime with a domestic nominal anchor (such as a money growth or inflation target), or (b) abandonment of a national currency through unilateral 'dollarisation' or multilateral monetary unions? Several countries, ranging from Britain to Brazil, have abandoned fixed exchange rate pegs and adopted floating regimes with domestic nominal targets. Other countries, such as Argentina and members of the euro area, have moved towards either rigid currency boards or a fully-fledged monetary union.

Second, if this is indeed the choice, how should a country decide between retaining its own currency with a domestic nominal target or allowing its monetary policy to be determined elsewhere?

Third, what should be the arrangements for the 'governance' of the international monetary system? Changes in the number of currencies, and the associated number of central banks, have already led to active discussion about the appropriate fora in which decisions on the international monetary system are discussed and made.

The proposition that the world is becoming polarised into countries with freely floating exchange rates and countries with rigidly fixed rate regimes is, on the face of it, plausible. It describes the failed experience of many countries who tried to pursue a middle path of fixed but adjustable rates. But recent experience may tell us more about the need for clarity in a country's monetary policy framework, and the resulting credibility which that generates, than an iron law of exchange rate regimes. For countries that have acquired credibility in their willingness to take whatever measures are necessary to maintain a fixed exchange rate, a fixed but adjustable peg may be a feasible regime. And there may be cases in which countries in transition from a state of hyperinflation to more conventional rates of inflation can benefit, at least for a time, from the clarity and simplicity of a commitment to an exchange rate objective. Nevertheless, it is likely that the number of countries choosing the two extremes will continue to increase.

As far as the choice between the two extremes is concerned, the issue hinges on the costs and benefits of an exchange rate agreement with other countries. This is not the place to rehearse the costs and benefits of a monetary union. In Europe, the greatest potential economic benefit is, in my view, the impact on growth of trade resulting from the greater exploitation of the larger market made possible by a single currency. Against that benefit must be set the economic cost of more pronounced business cycles which may result from interest rates which are inappropriate for the country concerned, even if they are in the interests of the monetary union as a whole. It will be interesting to see whether the example of the Economic and Monetary Union in Europe leads to an expansion of the number of regional monetary unions in other parts of the world.

The immediate implication of a monetary union is that a wide range of decisions which were previously taken within a country are now made collectively. That requires mechanisms for those joint decisions on matters such as exchange rates and fiscal policy. For example, the Euro 11 Group of finance ministers has an important role to play in the operation of monetary union. Its role is not to provide a political input into monetary policy. It is to provide a forum for member countries to reach agreement on those issues which are not the responsibility of the ECB. These include fiscal policy and any formal exchange rate arrangements between the euro and other currencies. They also need to develop a common view on a range of issues which will then be represented to other countries on the international stage.

Changes in currency arrangements will have implications for the international monetary system. Will fixed exchange

rates spring up within the three regions in which the dollar, the euro and the yen are the most important currencies? Or will currency boards emerge which link emerging market currencies to the dollar, irrespective of their regional affiliation? How will the three major currencies relate to each other? The answers will depend on politics at least as much as on economics.

There has been much talk, and even some action, about the architecture of the international financial system. Some of this relates to international monetary co-operation. The proliferation of meetings means that there are now many groups of a Gx form, where x is almost any integer between two and 182. Indeed, there is even a group called GX which has not yet determined the composition of its membership. The international monetary system is now very different from when the Bretton Woods institutions were set up. Free capital mobility has changed the playing field. The role of those institutions, and the way in which the member countries interact, is certain to continue to evolve. The G7 might become smaller (perhaps a G3); or it might become larger (including the leading emerging market countries); or it might even stay the same.

5 The future of central banks

Despite some ups and downs, central banks are ending this century well ahead of where they started it. There are more of them, and they have greater power and influence. But is this the peak? Will future historians look back on central banks as a phenomenon largely of the twentieth century?

Although central banks have matured, they have not yet reached old age. There remains much to be done. The case for price stability, and the role of central bank independence in achieving it, needs to be made to a wide audience. We must build a constituency for low inflation, without having to resort to episodes of high inflation to prove that instability is costly. To that end, communication has become more important—central banks have moved from mystery and mystique to transparency and openness. The language of central banking must evolve to reflect the need to maintain broader support for the objective of stability and the legitimacy of independent central banks in pursuing it.

Looking further ahead, the future of central banks is not entirely secure. Their numbers may decline over the next century. The enthusiasm of governments for national currencies has waned as capital flows have become liberalised and exchange rates more volatile. Following the example of the European Central Bank, more regional monetary unions could emerge. Short of this, the creation of currency boards, or even complete currency substitution, might also reduce the number of independent national monetary authorities.

But much more important is the potential impact of technological innovation. At present, central banks are the monopoly supplier of base money—cash and bank reserves. Because base money is the ultimate medium of exchange and of final settlement, central banks have enormous leverage over the value of transactions in the economy, even though the size of their balance sheet is very small in relation to those of the private sector. For years, economists have had difficulty in incorporating money into rigorous general equilibrium models. To the elegance of the Walrasian model of an exchange economy has been bolted on an assumption about the technology of making payments such as a 'cash in advance' constraint. These untidy ways of introducing money into economic models are not robust to changes in institutions and technology. Is it possible that advances in technology will mean that the arbitrary assumptions necessary to introduce money into rigorous theoretical models will become redundant, and that the world may come to resemble a pure exchange economy?

Electronic transactions in real time hold out that possibility. There is no reason, in principle, why final settlements could not be carried out by the private sector without the need for clearing through the central bank. The practical implementation of such a system would require much greater computing power than is at present available. But there is no conceptual obstacle to the idea that two individuals engaged in a transaction could settle by a transfer of wealth from one electronic account to another in real time. Pre-agreed algorithms would determine which financial assets were sold by the purchaser of the good or service according to the value of the transaction. And the supplier of that good or service would know that incoming funds would be allocated to the appropriate combination of assets as prescribed by another pre-agreed algorithm. Eligible assets would be any financial assets for which there were market-clearing prices in real time. The same system could match demands and supplies of financial assets, determine prices and make settlements.

Financial assets and real goods and services would be priced in terms of a unit of account. The choice of a unit of account (perhaps a commodity standard, which would produce broad stability in the price level) would be a matter for public choice and regulation, along the lines of existing weights and measures inspectors. Final settlement could be made without any recourse to the central bank. Only if the unit of account was managed would there be a role for a body such as a central bank. Whether the unit of account should be determined by a mechanical rule, as other weights and measures, or managed in a discretionary way depends on some deep issues about the nature of 'nominal rigidities' in such an economy. As Henckel *et al* (1999) have noted, the key to a central bank's ability to implement monetary policy is that it 'remains, by law or regulation, the only entity which is allowed to 'corner' the market for settlement balances'.

Without such a role in settlements, central banks, in their present form, would no longer exist; nor would money. Economies of this kind have been discussed by Black (1970), Fama (1980), Friedman (1999), Hall (1983) and Issing (1999). The need to limit excessive money creation

would be replaced by a concern to ensure the integrity of the computer systems used for settlement purposes. A regulatory body to monitor such systems would be required. Existing regulators, including central banks, would no doubt compete for that responsibility. Moreover, in just the same way as the Internet is unaware of national boundaries, settlement facilities would become international.

The key to any such developments is the ability of computers to communicate in real time to permit instantaneous verification of the creditworthiness of counterparties, thereby enabling private sector real time gross settlement to occur with finality. Any securities for which electronic markets exist could be used as part of the settlement process. There would be no unique role for base money, and hence the central bank monopoly of base money issue would have no value. Central banks would lose their ability to implement monetary policy. The successors to Bill Gates would have put the successors to Alan Greenspan out of business.

As a central banker interested in information technology, should I regard this prospect as a dream or a nightmare? Perhaps the answer is that central bankers should enjoy life today. I shall place my faith in the words of Walter Bagehot who, in *Lombard Street* (1873), wrote that:

> 'Nothing would persuade the English people to abolish the Bank of England; and if some calamity swept it away, generations must elapse before at all the same trust would be placed in any other equivalent.'

Central banks may be at the peak of their power. There may well be fewer central banks in the future, and their extinction cannot be ruled out. Societies have managed without central banks in the past. They may well do so again in the future. The web site of my favourite football team has the banner 'heroes and villains'. For some, central bankers are heroes—more powerful and responsible than political leaders—and for others they are villains—too fanatical to be entrusted with the world economy. For all our sakes, it is important that central bankers are seen neither as heroes nor villains. They should be modest technicians, striving to improve the way they use the tools of their trade, and always eager to learn. Openness of mind and fleetness of foot will be the best way to avoid extinction.

Appendix 1

The construction of survey based *ex ante* and *ex post* real interest rates for the United States and United Kingdom

1 Background to the surveys

1.1 Gallup (United Kingdom)

The survey started in January 1984 but was discontinued in September 1997. It was conducted on a monthly basis, in the first two weeks of the month. The survey covered 1,000 employees, drawn from a stratified sample of the population of Great Britain. Respondents were asked to forecast inflation in the following ranges: 0–1, 1–2, 3–4, 5–6, 7–8, 9–10, 11–12, 13–14, 15–20, and 20 plus. Gallup calculated an average by taking the mid-point of each range and weighting by the number of respondents within it. The mid-point of the 20 plus range was assumed to be 24%.

1.2 Basix (United Kingdom)

The survey is conducted by Barclays Bank on a quarterly basis in early March, early June, early September and early December. It began in December 1986. It looks at the inflation expectations of six separate groups of people: general public, business economists, academic economists, finance directors, trade unions and investment analysts. The question relates to twelve month ahead RPI inflation expectations, except for the general public group for which the inflation measure is not specified.

1.3 Livingston (United States)

The survey asks a range of 'professional' forecasters and academics to forecast US CPI inflation. The number of participants has been fairly steady over time averaging about 50 respondents in each survey. One set of questionnaires is sent out in May and must be returned in early June, and the other set of questionnaires is sent out in November and must be returned in early December.

The timing conventions of the Livingston Survey have been consistent throughout the period that the Federal Reserve Bank of Philadelphia has managed the survey (it took responsibility for the survey in 1990), and seem to be generally consistent with the above pattern before that time.

2 Nominal interest rates

2.1 UK nominal interest rate

The UK nominal rate is the twelve-month London interbank offer rate (Libor).

2.2 US nominal interest rate

The nominal interest rate is the one-year Treasury constant maturity rate. Yields on Treasury securities at 'constant maturity' are interpolated by the US Treasury from the daily yield curve. This curve, which relates the yield on a security to its time to maturity, is based on the closing market bid yields on actively traded Treasury securities in the over-the-counter market.

3 Constructing a survey based *ex ante* measure of the real rate

3.1 UK real rates

To calculate the survey based *ex ante* real rate, the average of the twelve-month Libor rate over the dates of the survey is calculated. The survey based inflation expectation corresponding to these dates is subtracted from this average nominal interest rate. The Gallup inflation expectations series tended to overpredict inflation outturns. If this were allowed for by subtracting the average error of 1.61 percentage points from the Gallup series, then there would be no examples of negative real rates in Chart 6.

3.2 US real rates

The majority of the Livingston sampling period lies in May and November, the real interest rate is calculated as the monthly average for the nominal interest rate in either May or November less the appropriate inflation expectation. The Livingston expectations series has tended to under predict inflation outturns. If this were allowed for by adding the average error of 0.65 percentage points to the Livingston series, then real interest rates would be negative in 10 half years out of 92, compared with four half years when no adjustment was made.

4 The *ex post* real rate

4.1 The UK ex post *real rates*

The nominal interest rate is again twelve-month Libor rate. The actual RPIX inflation outturn is subtracted from the appropriate month-average nominal interest rate.

4.2 The UK ex post *real rates*

As with the *ex ante* real rate, the nominal interest rate is the one-year Treasury constant maturity rate. The actual CPI inflation outturn is subtracted from the appropriate month-average nominal interest rate.

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Sterling's puzzling behaviour

In this speech,[1] Sushil B Wadhwani, member of the Bank's Monetary Policy Committee, considers alternative approaches to forecasting the exchange rate. Having reviewed the poor performance of the existing uncovered interest parity projection, he proposes an alternative method that can explain a significant part of sterling's appreciation since 1995.

Introduction

It is a great pleasure to speak at the LSE today. This is the institution that I came to as an undergraduate in 1977, and then stayed at for nearly 14 years, both as a student and as a member of the teaching staff. Those were happy, if intense, days. The LSE was an intellectually exciting place to be, and I learnt a great deal by just being around.

One of the things that we were puzzling about back then were aspects of currency movements (see, for example, Charles Goodhart's (1988) inaugural lecture; even I wrote a little paper then on excessive currency volatility—see Wadhwani (1987)), and it is perhaps in the challenging nature of the subject that we are still worrying about similar issues.

Today is the seventh anniversary of Black/Golden/White Wednesday, when the markets decided that a £/DM central rate of 2.95 was too high, and yet today we are wrestling with what many consider to be the opposite problem, ie that the current exchange rate of above DM3.00 is too high for the long-term health of the British economy. The MPC's exchange rate forecast is a critical component of the inflation forecast, which is a key input into the policy decision. Today, I shall discuss a variety of ways of coming up with an exchange rate forecast.

I shall begin in well-trodden territory, and compare our current (majority) convention of using the uncovered interest parity hypothesis ('UIP') for the modal (most likely) outcome with the naïve random walk hypothesis ('RW'), and also discuss whether it is appropriate to expect a higher interest rate currency to appreciate (rather than depreciate, as per UIP). Broadly speaking, the evidence appears to favour RW over UIP. Currently, UIP suggests that sterling might be expected to depreciate—but the evidence suggests that it might be unsafe to rely on the UIP-based forecast.

I then discuss valuation indicators such as purchasing power parity ('PPP') or the so-called fundamental equilibrium exchange rate ('FEER'), and propose an alternative model for the exchange rate, which encompasses these indicators as special cases. At present, measures based on either PPP or FEER suggest that sterling is significantly overvalued against the euro. However, our models imply that on the assumption that current economic conditions broadly persist, the markets might keep sterling at around DM3.00.

The evidence suggests that the markets might have re-rated sterling against the Deutsche Mark because, in recent years, the German unemployment rate has risen relative to that in the United Kingdom. It is important to emphasise that the market's current perception of the appropriate value of sterling (which is what we attempt to measure) might be very different from the 'true', underlying, long-term fair value. I have little doubt in my mind that the current level of sterling inflicts considerable pain on large sectors of the economy—therefore, I do not in any way seek to 'justify' the current level of sterling.

Many commentators have been puzzled by the extent of sterling's rise, from around DM2.20 in late 1995 to about DM3.00 today. This is especially because the actual change in relative UK-German interest rates can only explain a rather modest fraction of the rise (eg the Bank of England's 'monetary news' decomposition can explain a rise from about DM2.20 to about DM2.32). However, the model I present below can both explain a significant fraction of sterling's initial rise in 1996–97, and shed some light on why sterling is still high now. The model can be interpreted as a generalisation of the UIP condition and, importantly, it deviates from the UIP straitjacket which requires variables such as lagged unemployment and growth to affect exchange rates only through interest rates. The analysis presented here implies that a significant fall in the US stock market could have a significant downward impact on sterling's 'equilibrium value' against the Deutsche Mark, as would a large fall in German unemployment.

Obviously, modelling exchange rates is exceptionally difficult, and the estimates presented below are fragile and

(1) Abridged version of a lecture given at the London School of Economics on 16 September 1999. A more detailed paper entitled 'Currency puzzles', may be found on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech53.pdf. This lecture draws extensively on continuing joint work with Hasan Bakhshi of the Bank of England, to whom I am enormously indebted. Simon Cartwright and Peter Berry provided able research assistance. Spencer Dale, Paul Fisher and Chris Salmon gave me much helpful advice during the project. I am also extremely grateful to Bill Allen, Peter Andrews, Andy Brigden, Alec Chrystal, Rebecca Driver, Charles Goodhart, DeAnne Julius, Mervyn King, Gus O'Donnell, Ian Plenderleith, Meghan Quinn, Peter Rodgers, Clifford Smout, John Vickers and Peter Westaway for their comments and suggestions. Of course, this lecture only reflects my personal views, and does not in any way reflect a position held by the Monetary Policy Committee or the Bank of England.

uncertain. Also, more research is clearly needed. Nevertheless, I shall argue that when setting interest rates, the MPC should continue to examine alternatives to the current UIP convention (used by the majority), especially as some of the alternatives imply that sterling may remain stronger than the UIP convention assumes.

The importance of the exchange rate convention

The inflation forecast that the MPC produces is rather sensitive to the exchange rate convention for the modal forecast that it is prepared under. For example, during the last forecasting round, the collective projection used the UIP convention, whereby sterling was assumed to decline in line with market interest differentials, leading to a fall in the sterling ERI from around 103.1 (the 15-day average up to 4 August) to 96.6 by the end of the two-year forecast period. The corresponding assumption *vis-à-vis* the euro was that sterling would depreciate from around €0.66 (equivalent to about DM2.95) to €0.71 (equivalent to DM2.75). However, the *Inflation Report* also presented an alternative projection for inflation, based on the assumption that the exchange rate would remain constant. The difference in the outturn for our two year ahead RPIX inflation forecast was significant, with the constant exchange rate convention delivering a projection that was about 0.4 percentage points lower, which is large in relation to an inflation target of 2½%. Alternatively, recall that the MPC has previously reported model simulations (see MPC (1999)) that suggested that a temporary increase in the three-month interest rate of 1 percentage point might, under certain assumptions, be associated with a fall in inflation of between 0.2 and 0.4 percentage points after nine quarters. Hence, were one to use the inflation forecast and model mechanically (which the MPC does not), the implied difference for the appropriate level of the interest rate between the alternative exchange rate conventions would clearly be substantial. It therefore behoves one to examine the arguments for the two competing conventions, and, indeed, consider further alternatives, which I shall go on to do below.

The intuitive case for the uncovered interest parity convention

The intuitive appeal of the UIP convention is the same as the visceral appeal of the efficient markets hypothesis, ie that no arbitrage opportunities should remain in an efficient market. To see this, suppose that the one-year sterling interest rate is 6%, and the comparable euro interest rate is 4%. On the UIP hypothesis, this is only an equilibrium if investors also expect sterling to depreciate by 2%. If instead they did not expect sterling to depreciate at all, risk-neutral investors would borrow a very large amount in euros and lend it in sterling; this would cause sterling to appreciate against the euro, and cause upward pressure on euro interest rates and downward pressure on sterling interest rates. This process would continue until the interest differential (which would be lower) was equalised with the expected depreciation of sterling (which would presumably now exist, as sterling would have risen relative to its prior level).

It is easy to understand the intuitive appeal of the UIP hypothesis—so I turn next to some of the empirical evidence relating to this hypothesis.

UIP—the empirical evidence

About twelve years ago, in his inaugural lecture at the LSE, my colleague, Charles Goodhart, presented evidence based on a variety of datasets, suggesting that the econometric evidence was rather unsupportive of the UIP hypothesis (see Goodhart (1988)).

A standard test of the UIP hypothesis[1] is performed by regressing the actual change in the exchange rate on the prior interest rate differential, ie:

$$\Delta s_{t+k} = \alpha + \beta(i_t^* - i_t) + v_{t+k} \qquad \textbf{(1)}$$

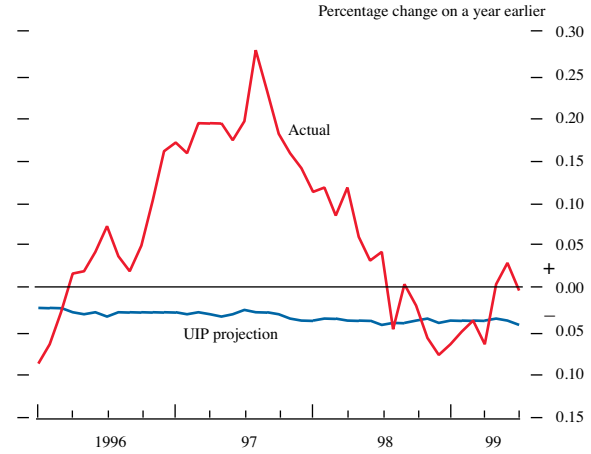
where Δs_{t+k} is the percentage appreciation of the currency over k periods, and $(i_t^* - i_t)$ is the current k-period foreign interest rate minus the corresponding k-period domestic interest rate. The null hypothesis of the weak form of UIP is that $\beta=1$, ie if the foreign interest rate is higher than the domestic interest rate, the currency appreciates in line with the differential (on average). Back in 1990, in surveying the literature which has estimated equations like **(1)**, Froot and Thaler (1990) wrote:

'A very large literature has … found that the coefficient β is reliably less than one. In fact, β is frequently estimated to be less than zero. The average coefficient across some 75 published estimates is -0.88 … . A few are positive, but not one is equal to or greater than the null hypothesis of $\beta=1$.'

More recently, the UIP hypothesis has continued to work poorly for UK policy-makers; Chart 1 reminds us that with UK interest rates above those in Germany, a UIP-based projection has, since 1996, always looked for sterling to depreciate against the Deutsche Mark. Yet, for much of this period, the actual 12-month change has been for sterling to appreciate, often very significantly (eg more than 25% in the 12 months to mid 1997).[2] Further, if one updates estimates of equation **(1)** (with k = 12 or 24 months) to include the period up to 1998, one continues to find results that conflict with the UIP hypothesis. Specifically, for the seven exchange rates considered in Wadhwani (1999b), all of the estimates of β were negative rather than being +1 and, in several cases, the difference was statistically significant.

(1) What we describe as the UIP hypothesis is sometimes referred to as the 'risk-neutral UIP hypothesis'. We consider the more general case, which allows for risk-averse investors, below.
(2) Of course, the monetary news associated with unanticipated increases in UK interest rates relative to those in Germany would, consistent with the UIP hypothesis, explain some of the appreciation. However, as discussed below, monetary news can only account for a small fraction of the actual rise in the exchange rate.

Chart 1
Actual and UIP-based forecast changes in £/DM, 1996–99(a)



(a) Twelve-month percentage changes.

Note that if, in line with some of the academic literature, β is set to zero, rather than being negative, one would then be left with the exchange rate being a random walk (recall that Charles Goodhart's inaugural lecture at the LSE was subtitled 'A random walk with a dragging anchor'), ie one would simply assume that the exchange rate would be constant.(1) In line with some of this earlier academic work, the results suggest that RW outperforms UIP. Specifically, Table A records the mean square error (MSE) of the forecasts associated with RW versus UIP. It is notable that for every one of the bilateral rates considered here, the rather naïve hypothesis that the exchange rate is constant does better than using the UIP convention—this does, indeed, appear to be an instance where a little bit of knowledge of textbook economics (ie UIP) appears worse than no knowledge!

Table A
Comparing the forecasting performance of UIP with the random walk hypothesis

Currency pair	MSE of forecast error		Sample period
	UIP ($\times 10^{-2}$)	RW ($\times 10^{-2}$)	
£-DM	1.18	1.16	1976:1–1999:7
£-$	1.69	1.53	1976:1–1999:7
£-¥	2.50	1.43	1978:9–1999:7
£-Ffr	1.01	0.87	1978:10–1999:7
$-DM	1.80	1.68	1976:1–1999:7
$-¥	2.31	2.01	1978:9–1999:7
DM-¥	1.79	1.72	1978:9–1999:7

Note: We form a twelve month ahead forecast, either based on interest differentials (UIP), or by assuming that the exchange rate is constant (RW).

Note, though, that some (see, for example, Fisher *et al* (1990) and McCallum (1994)) argue that the conventional econometric estimation of equation **(1)** is flawed, because the interest differential itself depends on exchange rate expectations. This is because when policy-makers set interest rates, they may well be influenced by what they expect the exchange rate to do. Under certain assumptions, this would bias the estimates of β away from 1 (towards being negative), and so might explain the results that are commonly found in the literature. However, Wadhwani (1999b) re-estimates equation **(1)** by using a more appropriate econometric technique, and, although the estimates of β are generally closer to 1, it is still the case that five out of seven of our estimates of β were negative, and the other two were less than 1. Hence, at least on this evidence, the alternative econometric estimation technique is not enough to make one feel comfortable with the UIP hypothesis. So the evidence might induce some of us not to want to use UIP in the preparation of our inflation forecast, although reasonable people may disagree with this. In particular, there remains the issue of whether one feels comfortable with not using UIP while simultaneously believing that financial markets might be efficient.

In the discussion of UIP so far, I have assumed that investors are risk-neutral. However, if investors are risk-averse, then the interest differential is the sum of the expected change in the exchange rate plus a risk premium, so one would no longer necessarily expect a finding of $\beta=1$, and the above evidence might still be consistent with efficient markets. There is a large and voluminous literature on this subject, and this is not the place to summarise it. Suffice it to say that in a survey of this literature, Lewis (1994, page 38) concludes:

'... no risk premium model with believable measures of risk aversion has yet been able to generate the variability in predictable (foreign currency) excess returns that are observed in the data.'

Alternatively, it is possible to argue that one should not expect the foreign exchange market to be informationally efficient. In his intriguing Presidential Address to the American Finance Association, Sanford Grossman (1995) appears to have some of the elements of a story that might help to explain the failure of UIP. I cannot hope to do justice to the subtleties of his explanation here,(2) but I recommend you to look at it.

It is important to emphasise that all the alternative approaches that were discussed above do a pretty poor job of forecasting the exchange rate. Although the MSE associated with assuming a constant exchange rate might be somewhat lower than using the UIP hypothesis, the naïve method of assuming a constant exchange rate is hardly an accurate one! Either convention gives you rather poor forecasts of the exchange rate. This is one reason that we need to contemplate other alternatives.

There is another reason to contemplate alternatives—it is that the constant exchange rate assumption does not allow for any interest rate effects on the exchange rate. This may be uncomfortable from a policy-making perspective, as the policy instrument (the short-term interest rate) would, in the model, be assumed to have no effect on the exchange rate. Yet, on average, interest rate changes do contemporaneously

(1) Recall that the economics profession has had to confront the possibility that the assumption that the exchange rate follows a random walk outperforms many other structural models ever since the work of Meese and Rogoff (1983).
(2) Also, he does not present a fully worked-out model, so not all the necessary elements of his argument are fully articulated in his address.

affect exchange rates. Wadhwani (1999b) reports some results that are consistent with unanticipated changes in the relative monetary policy stance having, on average, the theoretically expected effect on exchange rates. We might, therefore, supplement the constant exchange rate assumption with an additional, empirically based assumption about how much the exchange rate would contemporaneously jump in response to an interest rate shock. Alternatively, we might want to consider a more general model for exchange rates that, among other things, includes a role for interest rates.

'Fair value' measures of the exchange rate

Currently, sterling appears to be 'overvalued' on conventional, PPP-style measures, and the current academic consensus is that PPP might be valid in the long run (see, for example, Rogoff (1996)).

Table B displays some estimates of conventional, PPP-style estimates of the equilibrium value of the £/DM exchange rate. Clearly, current estimates of the PPP exchange rate (which are in the range of around 2.35–2.60) are well below the current spot exchange rate of 2.97, and hence it might be reasonable to expect mean reversion, and so to predict an exchange rate decline.

Table B
Alternative estimates of the PPP rate for £/DM

Alternative measure	Estimate
Consumer price index based measure (a)	2.57
Producer price index based measure (a)	2.37
Measure based on unit labour costs (b)	2.60
Actual exchange rate (c)	2.97

(a) Based on the CPI and PPI indices up to June 1999.
(b) Based on measures of unit labour costs up to May 1999.
(c) On 17 August 1999.

Of course, some economists point out that PPP relies on arbitrage in the goods market, but evidence suggests that there are important limitations to arbitrage in that market, primarily because of differentiated products and transport costs. An alternative longer-term equilibrium concept that has attracted a following is the so-called 'fundamental equilibrium exchange rate' ('FEER')—see for example Wren-Lewis and Driver (1998) for a recent review. There is no unique definition of FEER (John Williamson (1983) first used the term) but in general it refers to the level of the real exchange rate that would deliver both internal and external balance over the medium term. Table C presents some recent FEER-based estimates of the equilibrium value for the £/DM exchange rate. Note that, once again, the current exchange rate is well above existing estimates of the FEER.

It is important to emphasise that, to some extent, the FEER is a normative concept, in that it asserts what the exchange rate should be in the context of a particular model with certain specific assumptions about economic behaviour. There is little effort devoted in this approach to assessing whether, over some period of time, FEERs have provided an appropriate longer-run benchmark to which exchange rates

Table C
FEER-based estimates of the equilibrium exchange rate for £/DM

Author	Range of estimates
Wren-Lewis and Driver (1998)	2.13–2.60 (for 1995 H1) 2.04–2.49 (for 2000)
Church (1999)	2.30

do actually revert. By contrast, one might be interested in what exchange rates actually do (see, for example, Clark and MacDonald (1998), who distinguish between FEERs and the so-called behavioural equilibrium exchange rate ('BEER'), which is based on a model of the actual exchange rate).

Estimating a model for the exchange rate

Theoretical considerations

There are now a host of studies that attempt to link the real exchange rate to a host of macroeconomic variables. Indeed, MacDonald (1998, page 40) concluded a recent survey of this literature by asserting:

'It seems we do know a great deal about the behaviour of real exchange rates, although there is plenty of scope for refining and elaborating the current body of knowledge.'

Many Wall Street firms now routinely publish their estimates of the medium-term equilibrium exchange rate, and even central banks occasionally do so (see, for example, Deutsche Bundesbank (1995)). These approaches typically estimate a reduced-form equation. For present purposes, I shall follow a somewhat idiosyncratic approach, estimating a modified version of the risk-adjusted UIP condition and using proxy variables for the risk premium, ie starting with the modified UIP condition:

$$E_t s_{t+k} - s_t = \alpha + \beta(i_t^* - i_t) + \rho_{t+k} \qquad \textbf{(2)}$$

where ρ_{t+k} is a risk premium.

Wadhwani (1999b) shows that we may proxy the risk premium by:

$$\rho_{t+k} = F(q_t - \bar{q}_t, Z_t) \qquad \textbf{(3)}$$

where $q_t - \bar{q}_t$ is the estimated deviation of the real exchange rate, q_t, from an estimate of the equilibrium exchange rate, $\bar{q}_t$, and Z_t is a set of variables that commonly help to predict the returns on other assets (eg stocks, bonds, etc).

The main advantage of this approach is that we do not specify a particular model for the risk premium, ρ_{t+k}, because, as we noted earlier, we have no successful economic models for it. Instead, we have decided to use a proxy variable approach, where we rely on the fact that the deviation of the current real exchange rate, q_t, from some long-run equilibrium level, $\bar{q}_t$ will, in part, depend on perceived risk. In addition, conventional asset-pricing

theory considerations suggest that variables that help to predict excess returns on other assets such as stocks or bonds (and therefore act as proxy for the risk of those assets) should also play a role in predicting excess currency returns as, in this model, all assets must be priced off the same set of underlying risks.

If we follow a FEER-style approach, then we may proxy the equilibrium exchange rate, $\bar{q}_t$, by:

$$\bar{q}_t = F(CAD_t, UNED_t, NFAD_t, RWPCP_t) \quad \textbf{(4)}$$

where:

CAD_t = difference in current account/GDP ratios
$UNED_t$ = difference in unemployment rates
$NFAD_t$ = difference in the net foreign asset/GDP ratios
$RWPCP_t$ = relative ratios of the WPI to the CPI

Intuitively, relative to some current account target, a current account deficit will require an exchange rate depreciation to restore equilibrium. If a country is experiencing a current account deficit at a time when its unemployment rate is high, it will then require an even larger depreciation to restore external equilibrium while simultaneously being in internal equilibrium. Other things being equal, a higher stock of net foreign assets is compatible with a higher current account deficit and, therefore, requires a smaller depreciation. Finally, the ratio of the WPI/CPI is included as a crude proxy for differential productivity growth in the traded-goods sectors (see Balassa (1964)).

Turning now to the set of variables that help to predict asset returns more generally, we include (see also Bekaert and Hodrick (1992)):

(a) The difference in lagged dividend yields—this is rationalised by the evidence that a higher dividend yield appears to be associated with higher future stock returns (see, among others, Fama and French (1988b)).

(b) Relative lagged stock returns—again, there is evidence that these help to predict future stock returns, with the evidence suggesting some persistence in the short run (see, among others, Fama and French (1988a)).

(c) Lagged yield spreads—we experiment with the relative difference between yields on bonds of different maturities, with the evidence suggesting that a steeper yield curve is predictive of higher bond returns (see, for example, Keim and Stambaugh (1986)).

(d) Past inflation—this helps to predict stock returns (see, for example, Keim and Stambaugh (1986)), although it must be admitted that this is not an empirically stable relationship when one considers longer historical periods (see, for example, Mullins and Wadhwani (1989)).

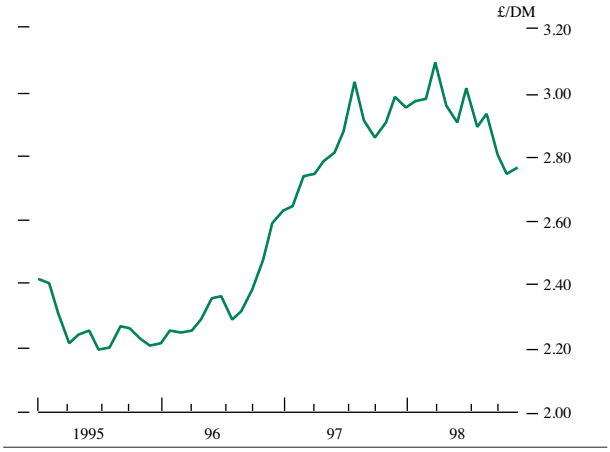
The main advantage of the approach used here is that it breaks free from the straitjacket that is imposed by the conventional UIP approach, which is often interpreted as requiring that a given variable should affect the exchange rate only indirectly, through interest rates. Since we often observes instances where a change in the economic environment affects the exchange rate without appearing to affect interest rates, our framework has obvious advantages. Also, within any framework, changes in interest rates do not only have an instantaneous effect on exchange rates, but can potentially continue to have a subsequent effect on the exchange rate in the same direction, which is consistent with the evidence on 'delayed overshooting' that is reported in, for example, Eichenbaum and Evans (1995).

Attempting to explain the rise in sterling against the Deutsche Mark

The detailed empirical results obtained by estimating such a model may be found in Wadhwani (1999b). Here we use our estimates to try to explain the post-1995 rise in sterling.

Recall that sterling rose from around DM2.20 in December 1995, to about DM2.60 in December 1996, and then to approximately DM3.00 in December 1997 (see Chart 2). I have already noted that the rise in sterling was not predicted by the interest differential using conventional UIP analysis, although it is true that about 2½% of the post-1995 rise can, in fact, be explained by 'news' about monetary policy using the UIP-based methodology outlined in Brigden, Martin and Salmon (1997). As monetary news appears to explain so little of sterling's appreciation, it is common to see commentators describe sterling's behaviour as 'puzzling'.

Chart 2
£/DM exchange rate



We may use the estimated exchange rate model to try to 'explain' the rise in sterling. Table D attempts just such a decomposition. The results suggest that of the actual appreciation of around 27½%, about two thirds can actually be explained by the model. Specifically, about 18½% of the appreciation is attributable to the fact that the real exchange rate was low by historical standards in early 1996 (see Chart 3). In addition, German unemployment rose

Table D
Explaining the 1996–98 rise in the £/DM exchange rate

Variable	Feb. 1996–Feb. 1998 (a)
	Per cent
Actual £/DM exchange rate	+27.6
Explanatory variables	
Real exchange rate (PPP)	+18.8
Unemployment differential adjusted for productivity effect	+ 7.1
Trend appreciation	+ 2.6
Lagged 'monetary effects'	+ 0.3
Equity market effect	- 0.7
Net foreign assets	- 9.0
Total	**19.1**
Unexplained residual	8.5

(a) Note that this refers to beginning-of-month values.

Chart 3
Real £/DM exchange rate based on CPI

substantially relative to UK unemployment (see Chart 4), which warranted a further appreciation. However, this effect needs to be adjusted in the light of what has happened to the relative prices of traded and non-traded goods in the two countries (possibly because of productivity differentials).

Chart 4
Relative German-UK unemployment rate

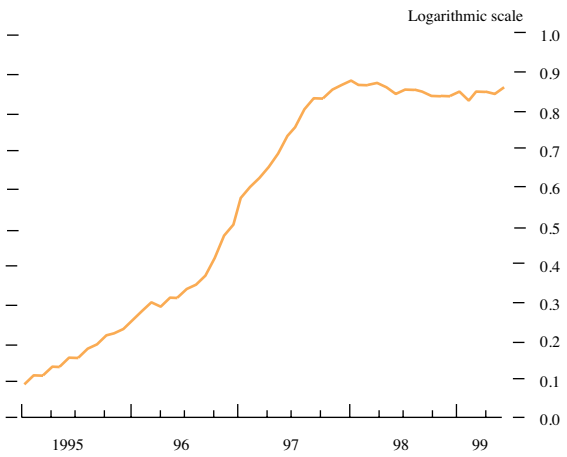
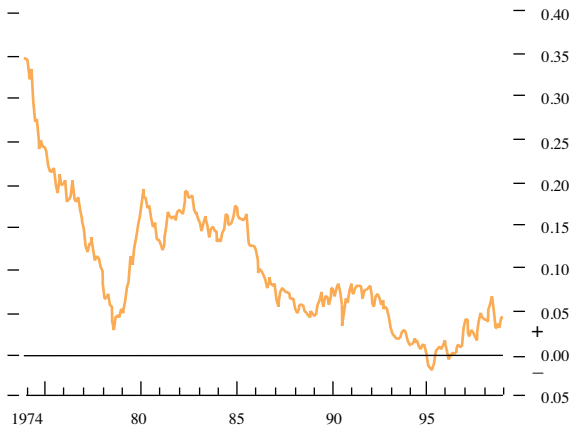


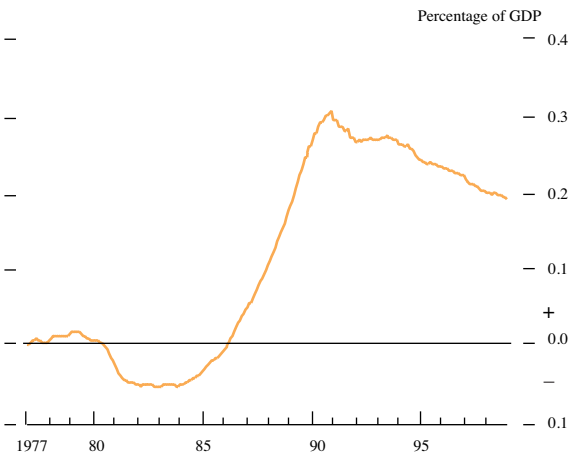
Chart 5 shows that the relative German-UK PPI/CPI ratio reached new historical lows in the 1990s. Nevertheless, even allowing for superior German productivity growth over this period, the net effect of the changes in unemployment and productivity is sterling-supportive (by about 7%) over this period. Those who think in terms of a UIP model usually assume that a rise in German unemployment should affect the exchange rate only by affecting relative interest rates. It is, therefore, notable that in the more general framework considered here, the change in relative unemployment has a direct effect on the exchange rate over and above the indirect effect through relative interest rates.

Chart 5
Relative German-UK PPI/CPI ratio



There are further modest positive contributions from lagged monetary effects (ie the lagged effect of movements in yield spreads) and the average trend appreciation that is implied by our model estimates. Note that before German unification, our model estimates suggested that the Deutsche Mark appreciated against sterling on trend, but by end 1995, the relevant coefficient suggest that this had been replaced by a tendency for sterling to appreciate against the Deutsche Mark on trend. Over this period, although the United Kingdom's net foreign asset position was improving relative to that of Germany (see Chart 6), there is still a negative effect on sterling, because the level of German/UK net

Chart 6
Relative German-UK net foreign assets



foreign assets is still high by historical standards. According to the equation, this should have knocked around 9% off sterling's value.

To conclude, around two thirds of sterling's appreciation from early 1996 to early 1998 can be explained in the context of our relatively simple medium-run model for £/DM. This is quite impressive as our model only relies on predictor variables, and does not include any contemporaneous news effects. Note that of the remaining unexplained effect, about 2.7% can be explained by the monetary news over this period. An important upward pressure on the exchange rate is the fact that, over this period, German unemployment has risen relative to UK unemployment. In the theoretical framework considered above, one reason that this depresses the Deutsche Mark against sterling is that because the markets infer that Germany's true current account position is weaker than the observed measure, because a subsequent fall in unemployment is likely to worsen the external account. In addition, if the unemployment differential reflects supply-side advantages, it might also affect the exchange rate. This is because the same factors that make a country's unemployment rate low might also make it more attractive to external investors, so it might thereby attract more foreign direct investment flows. In the latter case, the unemployment differential may act as a proxy variable for unobserved (to the econometrician) supply-side advantages.

I now move on to consider the intermediate-term model-based equilibrium exchange rate ('ITMEER') that is implied by our model, and investigate what might change it.

Computing the intermediate-term, model-based equilibrium exchange rate (ITMEER) under alternative scenarios

Table E reports estimates of the ITMEER that are implied by our baseline exchange rate model under alternative scenarios.(1)

Table E
Estimates of ITMEER for £/DM under alternative scenarios using the baseline model

Scenario		Estimate
I	All variables set to actual December 1998 values	2.92
II	The German unemployment rate falls (by 1%) relative to UK unemployment	2.81
III	UK current account deficit rises by 2% relative to the German surplus for five years (relative to Scenario I)	2.87
IV	Average equity returns are lower than in December 1998 (relative to Scenario I)	2.82
V	Scenarios II, III and IV occur together	2.66

Scenario I suggests that, using December 1998 values for the variables, the ITMEER for £/DM was about 2.92. However, if the German economy were to recover faster than the UK economy and the German unemployment rate were to fall by 1 percentage point more than in the United Kingdom, the equilibrium exchange rate would fall to 2.81 (Scenario II).(2)

Scenario III instead allows for the possibility that the United Kingdom's current account position deteriorates relative to that in Germany, and is expected to do so for a five-year period. This, though, is only worth around 5pf in terms of the ITMEER, which reflects the fact that the current account only appears to affect the ITMEER through the net foreign asset position, implying that the effect is rather glacial in pace.

Scenario IV attempts to capture the link that many investors/commentators make between the US equity market and the US dollar. The conventional argument is that as long as the US equity market is healthy, foreigners are likely to be willing to finance the US current account deficit. This argument is consistent with the fact that there is a strong, contemporaneous correlation between the S&P 500 and the US dollar, although it is not difficult to think of shocks to the system that could lead this correlation to break down. We are also more than aware of the fact that, especially in this case, correlation does not imply causality. Nevertheless, the notion that a general, above-average rise in equity markets leads to a decline in the degree of risk-aversion and, therefore, a greater willingness to hold assets of countries with current account deficits does appear intuitively attractive—recall that some members of the academic economics fraternity (for example, Fischer Black) did appeal to a wealth decline induced increase in risk-aversion to explain the October 1987 stock market crash. Normally, an increase in risk-aversion is associated with investors bringing their money back home. Such behaviour can be expected to affect countries with current account deficits disproportionately. Alternatively, a more straightforward 'story' for the link between the S&P 500 and the dollar or sterling is that some market participants believe in the 'new paradigm', and also simultaneously believe that some of the Anglo-Saxon economies (the United States, and to some extent, the United Kingdom) are ahead of the continental European economies in benefiting from the 'new era' (with the differences in unemployment performance being offered as evidence).

Anyhow, we attempted to calibrate the size of this effect by including the contemporaneous, average change in the UK and German equity markets in our £/DM model. The estimate in Table E reports the effect of the two stock markets being 30% lower than they were in December 1998.

(1) Recall that the ITMEER is obtained by solving from the implied equilibrium value from our twelve month ahead forecasting equation, which is cast in an error correction framework. Hence, the exchange rate will have a tendency to gradually converge to the ITMEER asymptotically. We, nevertheless, described it as an 'intermediate-term' rather than 'long-term' equilibrium because we have used the current values, rather than the steady-state values of the variables in the equation. Of course, when solving for the long-term equilibrium, it would be more appropriate to use the steady-state values.

(2) I should emphasise that all the estimates reported in Table F are simply partial equilibrium calculations based on our model. Of course, the general equilibrium consequences of some of these assumed scenarios could be quite different. However, our calculations are illustrative of how, other things being equal, a particular exogenous change would affect the ITMEER.

I suspect that the estimated size of the impact (around 10pf—taking the ITMEER from 2.92 to 2.82) is rather smaller than would actually materialise—certainly, our regression coefficient appears to be rising steadily over time, and it is, therefore, entirely possible that I have underestimated the likely effect.

Many economists have been puzzled by both the high level of the US equity market and the level of sterling against the Deutsche Mark. On the above evidence, it is possible that the two could fall together (eg if market participants were less enchanted with 'new era' thinking). Of course, if the fall in Wall Street that accompanied a fall in sterling were significant, the MPC would not necessarily respond to the fall in the exchange rate by increasing interest rates—as my colleague, Mervyn King, has emphasised on many occasions, we do not respond mechanically to a change in the exchange rate, but instead attempt to understand why it moved.

If all three scenarios were to materialise together (lower German unemployment, a higher UK current account deficit and lower global stock markets), the ITMEER falls to 2.66, which is in territory that UK businesses would find comfortable *vis-à-vis* EMU entry.

The above results are based on a model where the effects of the current account are relatively weak. However, I also experimented with a model that included future values of the current account balance, which were statistically significant. Table E suggested that a 2% current account deficit in the United Kingdom had to be expected to last for five years before it reduced the ITMEER by around 5pf. Table F suggests that a fall of 6pf with a deficit that lasts for only one year—a much larger response—might be achieved when using an alternative model based on the future current account deficit.

Table F
Effect of changes in the current account balance on the £/DM exchange rate using alternative models

Scenario		Estimate
Alternative model I		
A	All variables set to actual December 1998 values	3.01
B	UK current account deficit rises by 2% (of GDP) relative to the German surplus for one year	2.95
Alternative model II		
C	All variables set to actual December 1998 values	2.85
D	UK current account deficit rises by 4% (of GDP) relative to Germany and the S&P 500 falls by 20%	2.62

Another alternative model that was estimated allowed for the possibility that the current account deficit matters more when the US stock market is falling. On the assumption that the United Kingdom's current account deficit rises by 4% of GDP and the S&P 500 falls by 20%, the model suggests a decline in the ITMEER from 2.85 to 2.62—and this is consistent with one's casual impression (for example, following the Russian crisis of 1998) that the markets can punish countries with current account deficits quite suddenly if there is a rise in risk-aversion. Note, in passing, that the three alternative models generate a baseline value of the ITMEER ranging between 2.85 and 3.01, so our estimates are quite sensitive to model specification.

The simulations in Tables E and F are based on December 1998 values. Updating the calculation of the ITMEER to use current (ie 1 September 1999) values of the variables yields an estimated value of DM2.99, which is modestly higher than the December 1998 estimate of DM2.92. The ITMEER has edged up during 1999 primarily because the two-year–one-year yield spread has widened more in the United Kingdom than in Germany, and the fact that UK equities have outperformed those in Germany.

A potentially significant aspect of our results is that despite the fact that we have explicitly allowed for mean reversion towards the PPP value of around DM2.60, other factors in our model (especially the unemployment rate differential) currently suggest a rather higher equilibrium value of around DM3.00. Since this is clearly higher than the MPC's collective projection of a decline to DM2.75, this potentially has implications for the MPC's modal inflation projection. Therefore, one needs to critically assess whether or not one should put any weight on these estimates of the ITMEER.

ITMEER versus alternative equilibrium concepts

If one is trying to forecast the exchange rate because it affects the inflation forecast, it is, at first sight, more attractive to use the ITMEER, rather than a FEER (or a PPP value), because the former has done rather better in terms of explaining the post-1995 rise and persistence of sterling. Recall that FEER estimates are based on assumed current account targets, and are ultimately a normative concept, in that they say what the exchange rate should be—there is no attempt, within that framework, to cross-validate the estimates with what the exchange rate has actually done. FEER estimates are also, self-avowedly, 'medium-term' equilibrium estimates, where 'medium term' is defined to be five or ten years (see, for example, Wren-Lewis and Driver (1998)), which is well beyond the relevant horizon for our inflation forecast.

On the other hand, there is little doubt that an exchange rate of DM3.00, if sustained indefinitely, would inflict considerable pain on both UK manufacturing industry and agriculture. It is clear to me that the estimate of ITMEER should not necessarily be regarded as a level that is either socially desirable, or as one that would be obviously sustainable in any potential currency union. Nevertheless, using the ITMEER rather than a FEER or a PPP value might just give us better two year ahead inflation forecasts.

It is obviously important to understand why the ITMEER and FEER estimates are so different. One reason is that, in our model, though the current account deficit does affect the exchange rate, there is no requirement that at some stage the

deficit should be reduced to some pre-ordained 'sustainable' level.

In a world where current account flows are dwarfed by capital flows, downgrading the importance of the current account may well be the right thing to do, especially given how little impact the largely persistent current account deficits of the last two decades in the United States and Australia appear to have had on their currencies. On the other hand, the recent East Asian currency crisis should warn us against an overly complacent view of the sustainability of current account deficits—these deficits appear not to matter until, well, they suddenly do! The possibility that the financial markets might suddenly mark sterling down on account of a growing trade deficit if, say, the US stock market were falling significantly at the same time was captured in one of the models that were discussed earlier, and we saw that, on that scenario, the ITMEER could fall to around DM2.60. However, that scenario required a large fall in the US stock market, and a much larger increase in the UK current account deficit than anyone is projecting.

A second reason for the large difference between the ITMEER and the FEER estimates is that the former is affected by the difference in the raw unemployment rate in the two countries, whereas the latter is influenced only by the differences in the estimated cyclical level of unemployment (ie the unemployment rate is compared with its estimated natural rate in each country). We tested the alternative formulation of comparing cyclical unemployment rate differences instead of the gap between the raw unemployment rates. However, for all the five bilateral rates where the difference in unemployment exerts an impact on the exchange rate, the raw difference was preferred over the cyclical difference.

The discussion above suggests that though it is important for central bankers to understand what it is that makes market prices move, we must simultaneously guard against the danger of assuming that the markets have always got it right—indeed, if they have got it wrong, we need to be aware of the risk that they might suddenly change their mind. In the Lionel Robbins Memorial Lecture at the LSE, the former Vice-Chairman of the Board of Governors of the US Federal Reserve Board, Alan Blinder (1998, page 61) said:

' … financial markets seem extremely susceptible to fads and speculative bubbles which sometimes stray far from fundamentals. Central bankers must innoculate themselves against whimsy and keep their eye on the fundamentals… traders in financial markets… often behave as if they have ludicrously short time horizons, whereas maintaining a long time horizon is the essence of proper central banking.'

Although there is considerable merit in what Alan Blinder says, one still needs, somehow, to come up with a modal projection for the exchange rate. In that regard, Table G presents a comparison of the out-of-sample forecasting performance of the models for sterling that was previously discussed (with the additional requirement that we dropped all variables with Newey-West t-ratios below two), with the random walk and UIP alternatives. The MSE ranking is that the model-based forecasts appear to do best (followed by RW and UIP in that order), with the MSE associated with the model being less than half that associated with UIP for £/DM or £/$. However, the model-based forecasts deteriorated significantly relative to their in-sample performance—conventional Chow tests would point to a rejection over the out-of-sample period. Indicative of the problem, in the £/DM model, the $\bar{R}^2$ falls from 0.70 in the period up to 1995, to 0.37 over the 1996–98 period. Notwithstanding this problem, and the more general difficulties associated with the rather hard-to-forecast exchange rate, the above evidence does suggest that approaches other than UIP possibly deserve our attention.

Table G
Comparing the performance of the UIP, RW and model-based forecasts, 1996–99

Bilateral rate	MSE of forecast (x 10^{-2})		Model
	UIP	RW	
£/DM	2.33	1.73	1.04
£/$	0.23	0.20	0.10
£/¥	3.45	2.25	2.09

Note: Model-based forecasts assume that the coefficients estimated up to 1995:12 remain unchanged over the out-of-sample period.

In concluding this section, I cannot resist noting the obvious fact that the more optimistic that the MPC is about the level of sterling's equilibrium exchange rate, then, other things being equal, the lower the interest rate will be, and, consequently, the lower sterling will actually be. Hence, those who desire sterling to be lower must actually want the MPC to believe that sterling's equilibrium exchange rate will remain high!

Conclusions

This evening, I have attempted to look at the difficulties associated with producing our exchange rate forecast—a critical input into our views about the outturn for inflation. I first reviewed our current convention of using UIP, and compared it with the naïve convention of assuming a constant exchange rate. The bulk of the econometric evidence presented here, consistent with much of the academic literature, is that RW outperforms UIP, and indeed that having a bias that the high-interest currency would appreciate (not depreciate as per UIP, or remain constant, as per RW) might do even better than RW. However, one's overriding feeling about the UIP versus RW debate was that neither model fared particularly well in forecasting exchange rates, and that it was therefore important to consider alternatives.

We saw that conventional valuation measures such as PPP or FEER would, like UIP, imply a lower value for sterling.

I proposed and estimated an alternative econometric model for exchange rates, which potentially encompassed PPP and FEER as a special case. This model could explain a significant fraction of the rise in sterling versus the Deutsche Mark during 1996–97, a period during which the rise in the UK interest rates *vis-à-vis* those in Germany could explain only a rather modest fraction of the rise (which led many to conclude that sterling's rise was puzzling). On the conventional UIP framework, variables such as unemployment only affect exchange rates if they also affect interest differentials. In the framework presented above, variables such as unemployment have a direct effect on the equilibrium exchange rate over and above any indirect effect through the interest differential, which helps to resolve the 'puzzle' that exchange rates sometimes move without any associated change in the interest differential.

Further, a recent estimate of the intermediate-term equilibrium exchange rate was only a little below current levels (around DM3.00 versus current levels of around DM3.04) and, therefore, there is a risk that sterling might not depreciate as much as those who believe in PPP or FEER might think. It was noted, however, that market perceptions of the fundamentals could, on occasion, be wrong, or at least prone to change quite suddenly. Also, although the model appeared to have done moderately well recently (and had somewhat outperformed the naïve RW alternative), it was important not to overemphasise the precise econometric estimates, as they were rather fragile. However, I noted that the MPC's view on the likely path of the exchange rate can have counter-intuitive effects, ie if the MPC expects it to be weak it might stay strong, and *vice versa*. So it was important for the MPC to continue to examine alternatives to the current UIP convention (used by the majority), especially as some of the alternatives (eg RW, or the models considered here) imply that sterling might stay rather stronger than the UIP convention assumes.

I also argued, though, that although the model currently implied that sterling might remain strong, one could envisage circumstances (for example, a steep fall in Wall Street) that would, according to the model, bring sterling tumbling down. This was because in a period of investor risk-aversion that would follow a fall of the S&P 500, investors would be less willing to finance current account deficits. In this context, I have previously argued (see Wadhwani (1999a)), that there are, currently, above-average risks associated with owning US equities. However, if sterling fell significantly in association with a large fall on Wall Street, the net impact of these two opposing forces would be unlikely to be inflationary.

It is also important to emphasise that this lecture has not, in any way, attempted to 'justify' the current level of sterling as being normatively 'appropriate'. There is no doubt in my mind that the current level of sterling inflicts very considerable pain on many sectors of the UK economy. Normative measures of 'fair value' such as FEERs do, therefore, suggest a rather lower level for sterling. However, the MPC has an inflation target, not an exchange rate target. It must set interest rates on the basis of what it expects the exchange rate to do, and not on where it thinks the exchange rate should be.

I hope that this lecture has shed some light on the complexities associated with forming our best collective judgment about the likely path of the exchange rate. It is, therefore, hardly surprising that we do not always agree about the best way to forecast exchange rates—and we also observe significant heterogeneity of views among foreign exchange market participants. It is extremely difficult to have any significant degree of confidence in an exchange rate forecast. I am sure that the markets will continue to challenge us and we will need all our collective skill, and perhaps an above-average dose of luck, to get our forecasts right.

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Monetary policy and asset prices

In this speech,[1] John Vickers, Executive Director and Chief Economist at the Bank of England,[2] asks how asset prices should, and do, affect monetary policy. He argues that asset prices should not be included in the measure of inflation targeted by monetary policy, which should focus on the prices of goods and services for current consumption. He goes on to examine the information yielded directly by asset prices—for example about inflation expectations and interest rate expectations. Finally, he considers what asset prices add to other indicators, and concludes that asset prices matter for monetary policy because they help to inform judgments about inflation prospects.

Introduction

How should—and how do—asset prices affect monetary policy? This rather basic question can have strikingly different answers. In some regimes, both ancient and modern, monetary policy is entirely about asset prices. Under the gold standard, and in fixed exchange rate regimes, monetary policy is wholly geared to the domestic currency price of a single asset—gold or an international currency such as the dollar. An asset price is then the very anchor of the domestic price level. By contrast, asset prices do not figure at all in simple monetarist rules for the growth rates of monetary quantities. And where the aim—or at least an aim—of monetary policy is directly to control the rate of inflation of goods and services prices, it is not immediately obvious what role, if any, asset prices should play in the setting of policy.

In this paper I shall concentrate on the role of asset prices when monetary policy targets inflation—explicitly as in the United Kingdom for the past seven years, or at least implicitly. The discussion will be organised around three main questions:

- Should asset prices be included in the measure of inflation targeted by monetary policy?
- What can asset prices tell us directly about monetary policy?
- What do asset prices add to other indicators that inform monetary policy?

Needless to say, these are large questions with large literatures, and my remarks will be selective and in no way comprehensive. In particular, I shall draw some illustrations from asset price analysis in support of monetary policy at the Bank of England.

Before going any further, let me clarify what asset prices I am talking about. These include the prices of financial assets—eg bonds, equities, and the derivatives such as swaps, futures and options based on them—and non-financial assets, including residential property. I shall not attempt to cover foreign exchange rates or the prices of durable commodities such as gold.

There are many more asset prices nowadays than there used to be. This is partly because, thanks to financial innovation, there are many new kinds of asset, and also because assets are more traded across markets. For example, securitised debts, unlike bank loans, have readily observable prices. Futures and contingent-claims markets are far from complete, but they are somewhat less incomplete than they used to be. Nevertheless, many financial assets, including most corporate debt as well as the bulk of personal debt in the United Kingdom, are not traded. Market prices for those assets are therefore unavailable for monetary policy assessment, though of course there are other measures of credit conditions (both prices and quantities). So though asset price information has become vastly richer, it must be kept in mind that many of the effects of monetary policy continue to work through channels involving assets such as bank loans that do not have market prices. The prices of traded assets nonetheless have important effects on intermediated finance via loan collateral values and indeed the balance sheets of financial intermediaries.

A theme worth highlighting at the outset is expectations, which are central to any discussion of asset prices. Asset values depend on—and so can be revealing about—expectations of future behaviour, and asset prices are generally determined flexibly in markets with forward-looking, and perhaps far-sighted, participants. In particular, since the value of money depends on monetary policy, expectations about future monetary policy are key to the pricing of at least those assets with returns denominated

(1) Given at the Money, Macro and Finance Group 31st Annual Conference at Oxford University, on 22 September 1999. This speech is available on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech54.pdf, together with an annex that briefly discusses the main issues in the estimation of yield curves and implied probability distributions from asset prices.

(2) This paper is based on work by Nicola Anderson and James Talbot of the Bank's Monetary Instruments and Markets Division, to whom I am most grateful. Thanks also to Bill Allen, Peter Andrews, Andrew Bailey, Hasan Bakhshi, Roger Clews, Roy Cromb, Spencer Dale, Shamik Dhar, Tolga Ediz, Mark Gertler, Charles Goodhart, Simon Hall, Neal Hatch, Nigel Jenkinson, DeAnne Julius, Mervyn King, Jo Paisley, Chris Salmon, Andrew Scott, Clifford Smout and Peter Westaway for helpful comments and conversations. I alone am responsible for the views expressed in the paper, which are not necessarily shared by other MPC members.

in nominal terms. Thus the prices of five-year conventional bonds incorporate, among other things including risk and the possibility of the United Kingdom joining EMU, market expectations about the outcomes of the next 60 MPC meetings. One of the interesting questions, then, is how monetary policy should take account of asset prices that reflect market expectations about its own future course.

Should asset prices be included in the inflation measure?

Asset prices can affect monetary policy in two conceptually distinct ways. They can be part of the *objective* that monetary policy-makers pursue, and/or they can be part of the *information* that policy-makers look at, and hence an element in the policy 'reaction function'. Most of what follows concerns the informational role of asset prices, but there is a prior conceptual question about the policy objective—should asset prices be included in the targeted measure of inflation? This question is academic, because available price indices, such as those in the RPI family, generally measure the money cost of a basket of goods and services that are for current consumption.(1) Moreover, under UK arrangements, the choice of monetary policy target is of course for the Chancellor to make.

If current utility depends on current consumption—which of course includes consumption of the current services yielded by assets—then, subject to well-known measurement problems,(2) movements in those indices can be interpreted as changes in the money cost of achieving a current level of utility for a hypothetical individual—in short, changes in the cost of *living*. However, lifetime utility depends on future consumption as well as current consumption. So movements in price indices based on current consumption will mis-measure changes in the money cost of achieving a given level of lifetime utility—changes in the cost of *life*, as it were—unless the relative prices of current and future consumption happen to stay constant.

On these grounds, Alchian and Klein (1973) argue that a correct measure of inflation should include asset prices, because they reflect the current money prices of claims on future, as well as current, consumption.(3) For example, the fall in long-term real interest rates in the United Kingdom over the past year or so has significantly increased the current money price of future consumption.(4) Standard inflation measures do not pick this up.

True, but as Alchian and Klein themselves point out, the appropriateness of a price index depends on the question at hand. The issue for monetary policy is price stability. I believe that this should mean stability over time of the money price of current consumption, and *not* stability of the money price of current-and-future consumption.

First, money is the medium of exchange, including intertemporal exchange—ie exchange involving consumption goods (not utility) at different dates. The efficiency with which such exchanges can occur is enhanced the more that the rate of exchange at each date between money and consumption is stable, or at least predictable. Achieving that sort of stability—ie stability of the price level in terms of current consumption—would seem to be the best that monetary policy can hope to do in terms of facilitating efficient intertemporal exchange.

In particular, suppose realistically that markets do not exist for intertemporal exchange of consumption goods (including services),(5) but that they do exist for intertemporal exchange of money—ie there are bond markets. So parties wanting to exchange goods now for goods at time t cannot do so directly. They can however exchange money now for money at t by trading cash for bonds. This would replicate the (non-existent) opportunity for intertemporal exchange of goods, which the parties would really like to have, if the rate of exchange between money at t and goods at t were known in advance. In that case, the missing market for intertemporal exchange of goods would effectively come into being.

This suggests that the best that monetary policy can do to facilitate efficient intertemporal exchange of goods is to make predictable, for each time t, the rate of exchange between money at t and goods at t. This argument implies that in principle (not just in practice), the price stability objective of monetary policy should concern stability in terms of the money price of current consumption.

Second, introducing intertemporal considerations into price measurement adds a new dimension to the problems for cost of utility measurement arising from diversity among economic agents (without which there would be no trade, so no need for a medium of exchange). The concept of the cost of lifetime utility is therefore an order of magnitude more problematic than that of the current cost of living, which itself is far from straightforward.

Third, even if the concept were well-defined, I do not know how we could hope to measure the prices and quantities of the relevant assets, or even decide what they were.(6) Of course, measurement difficulties (eg relating to quality) are serious for current price indices also, but the intertemporal dimension would surely magnify them enormously. Measurement matters for all sorts of obvious reasons involving the specification and enforcement of index-linked

(1) In fact this is not exactly true. For example, for obvious practical reasons the retail price indices include the prices of durable goods such as refrigerators, rather than the prices of the current services that they yield. A measure of house prices is used to measure housing depreciation, which seeks to proxy the user cost of housing. So there is some direct effect of house prices on the RPIX index. And because a rise in house prices tends to increase the stock of mortgage lending, there is also an effect on the mortgage interest payment component of the RPI.
(2) See the Symposium on measuring the US Consumer Price Index in the Winter 1998 issue of the *Journal of Economic Perspectives*.
(3) Goodhart (1999), among others, agrees.
(4) By contrast, falls in short-term *nominal* interest rates *reduce* the RPI by lowering mortgage interest payments (which are excluded from the RPIX measure of inflation that is the target for UK monetary policy).
(5) Of course there are some index-linked bond markets, but with relatively few (mostly government) issuers.
(6) Alchian and Klein (1973, pages 187–89) discuss measurement problems. They conclude that the marginal cost of improving a price index along their lines is likely to be less than the marginal benefit of improved policy based on 'less misleading indicators of inflation'.

contracts, including the implicit contracts (eg embodied in explicit inflation targets) between the monetary authorities and those to whom they are accountable. Moreover, volatility of asset prices—or at least that part of it due to the volatility of real discount rates—would be transmitted to the price measure, further complicating measurement and accountability.

A separate line of argument for including asset prices in the inflation measure used for monetary policy purposes is that it would make the authorities respond in a more timely manner to inflationary (or deflationary) pressures. With consumption price indices used as an indicator or target of monetary policy, say Alchian and Klein, 'policy changes will often come too late and move too far'. Believers in this view might point to episodes such as the late 1980s inflation of UK house prices or of Japanese asset prices.

Their argument seems to be that policy-makers should be given objectives that include asset prices, because they often fail to take timely action when they have objectives that exclude asset prices, with the result that those objectives are missed. Put simply, if policy tends to be behind the curve, and asset prices ahead of it, then policy might be better if its objective included asset prices. Note that this argument is quite different from the claim discussed above that, as a matter of principle, the ultimate policy objective should include future goods prices. It is saying that, as a pragmatic matter, the authorities should be set a target that differs from the ultimate objective (which might only concern current goods price inflation) in order to offset a perceived bias against timely action. But if such a problem exists, a more direct solution involves the way that policy draws on asset price *information*, rather than the second-best solution of putting asset prices in the policy *objective*.

For these reasons, I do not subscribe to the view that asset prices should be included in the targeted measure of inflation for monetary policy purposes.

What can asset prices tell us directly about monetary policy?

Asset prices inform monetary policy both directly and more broadly. The direct value of asset price information is given by the answer to the question: what can asset prices on their own tell us about what monetary policy should be, or is expected to be? The more general value of asset price information (see the next section) can be assessed by asking what asset price information can tell us over and above all the other information that is relevant to inflation prospects.

Extracting information from asset prices typically involves addressing three kinds of question:

- How do observed market data relate to the economic variables of interest?
- Do asset prices reflect fundamental values—ie discounted (risk-adjusted) expected returns?
- What is the attitude to risk of market participants?

As usual in economics, there is the dilemma that making more assumptions yields sharper but more questionable results. For example, the nominal and real yield curves would provide very sharp information about inflation expectations if one was heroic enough to assume that one had a robust yield curve estimation technique *and* rational expectations *and* risk-neutrality. Given this dilemma, it is important constantly to be aware of which results depend on which assumptions, so that, especially when anomalies or puzzles arise, the assumptions (and data and methods) are properly questioned before results are given credence.

For the task of relating economic data to economic variables, some basic tools of inference are yield curves and implied probability distribution (PDF) functions.(1) Yield curves can be estimated for nominal or real interest rates and for spot or implied forward rates.(2) Of particular interest are yield *spreads*—ie differences between types of yield. For example, the spread between nominal and real interest rates gives 'break-even' inflation rates,(3) which under certain assumptions can be interpreted as expected inflation rates. And the spreads between corporate and government yields (or between the yields on common currency debt of different countries) provide measures of relative default risk.

Yield curve (and PDF) analysis involves the technical issue of how to derive curves from market data points, and the economic issue of how to interpret them. In what follows, I shall simply assume that yield curves can be observed directly, and so bypass the challenging and fascinating problems of how best to derive them from market data. The *Quarterly Bulletin* article by Nicola Anderson and John Sleath of the Bank's Monetary Instruments and Markets Division (see pages 384–92) contains a discussion of those problems, and how we are tackling them at the Bank.(4)

Inflation expectations

Measurement of inflation expectations is central to monetary policy analysis. Inflation prospects are influenced by inflation expectations, for example through the process of wage and price setting. Low and stable inflation expectations are key to price stability and the wider economic benefits that flow from it. And inflation

(1) Thanks to the development of reasonably liquid derivative markets and of techniques of financial market analysis, it is now possible to make inferences about entire probability distributions, not just the means of those distributions. Söderlind and Svensson (1997) provide an excellent recent survey of those techniques.
(2) Campbell (1995) gives an overview of yield curve economics. See also Anderson and Sleath (1999). The spot yield at maturity τ is the continuously compounded rate of interest on a zero-coupon bond of that maturity. The s-period forward rate at maturity τ—or the implied forward if there is no forward market—is the s-period spot yield τ periods hence. Yield curves show the term structure—ie rates as a function of time τ.
(3) The term 'break-even inflation rate' is used in the market specifically to refer to the average rate of inflation which equalises the real return on two comparable gilts: one conventional and one index-linked. The term is used more broadly here to refer also to the difference between the nominal and real (zero-coupon) yield curves derived from the gilt market.
(4) See Anderson and Sleath (1999).

expectations provide a way of appraising the MPC—inflation outturns are unlikely to be exactly on target *ex post*, and inflation expectations are a guide to whether policy is set broadly right *ex ante*, which is the best one can hope for. This point applies to introspection by the MPC as well as to external appraisal.

For example, if the forward break-even inflation rates implied by the nominal and index-linked yield curves are substantially above or below the inflation target of 2½%, then:

(a) the market expects inflation to miss the target, and/or

(b) forward break-even inflation rates do not measure the market's expectation (ie the mean) of future inflation.

In case (a), it might be that the MPC also expects inflation on average to miss the target—for example if shocks have hit the economy and the horizon is too short to offset them sensibly. Otherwise, the interpretation is that the market's expectation about likely economic developments and the MPC's reaction function together imply missing the target on average. One should then think hard about why the market's apparent assessment differs from that of the MPC. In that sense, 'the market' is like an external forecaster that puts its money where its mouth isn't.(1)

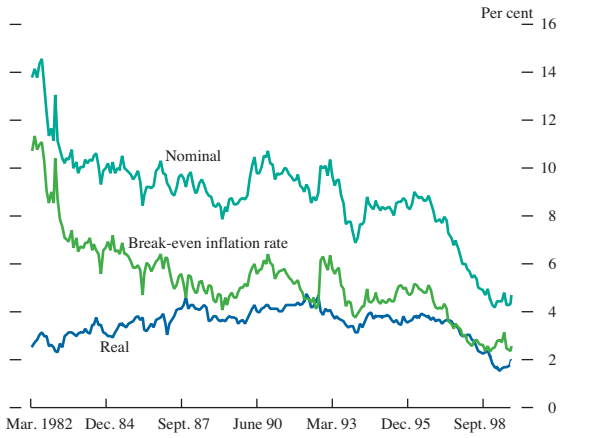
But, as case (b) recognises, the implied break-even inflation rate should not necessarily be equated with the market's expectation of inflation. Short real rates are notoriously hard to measure, institutional or liquidity factors may be affecting prices, and non-zero inflation risk premia are entirely possible.

Partly for these reasons, if break-even inflation rates were on target, it would not necessarily mean that policy was being set right. For example, if policy were totally credible, then market-derived measures of inflation expectations would contain no information about inflation expectations, beyond being a check that policy remained credible. In the possibly unhealthy situation in which the market was certain that the MPC would do whatever it takes to get expected inflation on target, market-derived inflation expectations would give no indication what to do, but market-based interest rate expectations might still be informative (see below). This is not for a moment to suggest, conversely, that so long as market participants form independent views, policy should follow the market—for example by aiming to get break-even inflation rates on target. The point is simply that market-derived inflation forecasts, like external forecasts generally, potentially have *some* informative value for policy, to the extent that they are independent.

Charts 1 and 2 show five and ten-year forward nominal and real interest rates derived from the Bank's zero-coupon government yield curve. The charts also show forward break-even inflation rates at the same maturities. Assuming rational expectations and risk-neutrality, these break-even

Chart 1
UK five-year forward interest rates

Chart 2
UK ten-year forward interest rates



inflation rates represent the market's inflation expectation for the six-month period beginning five and ten years from any given point on the chart. Ten-year forward break-even inflation rates have fallen from more than 10% in 1982 to 2.6% today. King (1995) used implied forward inflation rates to assess the credibility of monetary policy; a ten-year forward rate of 2.6% is consistent with the market expecting future UK inflation to remain broadly in line with the current inflation target. The fall in forward break-even inflation rates may partly reflect lower inflation risk premia. If so, that too is consistent with greater monetary policy credibility.

Of course, yield curves are not the only source of information about inflation expectations, just as financial market participants are but one of a number of groups in the economy whose inflation expectations matter. In addition there are direct measures such as the Barclays Basix survey (see the table, which shows that reported inflation expectations appear generally to have become closer to the 2½% target over the past year or so). These survey measures also need careful interpretation, but they are a valuable complement to, and cross-check upon, market-based measures.

(1) Humanising 'the market' by attributing expectations to it is deeply unsound philosophically, but useful shorthand.

Short-term inflation expectations[a]

	1998 Q2	1999 Q2
General public	5.1	4.6
Trade unions	3.8	3.2
Finance directors	3.2	2.4
Business economists	2.9	2.7
Investment analysts	3.3	2.8
Academic economists	3.1	2.6

Source: Barclays Basix survey.

(a) Expectations of inflation rate one to two years ahead. RPI inflation, except for General public, for which the measure of inflation is not specified.

Interest rate expectations

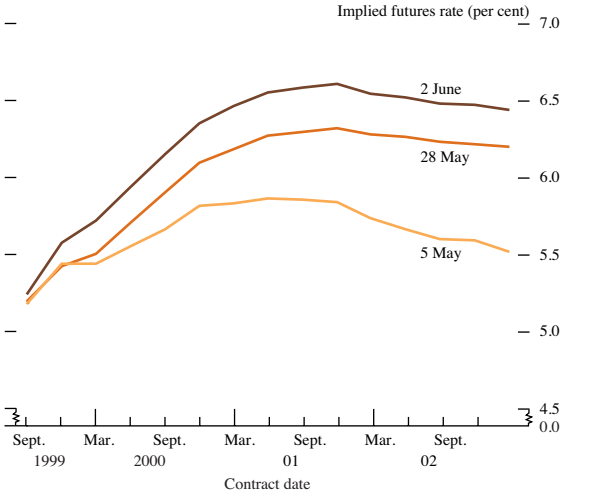
Yield curves are directly informative about expected future monetary policy, and therefore about market views of inflationary pressures. For example, if the market respectfully took the view that the MPC would do whatever was needed to keep inflation on target, the near-term yield curve would indicate how the market thought monetary policy should be set to deliver the target. A rising/falling curve would indicate a market view of strengthening/easing inflationary pressures.

Short sterling futures and swap rates indicate expected nominal interest rates, subject to the point above about risk premia. However, expected monetary policy—ie expected official rates—cannot be inferred directly from the short sterling or swap curves, because there are credit spreads, which may vary over time.

Thus short sterling futures are contracts on the three-month London interbank rate, whereas the MPC sets a two-week repo rate.(1) Normally the short sterling futures rate might be around 20 basis points (hundredths of one per cent) above the corresponding expected official repo rate for reasons of credit risk, liquidity and the difference in maturity of the two rates.(2) But there is no reason to think that this spread is constant—at present there are clear signs of a Millennium effect, for example—and indeed the analysis of spreads is an important topic of its own (see below). Likewise, since swap rates are based on current and expected future values of the six-month Libor rate, these tend to be higher than yields on government bonds of the same maturity.

For any given path for expected nominal interest rates—whether official or market rates—an important issue for monetary policy analysis is the decomposition between expected real rates and expected inflation (and risk premia). A recent practical example of this issue arose in May this year. The short sterling curve, which had been close to flat in the early part of the month, rose quite sharply (see Chart 3).(3) (This phenomenon was not confined to the United Kingdom, and indeed it seemed partly to have followed US developments.) Had expected inflation risen sharply? Or expected real rates? Or was something else, not in the textbooks, going on?

Chart 3
Short sterling curve



Different explanations have potentially different policy implications. Higher inflation expectations, if justified, might point in the direction of raising the official rate. However, a tightening in market real rates would tend to dampen activity and prospective inflation, which could be a factor pointing towards lowering the official rate, at least in the short term, to keep inflation on track to meet the target. (But note that this would not be appropriate if the higher real rates were anticipating a tightening of monetary policy needed to head off a rise in prospective inflation.)

The evidence considered at the June meeting of the MPC was mixed. At longer maturities, index-linked bond yields had changed little but nominal yields had risen, suggesting that inflation expectations had increased. But it was possible that changes in risk premia (eg as the after-effects of LTCM faded) and institutional factors (eg pension fund regulations) were distorting inflation expectations as measured by yield curve differentials. Survey evidence and other forecasters' projections showed little rise in short to medium-term inflation expectations. Overall it was judged implausible that inflation expectations had risen by as much as short-maturity forward rates, so short real yields had probably risen.

What do asset prices add to other information?

The fact that asset prices on their own can yield information for monetary policy purposes does not mean that such information is necessarily worth much—beyond its value as a cross-check on other forecasts—on top of all the other information that is available to guide policy. I want to argue, however, that its value-added is substantial.

(1) The repo rate is the official rate of interest chosen by the MPC at which the Bank of England lends to the money market. See the box on page 5 of Monetary Policy Committee (1999).
(2) See the box on page 331 of the November 1997 *Bank of England Quarterly Bulletin*.
(3) The steepening of the curve increased over the summer. One manifestation of this is the comparison between inflation projections conditional upon a constant interest rate and upon market interest rates. In the May 1999 *Inflation Report*, market rates were consistent with the official rate remaining not far from its then prevailing rate of 5.25% over the two-year forecast period. But by the time of the August *Inflation Report*, market rates were implying an official rate two years ahead some 2% above the then prevailing official rate of 5%. In May the inflation projections conditional upon market and constant rates were virtually indistinguishable. Not so in August.

One way to consider this issue is to start from the standard Taylor rule.[1] This rule sets the interest rate above or below some 'neutral' level to a degree which depends on (i) the difference between current inflation and target inflation, and (ii) the difference between actual and potential output—the output gap. Assuming that asset prices are not included in the inflation measure, this rule appears to ignore asset price information, except insofar as it is used to determine the neutral level of the interest rate.

Compare this with a regime, such as that in the United Kingdom, where monetary policy, which works with lags, is set with a view to getting *prospective* inflation on target. In that context, asset prices are helpful both in forecasting (making projections of inflation prospects) and in policy analysis (assessing how policy might affect those prospects).

At a technical level, asset prices feature in a number of the models, including the core macroeconometric model, that are used to help the MPC form its projections for inflation and growth—as described in the recent book *Economic models at the Bank of England*. And a central theme of the recent MPC paper on *The transmission mechanism of monetary policy* is the key role of asset prices in the processes whereby monetary policy decisions work through the economy. But I will not attempt to summarise those expositions here.

House prices

Most of the discussion so far has concerned financial assets that are continuously traded in liquid wholesale markets with low transactions costs, where prices reflect market perceptions more or less instantaneously. Markets for residential property are different. Homes, and loans secured on them, are the most important assets and liabilities respectively of the United Kingdom personal sector. Developments in house prices and activity are therefore a major part of the asset price information relevant for monetary policy. However, the relationships between house prices and inflation are complex and imperfectly understood.

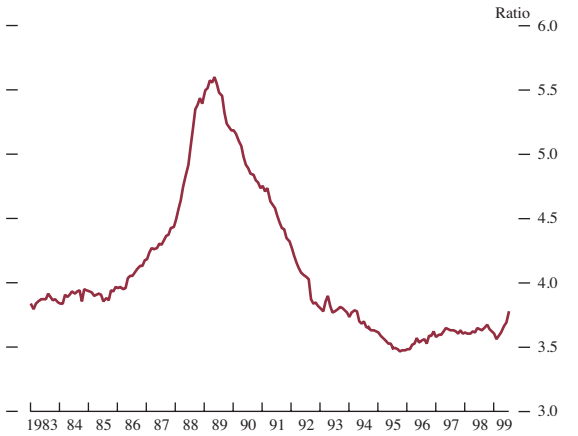
Consider, for example, some aspects of the relationship between house prices and consumer expenditure.[2] Higher house prices increase the (gross) wealth of homeowners, and greater wealth tends to lead to higher consumer spending. Indeed, it may be that increases in housing wealth tend to influence consumption more than increases in financial wealth. Property can be used as collateral for household borrowing—through mortgage equity withdrawal—more readily than, say, pension fund wealth. House prices may also reflect other influences on consumption, such as the level of, and uncertainty about, expected future income from employment—in short, confidence. And activity in the housing market, which tends to be greater when prices are rising, can have natural direct effects on the demand for consumer durables.

However, the effects of higher house prices on consumer spending are far from unambiguous. For example, higher house prices may lead non-homeowners—and more generally those who own less housing than their anticipated housing needs—to scale back expenditure on non-housing services.

With these and various other possible influences at work, there can be no precision in judging the implications for aggregate consumption even of past developments in house prices. There is the further difficulty of assessing possible future house price developments. At times house prices move sharply, not only in particular localities, and there have been episodes such as occurred ten years ago when an apparently self-fuelling house price boom abruptly collapsed. The rise in house prices was followed by a surge in goods and services price inflation, which neared 10% in 1990. A protracted depression of consumer demand followed the fall in house prices, partly on account of the negative equity of a number of indebted homeowners.

The current level of house prices nationally does not appear to be obviously abnormal in relation to income—see Chart 4—but house price indices have accelerated quite sharply in recent months. Annual house price inflation is currently 9% or so, and in the three months to August, house prices rose by about 5% and 4%, according to the Halifax and Nationwide measures respectively.

Chart 4
House price to earnings ratio[a]



(a) Ratio of Halifax house price index to ONS whole-economy earnings.

Assessing the possible implications for demand and inflation of house price developments is a highly uncertain matter. But monetary policy requires continuous assessment of the evolving balance of risks to prospective inflation. House price developments are a part of this—if only a relatively small part of a larger picture—because, like other asset price developments, they add to the other information available to guide judgments about inflation prospects. So house prices are not an independent concern of monetary policy. Like

(1) There are of course many variants of the standard Taylor rule—for example incorporating expected future inflation rather than current inflation. Bernanke and Gertler (1999) compare policy rules based on expected future inflation with and without an independent role for asset prices. In their simulation experiments, the best policy—in terms of minimising inflation and output volatility—is to focus aggressively on expected inflation and not to pay attention to asset prices, except insofar as they matter for expected inflation (which they do).
(2) There are also direct effects of house prices on inflation measures—see footnote (1) on page 429.

every other economic indicator, they matter to the extent—and only to the extent—that they say something about overall inflation prospects.

Equity prices and the bubble question

No discussion of asset prices nowadays would be complete without a word on the equity bubble question. Is there a bubble in equity prices? Can monetary policy deflate, or pre-emptively burst, asset price bubbles? If so, should it? The answer to the first of these questions is that you never know for sure whether market prices do, or do not, reflect economic fundamentals. Most of the techniques for extracting information from asset prices discussed above are based on the bubble-free assumption that asset prices do reflect fundamentals. Sensible use of those tools requires constant awareness that this might not be true. Bubble detection, by contrast, requires independent knowledge of the fundamentals, or at least of their bounds.

Explanations based on fundamentals of the current levels of equity prices, notably in the United States, have to stretch in a number of directions—for example concerning future profit growth rates, discount rates and risk premia.(1) However, it is by no means certain that there is a large bubble in equity prices, and that a sharp 'correction' will happen. But of course it might.

Can monetary policy burst bubbles? This question is hard to think about, because in theory the ways that monetary policy might naturally affect equity prices involve the fundamentals—short-term discount rates and perhaps profit growth rates—whereas bubbles are departures from the fundamentals. It is quite possible that a sharp monetary policy tightening could be the straw that breaks a bubble's back, but exactly how we do not know.

Suppose, I think unrealistically, that the monetary authorities *could* identify and pre-emptively burst bubbles; then should they do so, even if this meant prospective inflation undershooting the target? Assume that bubbles grow before they burst, and that as they grow, so too do the associated uncertainties for future inflation and output. If those uncertainties are undesirable, which is entirely consistent with inflation targeting, then there is a case for tightening policy to burst a growing bubble early on. Even with a symmetric inflation target, expected inflation somewhat under target with moderate inflation uncertainty might be better than expected inflation on target with high inflation uncertainty.(2)

Yes, but there are such doubts about the authorities' ability to detect and burst bubbles, especially in their infancy, that I do not find this a practically persuasive argument for aiming *off* the inflation target on account of possible bubbles. Of course, this is quite consistent with taking account of possible bubbles when aiming *at* the target. Moreover, if markets believed that monetary policy was responding, or would respond, directly to particular asset price developments, then monetary policy could itself come to distort those asset prices, with consequent misallocation of resources.

This discussion has echoed the findings in the recent paper by Bernanke and Gertler (1999). The main conclusion from their analysis is best quoted verbatim (but with emphasis added):

'Inflation-targeting provides an effective, unified framework for achieving both general macroeconomic stability and financial stability. Given a strong commitment to stabilizing expected inflation, it is neither necessary nor desirable for monetary policy to respond to changes in asset prices, *except to the extent that they help to forecast inflationary or deflationary pressures*.'

Conclusion

In a number of countries, including the United Kingdom, recent times have seen sharply rising asset prices while the inflation of consumption goods and services prices has been subdued. Does asset price inflation mean that monetary policy should be tight even if current inflation is low? And if asset prices were to fall sharply, should monetary policy be loose even if current inflation was higher?

One way of summarising the arguments in this paper is to say that the answers to questions of this kind flow from the straightforward proposition that monetary policy should be set so that *prospective* inflation of consumption prices is on target. If asset prices were a substantial element of the targeted inflation measure, then policy would respond partly automatically to asset price inflation/deflation. But I doubt that they should be. If policy-makers went bubble-hunting, then suspicious asset prices could acquire special significance for policy. But that would seem a hazardous pursuit.

Asset prices matter for monetary policy simply because they help to inform judgments about inflation prospects. They do this because, in part, asset prices *are* judgments about economic prospects. So asset price makers and interest rate setters have a good deal in common. Both must look ahead, and in doing so they are well advised to keep an eye on each other.

(1) See Wadhwani (1999) for a discussion of US equity price levels.
(2) Kent and Lowe (1997) develop this sort of argument formally. The logic is like Brainard uncertainty. If the policy-makers' loss function—ie loss as a function of the extent to which inflation misses the target—is convex, then inflation uncertainty matters as well as mean inflation. For example, with a quadratic loss function, the mean and variance of inflation both matter.

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Interest rates and the UK economy—a policy for all seasons

In this speech,[1] *Mervyn King,* ***Deputy Governor****, explains that ensuring macroeconomic stability is the Monetary Policy Committee's key objective. He stresses the forward-looking nature of monetary policy, and argues that the September interest rate rise should be seen as pre-emptive rather than premature. He dismisses suggestions that fiscal and monetary policy are not well coordinated and that fiscal policy could be used on a monthly cycle to help control inflation.*

Introduction

Twelve months or so ago, interest rates were 7½%; now they are 5¼%. Twelve weeks ago they were only 5%. So why do interest rates sometimes go down and sometimes go up? And why, in particular, did interest rates rise in September? At one level, the answer to these questions is straightforward: interest rates move—whether up or down—in order to keep inflation on track to hit the target of 2½%.

But, at a deeper level, why should monetary policy aim at a target for inflation rather than at growth and employment? Most people in this audience today belong to the 'inflation generation'. You will have lived through a time in which inflation was a fact of life. For much of UK history, prices were relatively stable. But during the 1960s, inflation started to rise. In the 1970s, inflation averaged no less than 13% a year, with a peak of more than 27% in August 1975. During the following decade, inflation averaged 7% a year, and it has fallen to around 4% in the 1990s. Between June 1997—when the Monetary Policy Committee met for the first time—and August 1999, RPIX inflation averaged 2.6%. During that period, inflation has ranged from a low of 2.1% to a high of 3.2%. The experience of the past decade has been that low and stable inflation has gone hand in hand with more stable growth of output and employment. Total output in the economy has now increased for 28 consecutive quarters—an unprecedented period of positive growth. And unemployment, as measured by the Labour Force Survey, has fallen from a peak of 10.7% in 1993 to its current rate of 5.9%, the lowest level for nearly 20 years. The current outlook is for continued growth with low inflation.

If Britain is to retain this degree of macroeconomic stability, then there will be periods when interest rates will rise and periods when they will fall. For some commentators, however, interest rates can never be too low. But for too long there has been a view that interest rates should rise only when *necessary*, and should be lowered whenever *possible*. That asymmetric response was a recipe for instability.

The current monetary policy regime has been designed to lock in the greater stability of both inflation and output. There are three key elements in the regime. First, there is a clear and unambiguous objective for monetary policy—an inflation target of 2½%—set by the Government. Second, decisions on interest rates are taken each month by the Monetary Policy Committee (MPC), comprised of nine individuals with expertise in monetary policy—five executive members of the Bank and four non-executives—who operate on the basis of one person, one vote. There is, therefore, an appropriate division between the objectives of monetary policy, which are set by the democratically elected government, and the implementation of those objectives, which is delegated to a group chosen for its expertise. The third, and crucial, component of the regime is that the monetary policy process is characterised by a high degree of transparency and openness. Minutes of the MPC meetings are published within two weeks, and each quarter the Bank's *Inflation Report* contains the Committee's views on the outlook for inflation and output. It is important that the MPC explain its decisions, not least to make future decisions as predictable as possible in the light of the evolving economic data.

Of course, it is always easier to explain policy when the decisions are popular. We have to redouble our efforts when decisions are less popular, and so I am delighted to have an opportunity this evening to explain and to listen. I shall leave plenty of time for questions, because one of the purposes of visits such as these is to see things from *your* perspective. As Rabbie Burns wrote,

> 'O wad some Pow'r the giftie gie us
> To see oursels as others see us!'

So the job of the MPC is to listen and to explain. And the test of the Committee is whether it is successful, both in meeting the inflation target and in explaining why interest rates must change in order that the target be met. For that reason, the MPC must be setting a policy for all seasons. Some of you may say that it is all very well to set a policy for all seasons, but what about a policy for all regions, or all parts of the United Kingdom? Many critics disapproved of

(1) Speech to the Scottish Council Development and Industry, Edinburgh, on 11 October 1999. The speech may be found on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech55.pdf.

the recent increase in interest rates. Indeed, the Scottish Council Development and Industry (SCDI) itself described the decision as 'disappointing'. It also described the rise as 'premature'; we would describe it as pre-emptive: prompt action to head off inflationary pressures in the future and so lower the level at which interest rates might otherwise need to be set. The SCDI said that 'Scottish business is regaining confidence after a tough period, but this announcement [of a rate rise] will dent that confidence'. Yes, it has been tough—indeed remains tough—for some industries, especially agriculture, tourism and parts of manufacturing. But there has not been an overall recession. GDP growth in the United Kingdom, over the previous twelve months, reached a trough of 1.3% in the first quarter of this year, and has been rising since then. With the new quarterly data, published by the Scottish Executive, it looks as though in the year to Q1, output growth in Scotland was higher than in the United Kingdom as a whole. The latest surveys show business confidence continuing to rise. And most welcome of all, unemployment has continued to fall in Scotland, as in most parts of the United Kingdom.

Nevertheless, the high level of sterling has undoubtedly caused serious problems for many sectors of the economy. As a result, some critics have argued that, with sterling at its present level, the burden of containing inflation should fall more on fiscal policy. By raising taxes or cutting expenditure this would, it is argued, enable the MPC to lower interest rates, thus bringing down the pound. There is, it is alleged, a failure of coordination between monetary and fiscal policy. This argument deserves a reasoned answer.

So tonight I want to answer two questions. First, why did the MPC feel it necessary to raise interest rates in September, at a time when inflation was a little below target and might fall further in the next few months? Second, is there adequate coordination between monetary and fiscal policy under the new arrangements?

Setting interest rates to meet the inflation target

What a difference a year makes. Last October, bankers, especially in the United States, were talking about the worst financial crisis of their adult lifetimes. Reports from the Bank's regional Agents indicated that business sentiment had deteriorated sharply, and the CBI's October Industrial Trends Survey showed that optimism about business conditions among manufacturers fell to its lowest level since 1980. The possibility of a recession was widely discussed. The MPC responded to the change in sentiment and to worsening conditions in the world economy. It reduced interest rates by 2½ percentage points between October 1998 and June 1999. And there has been a marked turnaround in sentiment during this year. Confidence measures have returned to their pre-October 1998 levels.

This volatility in sentiment is not reflected in the statistics on economic growth. The latest estimates show that over the past two years, output growth in the United Kingdom has been steady and close to trend with the exception of two quarters (1998 Q4 and 1999 Q1), during which a run-down in stocks temporarily reduced growth. This stability was partly the result of pre-emptive monetary policy which, by reacting to the forward-looking information in surveys and other data, was able to prevent the volatility in confidence feeding through to the real economy.

For some time now, the high level of sterling together with falling world commodity and food prices has restrained retail price inflation. The prices of imports into the United Kingdom fell by 15% in the past four years. It is inevitable that this favourable impact on inflation can be only temporary. Only a further sharp rise in sterling, and further falls in commodity prices, could maintain these rates of decline of import prices and their benign effect on retail price inflation. And we see that these effects are now coming to an end. Import prices are beginning to rise, partly because of the recent rise in oil prices, but also because the rate of decline in other prices is slowing, with sterling no longer appreciating as fast as it was.

It was possible to allow domestic spending in the economy to grow rapidly in recent years because the appreciation of sterling led to weak net trade. In real terms, the deficit in trade of goods and services has deteriorated sharply. But just as the one-off effects of lower import prices will not continue to hold down retail price inflation, so the rapid growth of domestic spending is itself unsustainable. In 1998 the increasing trade deficit reduced output growth by more than 2%. So modest output growth in the economy as a whole was consistent with rapid growth of final domestic demand—that is spending by households, governments and business on consumption and investment. But the pace at which the trade position is deteriorating is itself now moderating, and final domestic demand grew by 4½% in the first half of 1999. So, even without any improvement in the trade deficit, the growth of final domestic demand will have to moderate to prevent GDP growth rising above trend and putting pressure on the supply capacity of the UK economy. Indeed, if the trade deficit is to be reduced, then domestic demand growth will have to fall below the growth of total output for a while.

So by the time of the September MPC meeting, much had changed from earlier in the year. New data showed that final domestic demand was growing faster than expected. The data on the housing market—for the United Kingdom as a whole, not just the South East—as well as credit indicated that the strong consumption growth over the past year might persist. And house prices, I should add, enter our decisions, because of their implications for future consumption, not because we are trying to target house or indeed any other asset prices. Unemployment was still falling: the Labour Force Survey measure of unemployment had reached its lowest rate since the series started, while the claimant count had fallen to its lowest level since 1980. The Bank's Agents had also noted tightness in the market for both skilled and unskilled labour. Oil prices had risen

sharply during the year. These factors led a majority of the Committee to vote for a modest rise in interest rates of 25 basis points in order to keep inflation on track to meet the 2½% target.

The task now is to continue looking ahead. To do this the MPC has to assess the prospective balance between demand and supply in the economy as a whole. That requires an analysis of both demand *and* supply developments. The interesting feature of recent quarters has been the combination of strong demand growth and a tight labour market on the one hand, with weak wage and price pressures on the other. So the MPC monitors monetary data as well as signs of tightness in both labour and product markets, in order to detect early warning signs of inflationary pressures.

The MPC needs as much timely and accurate information as possible. Official statistics and surveys provide an excellent starting-point. But they often need to be complemented by more timely and focused information on particular aspects of the economy. So the Bank has a network of twelve Agencies, which gather economic intelligence from all parts of the United Kingdom—from Cornwall to the Highlands and Islands, and from County Tyrone to the Norfolk Broads. The task of these Agencies is to provide information on the state of the local economy. In total, the Agents have around 7,000 business contacts covering all sectors of the economy, from farming to finance and textiles to tourism. Our Scottish Agent, Janet Bulloch, who is with us tonight, is well known to many of you. I would like to thank those of you who give your valuable time to see Janet and her team. She and her staff see some 500 business contacts a year, and report the information gathered directly to the MPC. In addition, members of the MPC themselves make regular visits to different parts of the country to listen and learn. And I shall be doing that during my visit to Scotland.

So whatever the critics may think, we are not short of information. Of course, whenever interest rates rise it is always said that the rise might be appropriate for *certain* parts of the country, but is wrong for some sectors of the economy, some regions or even some companies. The UK economy, we are reminded, is not homogeneous. Of course it isn't, and a good job too. But policy can never be set with the interests of one sector, or one region, let alone one company, in mind. And it isn't. I can assure you that policy is not set with the South East of England in mind. But equally, it is not set either in the sole interest of the North East of England or Scotland. It is set for the United Kingdom as a whole.

Some have argued that if monetary policy has but a single instrument, namely the national interest rate, then would it not be sensible to use other policies to reduce imbalances in the economy? In particular, it has been suggested that fiscal policy should complement monetary policy in bringing demand into line with supply.

Coordination between monetary and fiscal policy

An occasional criticism of the new arrangements is that they impede proper coordination of monetary and fiscal policy. Two main reasons are usually advanced. First, the monetary and fiscal authorities may have conflicting objectives which they are free to pursue. Second, even if they have the same objectives they may be uncertain of each other's intentions. Neither concern is, I believe, well-founded. The first stems from a line of academic thinking which assumes that the central bank attaches more importance to the control of inflation than does the government, which in turn gives greater weight to output and employment. Hence when setting interest rates and fiscal policy, the two authorities could be pulling in opposite directions, and, realising this, might pull harder to offset the actions of the other, resulting in a distorted policy mix. Although such an outcome is possible in principle elsewhere, this problem does not arise in the United Kingdom. The reason is simple. The Chancellor sets the objectives for both fiscal *and* monetary policy. It is the Chancellor who sets the inflation target and then delegates the responsibility for achieving that to the MPC. So no conflict arises.

Nor are the two authorities unaware of what the other is doing. A Treasury representative attends meetings of the MPC, and one of his duties is to brief the Committee on fiscal policy developments. This may take the form of advance notice of the overall fiscal stance to be announced in the Budget. Equally, he reports back to the Chancellor on the monetary policy decisions of the MPC. This clear, open and systematic line of communication works, if anything, better than the old practice where the markets would speculate on whether the government might 'reward itself' by an interest rate cut if the Budget was well received.

But there is a further weakness in the proposition that monetary and fiscal policy are in some sense alternative instruments for influencing movements in aggregate demand over the cycle. There is a natural monthly cycle to monetary policy. Many of the relevant economic statistics are available monthly. But the natural cycle for fiscal policy is annual rather than monthly. It is costly to change taxes and government spending frequently. Changes in tax rates can distort the choices of the private sector and lead to a misallocation of resources. To raise and lower public spending at short notice can disrupt the provision of public services. And there are inevitable legislative and administrative lags in quickly implementing changes in tax rates and government spending. Tax rates and public expenditure should reflect long-run priorities of the elected government, and are not well-suited to frequent changes. Since the MPC first met in June 1997, it has raised interest rates on six occasions, lowered them on seven occasions and left them unchanged sixteen times. It would make no sense for a government to try to change tax rates with that frequency.

For these reasons, fiscal policy is set so that the public finances follow a sustainable medium-term path. This commitment to budgetary prudence is enshrined in the net debt rule and the rule that public borrowing should finance investment and not current expenditure. In Hamlet, the advice of Polonius to his son was, 'neither a borrower nor a lender be'. If we update Shakespeare's dictum to 'neither a borrower nor a lender be over the economic cycle except to finance public investment', then you have the spirit of the government's fiscal policy rules, if not the same elegance of language. So fiscal policy is set on an annual basis to maintain a sustainable path for the public finances in the medium term. Monetary policy is set month by month to meet the inflation target. It is no part of the government's responsibility to make life easier for the MPC by manipulating fiscal policy to manage the economic cycle. What matters to the MPC is the overall fiscal stance, and that it remains on a sustainable basis. Decisions on that are made once a year in the spring Budget. In the United Kingdom, coordination between monetary and fiscal policy works well.

Conclusions

In conclusion, therefore, I do not offer any simple solutions to the imbalances between different parts of the British economy. Fiscal policy is not an alternative to the month-by-month determination of monetary policy. And interest rates cannot target both inflation and asset prices, whether the exchange rate or share prices or house prices. Nor should they. Interest rates must focus on the economy-wide inflation target. But macroeconomic stability benefits *all* sectors of the economy. That stability, upon which the aspirations of parliamentarians, both at Westminster and in Edinburgh, depend, is fundamental to the future prosperity of the United Kingdom. And to maintain stability, interest rates will sometimes go down and sometimes go up. For a quarter of a century, my generation—the inflation generation—suffered from the instability created by high and unpredictable inflation. To the next generation, I would like the Prime Minister, whoever he or she is at that point, to be able to say, 'You've never had it so stable, not just for one year, or two years, or even three, but for a whole generation'.

It is well known that many, if not most, of the great British economists were Scottish. One of the few English economists to rival the Scots was John Maynard Keynes. His view was that, 'If economists could manage to get themselves thought of as humble, competent people, on a level with dentists, that would be splendid!'. So perhaps the fate of the MPC is, rather like dentists, to perform an important service but one which does not make people happy. Regular monitoring and early treatment, while rarely pleasurable, prevent more unpleasant symptoms later. So it is with a pre-emptive monetary policy. As we said in our press release in September, an early move in interest rates 'could lower the level at which interest rates might otherwise need to be set'. That is why we raised interest rates last month and why the MPC is committed to the consistent pursuit of a symmetric inflation target.

But that is not all. The new monetary policy regime is probably the most transparent and open in the world. We are committed to explaining our policy—both to improve the efficiency of monetary policy itself and also to build up support for what we are doing. Try going onto the Bank of England's web site—the address is www.bankofengland.co.uk—and you will find there the minutes of our meetings, as well as the *Inflation Report*, available to everyone. You will even find a copy of this speech. You may not always agree with our decisions, but I do hope you will understand the reasons for them.

Since the MPC was set up, there is, I think, a better understanding of what we are trying to achieve. Most of those who disagree with particular interest rate decisions accept that it does make sense to have an inflation target. Some might wish that we interpret the inflation target in a way that better serves the interest of their own sector of the economy, but that would be to court popularity in the short term at the expense of achieving low and stable inflation in the long term. We are committed to a dialogue, and that includes a dialogue with the people of Scotland. I cannot claim that we shall always do what some of you would like us to. But I can promise that we shall explain and we shall listen. And we shall remember those words of Rabbie Burns,

> 'O wad some Pow'r the giftie gie us
> To see oursels as others see us!
> It wad frae mony a blunder free us,
> And foolish notion.'

Some of you may still feel that the MPC's decision to raise interest rates in September was a 'foolish notion'. But I can assure you that our mission to explain will continue, and that we shall take the case for stability to every part of the country in order 'to see oursels as others see us'.

Contents of recent *Quarterly Bulletins*

The articles and speeches which have been published recently in the *Quarterly Bulletin* are listed below. Articles from November 1998 onwards are available on the Bank's web site at www.bankofengland.co.uk/qb/qbcontents.htm

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The relationship between openness and growth in the United Kingdom: a summary of the Bank of England Openness and Growth Project
Rationalisation of European equity and derivative exchanges
Implied exchange rate correlations and market perceptions of European Monetary Union
The Bank's regional Agencies
The Bank's Centre for Central Banking Studies—an update
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Are prices and wages sticky downwards?
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Testing value-at-risk approaches to capital adequacy
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Trade and investment in the light of the Asian crisis (S)
The UK economy and monetary policy—looking ahead (S)
Recent economic developments and the MPC approach to monetary policy (S)
Financial services into the year 2000 (S)

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Public sector debt: end March 1998
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The foreign exchange and over-the-counter derivatives markets in the United Kingdom
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Bank of England publications

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29	Pricing deposit insurance in the United Kingdom *(March 1995)*	David Maude William Perraudin
30	Modelling UK inflation uncertainty: the impact of news and the relationship with inflation *(April 1995)*	M A S Joyce
31	Measuring core inflation *(April 1995)*	Danny T Quah Shaun P Vahey
32	An assessment of the relative importance of real interest rates, inflation and term premia in determining the prices of real and nominal UK bonds *(April 1995)*	David G Barr Bahram Pesaran
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95	Price formation and transparency on the London Stock Exchange *(April 1999)*	Victoria Saporta Giorgio Trebeschi Anne Vila

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101	Monetary policy loss functions: two cheers for the quadratic *(September 1999)*	Jagjit S Chadha Philip Schellekens
102	Monetary stabilisation policy in a monetary union: some simple analytics *(October 1999)*	Andrew Brigden Charles Nolan

Statistical Abstract

The annual *Statistical Abstract* comes in two parts: Part 1 contains a range of banking and other financial data; Part 2 provides longer runs of monetary statistics and related items. For 1999, each part is priced at £20.00 (including postage) in the United Kingdom. A concessionary price of £15.00 per part is available to academics in the United Kingdom and £12.00 per part to students and secondary schools in the United Kingdom.

Monetary and Financial Statistics

A monthly publication, *Bank of England: Monetary and Financial Statistics (Bankstats),* was launched in January 1997. This comprehensive publication (priced at £80.00 per annum in the United Kingdom for 1999) contains detailed data on money and lending, bank and building society balance sheets, international positions of banks operating in the United Kingdom, government financing and the money markets (including gilt repo and stock lending), issues of securities and short-term paper, interest rates and exchange rates; it also contains occasional background articles. If you would like more information, please contact Daxa Khilosia, Monetary and Financial Statistics Division HO-5, telephone 020–7601 5353.

The following articles have been published in recent issues of *Monetary and Financial Statistics*. They may also be found on the Bank of England web site at www.bankofengland.co.uk/mfsd/article

Title	Author	Month of issue	Page numbers
Financial market data for international financial stability	Robert Heath	August	1–3
Internationalisation of financial markets and implications for data collection and statistics	Robert Hamilton	August	4–7
Statistics for international financial markets	Michael Bollan and Robert Hamilton	August	8–11
Developments in international banking statistics in 1998	Michael Bollan	July	1–6
Monetary statistics and the monetary financial institutions consolidated balance sheet	Sue Docker and David Willoughby	July	7–12
New data on financial derivatives for the UK National Accounts and Balance of Payments	Andrew Grice	July	13–19
1998 gilt ownership survey	Jonathan Bailey	July	20–23

Targeting Inflation book

In March 1995, the Bank hosted a conference of central banks currently adhering to inflation targets. This book, edited by Andrew Haldane, draws together contributions from each of the eight countries represented at the conference. It details cross-country experiences of this monetary framework and the key operational and theoretical issues it raises. The book is suitable for both academics and practitioners. The price of the book is £20.00 plus postage and packaging.

Index-linked debt book

In September 1995, the Bank held a conference to discuss a broad range of theoretical and practical questions raised by index-linked debt in general, and the UK experience in particular. This book contains revised versions of the papers presented at the conference, as well as the papers that were circulated by the Bank ahead of the conference, setting out background information and key policy issues. The price of the book is £10.00 plus postage and packaging.

Openness and Growth book

The *Openness and Growth* book, published in October 1998, contains the proceedings of an academic conference held at the Bank of England in September 1997. The research described in the book investigates the link between productivity growth and the international openness of the UK economy. The price of the book is £10.00 plus postage and packaging.

Economic models at the Bank of England

The *Economic models at the Bank of England* book, published in April 1999, contains details of the economic modelling tools that help the Monetary Policy Committee in its work. The price of the book is £10.00 plus postage and packaging.

Government debt structure and monetary conditions

In June 1998 the Bank of England organised a conference to discuss the interactions between the size and structure of government debt and monetary conditions. This book, to be published in December 1999, contains all but one of the papers presented at the conference, plus a background paper prepared within the Bank. The price of the book is £10.00 plus postage and packaging.

These publications are available from Publications Group, Bank of England, Threadneedle Street, London, EC2R 8AH; telephone 020–7601 4030; fax 020–7601 3298; e-mail mapublications@bankofengland.co.uk

Quarterly Bulletin and Inflation Report subscription details

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The *Quarterly Bulletin* is also available from Bell & Howell Information and Learning: enquiries from customers in Japan and North and South America should be addressed to Bell & Howell Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106, United States of America; customers from all other countries should apply to White Swan House, Godstone, Surrey, RH9 8LW, telephone 01444 445000.

An index of the *Quarterly Bulletin* is also available to customers free of charge from Publications Group at the address given below. It is produced annually, and lists alphabetically terms used in the *Quarterly Bulletin* and articles written by named authors.

Bound volumes of the *Quarterly Bulletin* for the period 1960–85 (in reprint form for the period 1960–80) can be obtained from Schmidt Periodicals GmbH, Dettendorf, D-83075 Bad Feilnbach 2, Germany, at a price of DM 190.00 per volume or DM 4,380.00 per set.

The *Quarterly Bulletin* is available on the Bank's web site at www.bankofengland.co.uk/qb/index.htm

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