Quarterly Bulletin

Spring 2003

Bank of England Quarterly Bulletin

Spring 2003

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Quarterly Bulletin—Spring 2003

This article reviews developments in sterling and global financial markets, UK market structure and the Bank's official operations since the Winter *Quarterly Bulletin*.

Research work published by the Bank is intended to contribute to debate, and does not necessarily reflect the views of the Bank or of MPC members.

Market-based estimates of expected future UK output growth (by Ben Martin and Michael Sawicki of the Bank's Monetary Instruments and Markets Division). This article derives some simple market-based projections of future output growth from a Taylor monetary policy rule, yield curves and inflation surveys. The results can be used as a timely cross-check on output growth expectations from other sources. We find that over the recent past the projections have been plausible in magnitude against both recorded outturns and survey expectations.

Monetary policy and the zero bound to nominal interest rates (by Tony Yates of the Bank's Monetary Assessment and Strategy Division). Some commentators have recently discussed the possibility that certain countries may experience a period of general price deflation. In such a situation, nominal interest rates may reach their lower bound of zero. This article concludes that the evidence available suggests that such a situation is highly unlikely to occur in the United Kingdom. It reviews what the academic literature has to say about the scope for alternatives to cutting interest rates in the improbable event that nominal interest rates do reach zero.

The measurement of house prices (by Gregory Thwaites and Rob Wood of the Bank's Structural Economic Analysis Division). House prices are an important consideration in assessing macroeconomic developments in the United Kingdom. But the special characteristics of housing—heterogeneity, infrequent sale and negotiated prices—give rise to important issues that complicate their measurement. There are several valid concepts of house prices—such as the average transaction price, the price of a typical house and the housing stock deflator—each of which is useful for a different purpose. Users must therefore be careful to match the measure they use with the concept of house prices they are interested in. Furthermore, all the available measures are volatile, so high-frequency changes in house price inflation should not be expected to persist.

Report on modelling and forecasting at the Bank of England. Report to the Court of Directors of the Bank of England on the modelling and forecasting systems within the Bank, prepared by Adrian Pagan of the Australian National University and the University of New South Wales.

The Bank's regional Agencies (by Phil Eckersley, the Bank's Agent for Northern Ireland and Pamela Webber, of the Bank's Inflation Report and Bulletin Division). This article describes the work of the Bank's regional Agencies, updating that published in the November 1997 *Quarterly Bulletin*. It outlines, in particular, the contribution of the Agencies to the work of the Monetary Policy Committee.

A review of the work of the London Foreign Exchange Joint Standing Committee in 2002. This note reviews the work undertaken by the London Foreign Exchange Joint Standing Committee during 2002.

Markets and operations

This article reviews developments in sterling and global financial markets, UK market structure and the Bank's official operations since the Winter Quarterly Bulletin.[1]

- *Forward sterling interest rates over the next five years fell significantly as the yield curve steepened, and the sterling ERI declined to a four-year low.*
- *This was against a background of broadly similar declines in euro and US dollar interest rate expectations and falls in equity markets globally, consistent with reduced expectations for global economic growth over the next few years.*
- *But it is difficult to disentangle the financial market effects of uncertainties relating to a possible war with Iraq. Indicators of uncertainty in financial markets give a mixed picture.*
- *The value of trades, including in sterling, settling through Continuous Linked Settlement has continued to increase, further reducing settlement risk in the global foreign exchange market.*
- *Work continues to allow money market instruments to be dematerialised, and issued and settled in CREST from September 2003, with the Bank planning to publish finalised* pro forma *terms of issue for these securities in early summer.*
- *CRESTCo also plans to introduce a new mechanism for settlement of term general collateral repo transactions, which might bring a welcome reduction in intraday payment flows and exposures among settlement banks and their customers.*
- *The Bank increased the size of its euro note programme by issuing the first €1 billion tranche of a 2006 note at 7 basis points below the three-year swap rate.*

Sterling markets

During the review period, the expected path of future sterling interest rates over the next few years, derived from market prices, declined materially (Charts 1 and 2). Broadly similar changes occurred in euro and US dollar markets, suggesting that the main underlying factors were international rather than specific to the United Kingdom.[2]

The Monetary Policy Committee (MPC) changed the Bank's repo rate once during the period, reducing it by 0.25 percentage points to 3.75% on 6 February (Chart 3). The Bank's repo rate had been 4% since 8 November 2001, the longest period of unchanged official UK interest rates since the period from February 1964 to June 1965. The rate reduction was followed by sharp falls in money market interest rates. Market participants reported that they had not anticipated a reduction until the second quarter of the

Chart 1
Changes in implied forward rates(a)
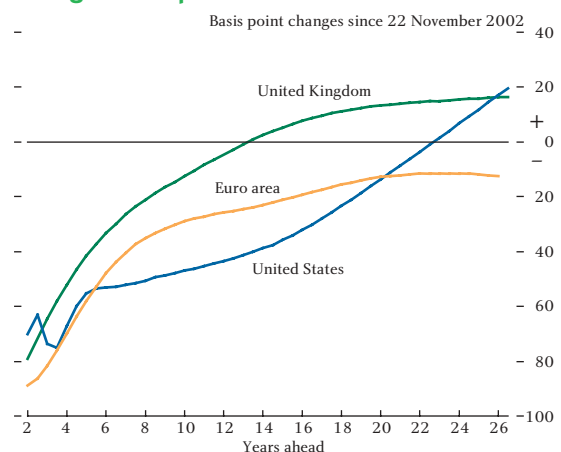
(a) Six-month forward rates derived from the Bank's government liability curves. (Estimates of the UK curve, and of instantaneous forward rates, are published daily on the Bank of England's web site at www.bankofengland.co.uk/statistics/yieldcurve/main/htm.)

year. Prior to the announcement, a Reuters poll suggested that economists had attached a mean probability of 20% to a quarter point rate reduction on

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(1) The period under review is 22 November 2002 (the data cut-off for the previous *Quarterly Bulletin*) to 3 March 2003.
(2) On 6 March 2003, shortly after the end of the review period, the European Central Bank reduced its official interest rate by 0.25 percentage points to 2.5%.

Chart 2
Changes in short-term interest rate expectations(a)

Basis point changes since
22 November 2002

Euro area

United Kingdom

United States
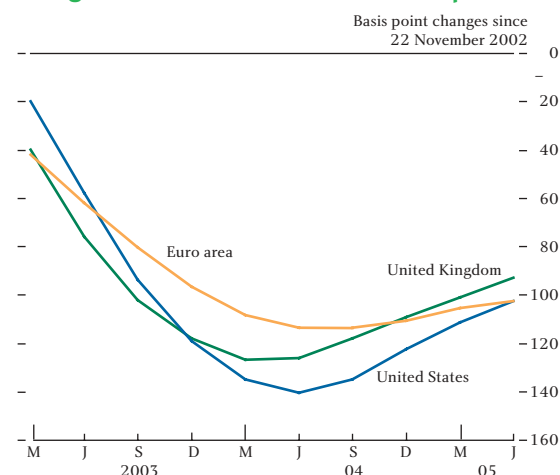
Source: Bloomberg.

(a) As implied by short-term interest rate futures contracts.

Chart 3
UK interest rates

Per cent

22 November 2002 (a)

Three-month £ Libor

Bank of England's repo rate
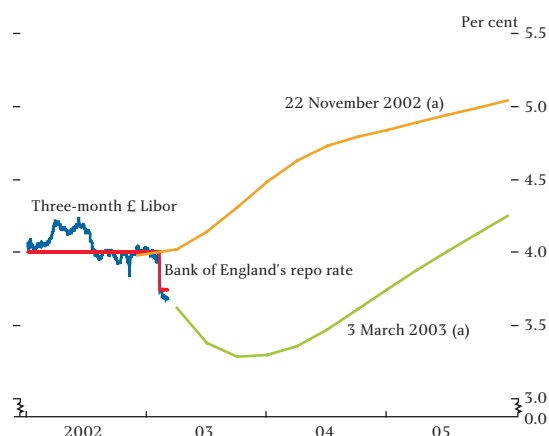
3 March 2003 (a)

Source: Bloomberg.

(a) Three-month interest rates implied by short sterling futures contracts
at the dates specified. From March 2003 onwards, the x-axis relates to
contract expiry dates.

Chart 4
Interest rate changes during 6 February(a)

Basis points

MPC
announcement

Euribor June 2003

30-year gilt

10-year gilt

5-year gilt

Short sterling December 2004

Short sterling June 2003
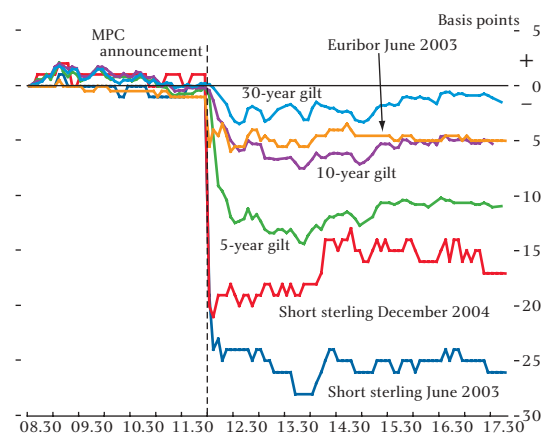
Source: Bloomberg.

(a) Cumulative changes at five-minute intervals.

6 February. Implied forward rates for the second half of
2003 also fell sharply, with an increase in expectations
that further rate reductions would follow (Chart 4).

The declines in implied interest rates 6 to 18 months
forward were greater than those on all previous MPC
announcement days (Chart 5); and these changes in
implied rates were larger than reactions to other news
events and economic data published since the previous
Quarterly Bulletin (Table A).

Chart 5
Range of changes in interest rates implied
by short sterling futures contracts on MPC
announcement days(a)

Basis points

Change on 6 February

Quarters to contract expiry
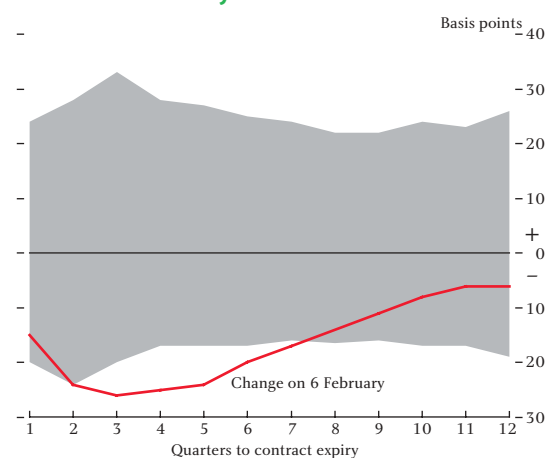
Source: Bloomberg.

(a) Grey area shows range of changes in interest rates in reaction to all
previous MPC announcements.

Table A
Financial market reactions to economic news(a)

|	June 2003 short sterling implied rate (basis points)	Ten-year gilt yield (basis points)	FTSE 100 (%)	$/£ (%) (b)	€/£ (%) (b)
Pre-Budget Report (27/11)	7	3	0.67	-0.03	-0.09
US non-farm payrolls and unemployment rate (6/12)	-4	-3	-0.76	0.22	-0.24
US ISM manufacturing (2/1)	3	1	0.90	-0.27	0.40
BRC retail sales monitor (c) (8/1)	-2	-2	0.20	0.80	-0.60
US non-farm payrolls and unemployment rate (10/1)	-4	-3	-1.00	0.29	0.01
UK retail sales (23/1)	4	1	0.30	0.12	-0.20
MPC announcement (6/2)	-22	-3	0.20	-0.32	-0.35
MPC minutes (19/2)	3	1	-0.20	-0.03	0.01
G7 Summit (c) (22–23/2)	-5	-3	0.20	-0.59	0.01
UK Treasury Select Committee (25/2)	-2	-3	-0.70	-0.53	-0.42

Source: Bloomberg.

(a) Reactions are broadly from 15 minutes before the data release to 15 minutes after,
except for Pre-Budget Report where they are from 15 minutes before to 45 minutes after
the Report.
(b) Positive numbers indicate sterling appreciation.
(c) Occurred outside trading hours. Reactions are from close of business the day before
to 15 minutes after the market opened.

Although changes in sterling money and bond markets
were broadly in line with overseas markets over the
period, the sterling exchange rate index (ERI) declined
by nearly 6.5% (Chart 6).

Chart 6
Effective exchange rate indices

22 November 2002 = 100

Chart 8
Sterling effective exchange rate

1990 = 100
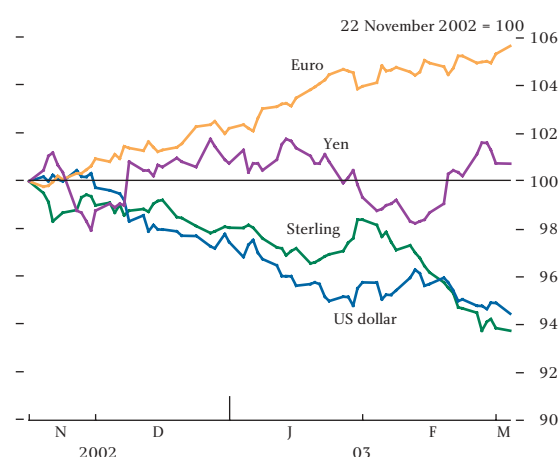
Market participants linked part of the decline in the ERI to the appreciation of the euro against the US dollar between November and January. But in February, sterling depreciated against all currencies in the ERI, and independently of movements in the euro/dollar exchange rate. Implied correlations, derived from options prices, suggested that options market participants had revised downwards their assessment of how closely sterling would trade with the euro over the next year (Chart 7).[1]

Table B
Exchange rate movements and news:
close of business 22 November–3 March

	£ ERI	€/£	$/£	$/€
Actual change				
(per cent)	-6.3	-7.9	-0.1	8.6
Interest rate news				
(percentage points)	0.7	1.5	1.7	0.2
of which: domestic	-6.0	-6.0	-6.0	-7.5
foreign	6.7	7.5	7.7	7.7

dollar market interest rates. Table B decomposes exchange rate movements according to the uncovered interest rate parity condition, which seeks to identify the role of interest rate news in explaining exchange rate moves.[2] Interest rate news here is measured as the change in the differences between ten-year UK and overseas government bond yields. This measure was not consistent with changes in the direction of either the sterling ERI or the bilateral euro/sterling and dollar/sterling exchange rates.

Chart 7
One-year implied exchange rate correlations

Correlation coefficient

Source: UBS Warburg.

Market participants have explained the decline in the sterling ERI partly as a result of downward revisions to forecasts for UK GDP growth in the next few years, including in the Bank's February *Inflation Report*. Some have also talked of a higher risk premium being applied to sterling because of expected UK involvement in a possible Iraq war and heightened alerts about possible terrorist attacks.

The sterling ERI had fallen to a four-year low of 100.1 by the end of the review period (Chart 8). Although much of this depreciation was subsequent to the reduction in official interest rates by the MPC, it is not easily explained by relative movements in sterling, euro and US
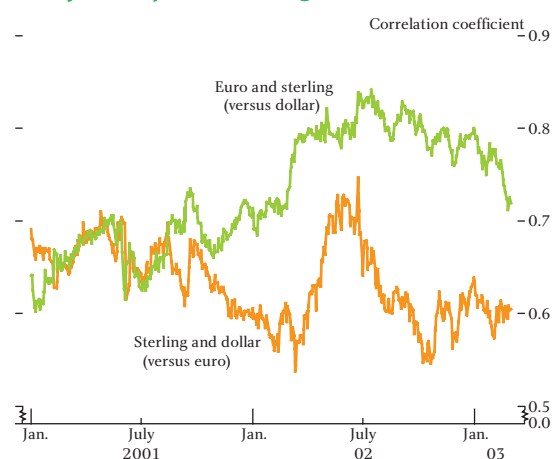
The Merrill Lynch survey of fund managers found that, despite the depreciation of sterling since December, the balance of respondents who thought sterling was overvalued had risen from 22% in November 2002 to 28% in February 2003. By contrast, more fund

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(1) For a discussion of implied correlations, see Butler, C and Cooper, N (1997), 'Implied exchange rate correlations and market perceptions of European Monetary Union', *Bank of England Quarterly Bulletin*, November, pages 413–23.
(2) The method of decomposing the uncovered interest rate parity condition to assess the impact of interest rate news on the exchange rate is explained in Brigden, A, Martin, B and Salmon, C (1997), 'Decomposing exchange rate movements according to the uncovered interest rate parity condition', *Bank of England Quarterly Bulletin*, November, pages 377–89.

managers thought that the dollar had become less overvalued, and the euro had become less undervalued.

Global asset price developments

The similar declines in sterling, euro and US dollar forward interest rates were combined with common falls in equity indices, particularly in common currency terms (Chart 9), perhaps reflecting expectations of slower global economic growth over the next few years. MSCI world equity price indices of companies in the same industries have fallen across a wide range of sectors (Chart 10), which might also suggest slower expected overall economic growth, or higher overall equity risk premia, rather than altered outlooks for particular industries.

Chart 9
Change in FTSE All-Share, Euro Stoxx 50, S&P 500 and MSCI,(a) **22 November–3 March**
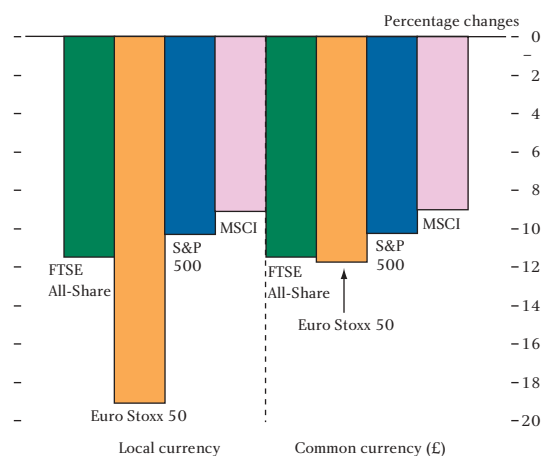
Source: Bloomberg.

(a) The Morgan Stanley Capital International World index is a capitalisation-weighted index that monitors the performance of stocks from around the world.

Chart 10
Sectoral performance of MSCI world equity index, 22 November–3 March
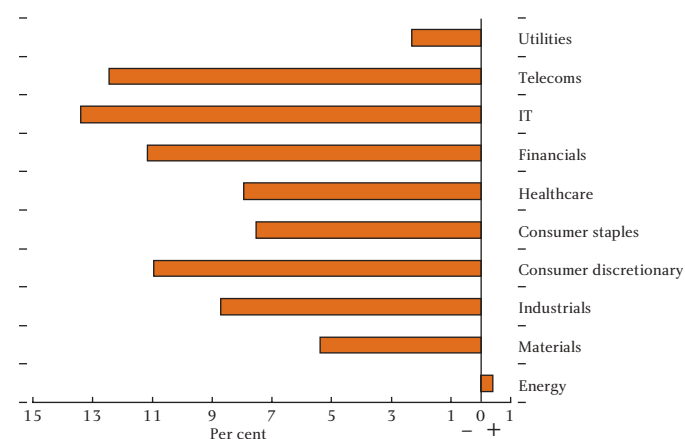
Source: Bloomberg.

Chart 11
Expectations for GDP growth
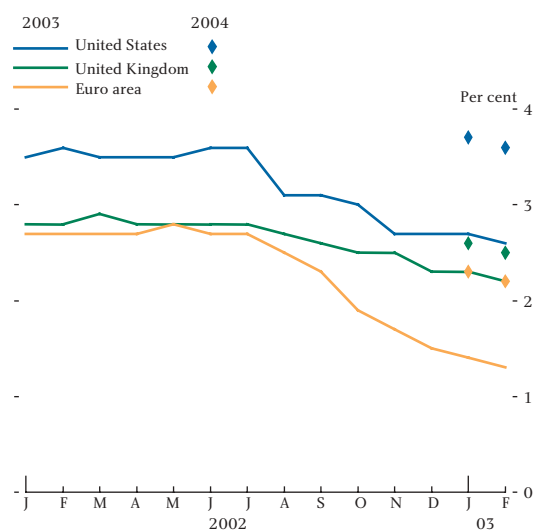
Source: Consensus Economics.

Consensus forecasts for UK, euro-area and US growth in 2003 and 2004 have indeed been revised downwards (Chart 11). But these changes in growth expectations are difficult to disentangle from possible changes in the real expected returns that investors require on more/less risky assets, perhaps linked currently to uncertainties about the economic effects of a war in Iraq.

Declines in nominal forward interest rates have been greatest at maturities in 2004–06 (Charts 1 and 2). At longer maturities, US dollar and euro nominal forward rates generally fell by less and sterling forward rates increased slightly as yield curves steepened, perhaps suggesting that the changes to growth expectations related mainly to the next few years rather than to the longer run. That would be consistent with a material fall in short-maturity real forward rates derived from index-linked gilts, whereas longer-maturity real forward rates are broadly unchanged; the net effect being that longer-maturity spot real yields have fallen.

Downward revisions to Consensus forecasts for GDP growth in 2003, although not 2004, have been greater for the euro area than for the United States and the United Kingdom. The greater fall in euro-area equity indices and the greater declines in near-term euro forward interest rates derived from government bonds (Charts 1 and 9) are perhaps consistent with these forecast revisions. But the appreciation of the euro against the US dollar and sterling over the period is less

easy to explain purely in terms of weaker economic prospects.[1]

Euro/US dollar exchange rate movements

The underlying explanation for the US dollar depreciation most commonly advanced by market participants is an adjustment to the further widening of the US current account deficit. The December 2002 OECD *Economic Outlook* forecast current account deficits of 5.1% and 5.3% of GDP for the United States in 2003 and 2004, but surpluses of 0.9% and 1.2% of GDP for the euro area and 3.8% and 4.2% of GDP for Japan, respectively. Chart 12 shows the US dollar ERI and the US current account balance since 1990. The appreciation of the US dollar ERI between 1995 and 2001 occurred broadly at the same time as the current account deficit widened, with overseas investors apparently prepared to finance the deficit because of the higher expected returns on US dollar-denominated assets, perhaps associated with the greater increases in US productivity relative to most other developed economies at that time.[2]

Chart 12
US current account balance and dollar effective exchange rate
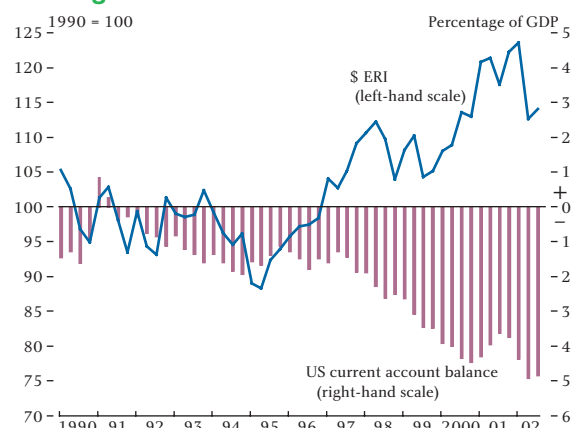
Sources: OECD and Bank of England.

For much of 1995 to 2000, net capital inflows to the United States were largely via equity purchases. More recently, purchases of bonds have accounted for a greater share of US capital inflows[3] (Chart 13). Increasing purchases of less risky assets may have given overseas investors less scope to benefit from the feed-through into corporate earnings of any greater US

Chart 13
Portfolio inflows into the United States
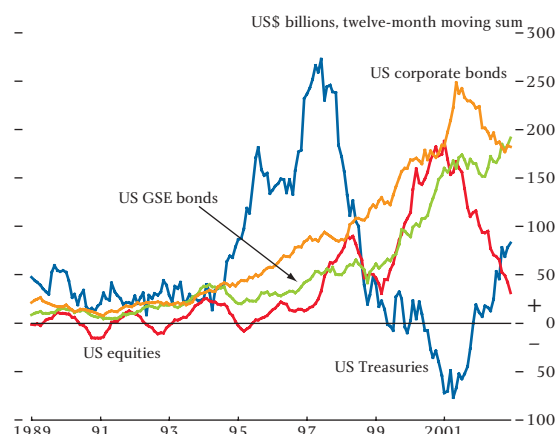
Source: US Department of the Treasury.

productivity gains. They may therefore have required some depreciation of the US dollar in order for expected risk-adjusted returns to reach their required level.

It may be that such an adjustment to the current and capital account positions of the United States and the euro area, combined with some downward revisions to global growth expectations, explains much of the financial asset price and exchange rate changes over the review period. But market participants have also stressed the importance of uncertainties related to a possible war with Iraq, the effects of which are difficult to disentangle.

Uncertainties about a possible war in Iraq

The financial market reaction to a possible war can be considered in terms of how a war is expected to affect the global economy, including the range of uncertainty around these expectations, and whether increased uncertainty itself has decreased willingness to take risk. The Bank's February *Inflation Report* (pages 48–49) included a broad analysis of the economic implications of a war, stressing the wide range of possible outcomes depending on the nature and length of any conflict and its aftermath. In general, equity prices fell and bond yields declined on developments interpreted by market participants as making war more likely or imminent, perhaps on an interpretation that any war could reduce expected global growth further.

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(1) Some of the greater fall in euro-area share price indices may have been to offset the effect of the euro's appreciation on overseas earnings of companies in these indices; but euro-area indices fell by slightly more even in common currency terms.
(2) For a discussion of the US dollar and the US balance of payments in the 1990s, see 'The financial stability conjuncture and outlook', *Financial Stability Review*, December 2000, pages 21–24.
(3) Including purchases of bonds issued by US government sponsored enterprises (GSEs, or 'agencies'). More information on GSEs is contained in Box 5 of the *Financial Stability Review*, June 2000, pages 54–55.

Chart 14
Brent oil futures

$ per barrel

3 March 2003

22 Nov. 2002

Source: Bloomberg.

Chart 15
Implied volatility of S&P 500 index compared with market value-weighted average implied volatility of S&P 500 stocks

Per cent

Market value-weighted average implied volatility

S&P 500 index implied volatility

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

One channel might be through higher oil prices. The spot oil price rose over the period (Chart 14), probably in part reflecting a higher risk premium as concerns about the impact of a wa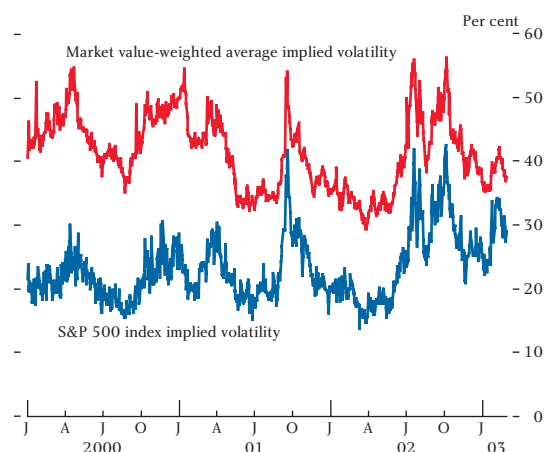r on oil supply increased. Disruption to oil supply related to strikes in Venezuela and heightened demand for heating oil due to the cold US winter may also have been influences.

Added uncertainty about the economic outlook due to a possible war might be expected to have led to higher implied volatilities of equity indices, interest rate swaps and short-term interest rates derived from options prices. But the picture is mixed. Implied volatilities of short-term interest rates have been fairly steady over the period. Equity index implied volatilities have remained at high levels, but below those of mid-2002, before prospects for an Iraq war increased.

One diagnostic that war-related uncertainties might be a factor, however, is that the implied volatility of the S&P 500 index has risen relative to the market value-weighted average of the implied volatilities of the individual stocks in the index, derived from single stock options (Chart 15). This might suggest that current uncertainties are mainly general, affecting all stocks more or less equally, rather than idiosyncratic, affecting some stocks more than others. The uncertain economic effects of a war, including via risk appetite, might be such a general factor.

It is, however, particularly difficult to tell whether war-related uncertainties have led to a general decrease in willingness to take risk. One set of indicators might be the prices of so-called 'safe-haven' assets. Unlike during some previous periods of heightened

international political tension, the US dollar has not behaved as a 'safe haven' and has fallen against other currencies on events interpreted as increasing the likelihood and bringing closer the timing of an Iraq war. Market participants have attributed this to an expected increase in the fiscal deficit related to a military conflict, against the backdrop of an already pronounced current account deficit and a risk of asset repatriation by foreign investors.

By contrast, the US dollar prices of gold and the Swiss franc rose sharply in the first half of the period (Charts 16 and 17). This may, however, simply have reflected the more general US dollar depreciation. There were smaller changes in the euro-denominated price of gold and the value of the Swiss franc against the euro over the period, indicating that the changes primarily reflected US dollar weakness.

Other indicators of willingness to take risk are also inconclusive or suggest little change. Spreads of swap rates over government bond yields rose in the euro area, except at shorter maturities, and generally declined in the United States and the United Kingdom. And in the corporate sector, spreads over swaps of US dollar and euro-denominated corporate bonds generally fell over the period while those on sterling-denominated corporate bonds fell for the first part of the period, but subsequently moved a little higher (Charts 18 and 19). The fall in spreads in December and January may have reflected some unwinding of the significant but selective tightening of wholesale credit markets in the late autumn, particularly in the United States.[1] Access to

(1) See also 'The financial stability conjuncture and outlook', *Financial Stability Review*, December 2002, pages 48–54.

Chart 16
Change in gold price

Percentage changes since 22 November 2002
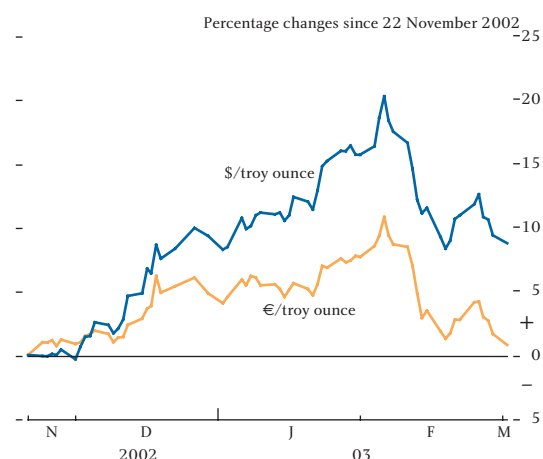
Source: Bloomberg.

Chart 17
Swiss franc exchange rates

22 November 2002 = 100

Chart 18
Spreads over swaps of international investment and sub investment-grade corporate bonds

22 November 2002 = 100
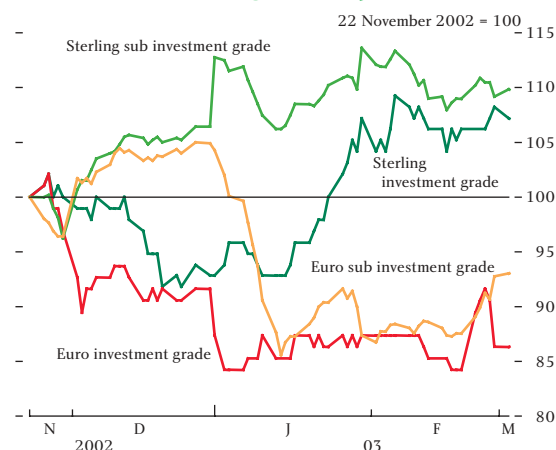
Source: Merrill Lynch.

Chart 19
Changes in spreads over swaps of US dollar corporate bonds, by credit rating
22 November–3 March
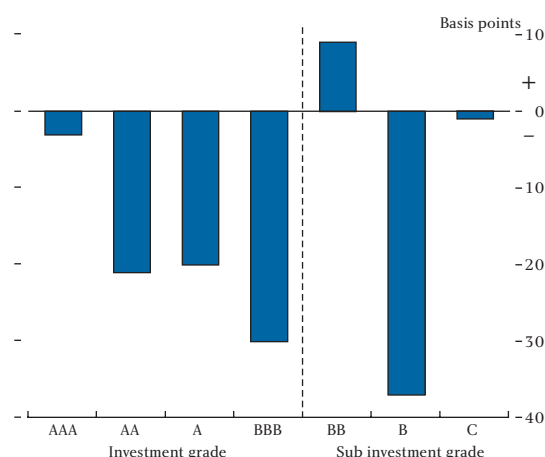
Source: Merrill Lynch.

Chart 20
Non-government international bond issuance

US dollar equivalent, billions

Source: Dealogic.

the primary market then bifurcated, with high demand for issues by strong companies, but with companies in more troubled sectors or with high leverage having to pay a premium for, or being unable to access, bond finance. Secondary market conditions were occasionally somewhat disorderly, and there was a sharp rise in demand for credit protection, for example in credit derivative markets.[1] By contrast, in the early months of 2003, non-government international bond issuance was strong (Chart 20), even for less creditworthy issuers. Many corporate issuers were able to raise funds at longer maturities, including 30-year euro-denominated issues by some European telecoms companies. While the US and European markets for initial public offerings have remained difficult, companies have been able to issue sizable convertible bonds in US dollars and euro.

(1) For a discussion of this market, see Rule, D, 'The credit derivatives market: its development and possible implications for financial stability', *Financial Stability Review*, June 2001, pages 117–40.

Reassessment of relative valuations of equities and bonds

Some market participants have linked the contrast between the strength of primary bond markets and weakness of primary equity markets, and between rising bond prices and falling equity prices, to evidence of sizable portfolio reallocations from equities into bonds. Many UK life funds, for example, have made substantial switches over the past couple of years and these are said to have continued over the period (see the box on page 13). Changes in pension fund asset allocation are said generally to have been smaller. Retail investors also seem to have favoured corporate bond rather than equity funds: for example, net sales of UK corporate bond individual savings accounts (ISAs) were significantly higher in January 2003 than a year previously, and net sales of UK equity ISAs significantly lower. Over 2002 in the United States, there was a net outflow from equity mutual funds, for the first time since 1988, of US$27 billion, or 0.9% of equity fund assets. Net new investments in bond funds reached a record US$140 billion.

It is tempting to link flows to relative price changes, and there may be some short-term impact. Over a longer period, however, arbitrage would be expected broadly to correct any obvious movement of prices away from the risk-adjusted present value of expected future cash flows. But the reallocations might have reflected a reassessment by some investors of the equity risk premium: the additional returns required on equities compared with bonds to compensate investors for equity market risk. In theory, the risk premium should depend on the covariance between equity returns and investors' consumption—so required returns would rise if expected equity returns or consumption became more volatile, or if they became more correlated. There is anecdotal evidence that some managers of life funds and company pension funds have indeed been rethinking what equity risk premium they require given the nature of the funds' liabilities. On the other hand, the series of leveraged buyouts of whole, or parts of, listed companies in recent months in Europe and the United States might suggest that other investors assess equity risk differently.

Looking forward, uncertainty about the equity risk premium may make it more difficult to judge whether equity prices have reached 'fair' values following recent declines. The decline in the price-earnings ratio for the

Chart 21
FTSE All-Share price-earnings ratio
(based on ten-year trailing earnings)

Source: Global Financial Data.

FTSE All-Share index—calculated in Chart 21 on the basis of ten-year trailing earnings to attempt to smooth out temporary variations in earnings—could be consistent with a rise in the equity risk premium to close to its average since 1937, but downward revisions to expected future earnings growth could equally explain some or all of this change.[1]

Another possible explanation for the decline in equity prices and bond yields is that there has been a reassessment of corporate bond risk following attempts by some companies to reduce debt an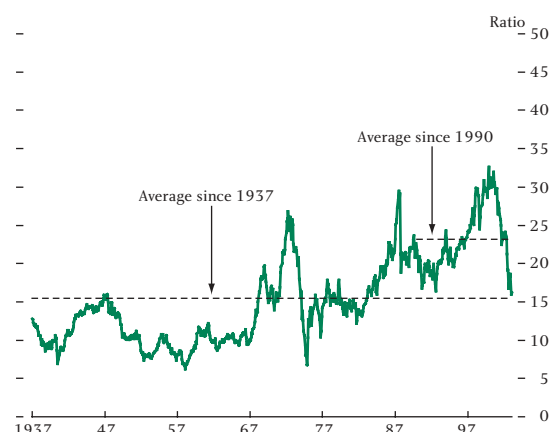d refinance existing debt at longer maturities. Chart 22 shows a reduction in capital gearing (at replacement cost) for UK private non-financial companies (PNFCs), from the peak of 33% in September 2001. Other things being equal, as a company's debt is progressively reduced

Chart 22
Capital gearing of UK PNFCs
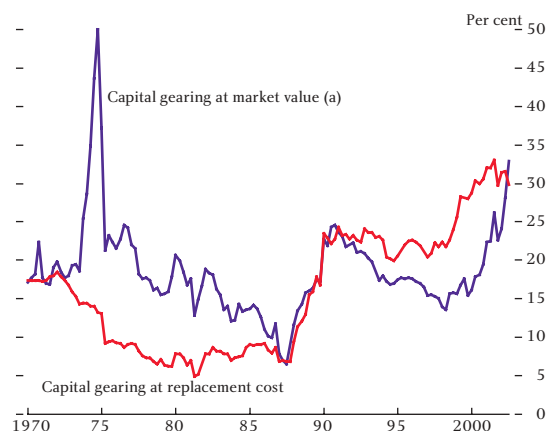
Sources: ONS and Bank of England.

(a) PNFCs' net debt divided by the market valuations of PNFCs.

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(1) See Vila Wetherilt, A and Weeken, O (2002), 'Equity valuation measures: what can they tell us?', *Bank of England Quarterly Bulletin*, Winter, pages 381–404, for a detailed analysis.

UK life insurance companies

UK life insurance funds intermediate a significant proportion of long-term UK household savings. For example, at end-2001 they held 20% of total UK equities.[1] Some of the market risk on these assets is passed on to savers: for example, through unit-linked products. But the companies are also exposed to falls in asset values, for example, through the provision of guaranteed returns on savings products, annuities, and 'with profits' policies.

Over recent years, the proportion of life insurance companies' assets held in equities has fallen (Chart A). In part, this reflects the fall in the value of equities relative to other assets. But they have also made net disposals of equities: for example, ONS data show that life insurers were net sellers of over £750 million in the third quarter of 2002.[2] The funds appear to have increased their holdings of bonds, particularly corporate bonds.

Chart A
Large UK life insurance companies' equity asset share(a)
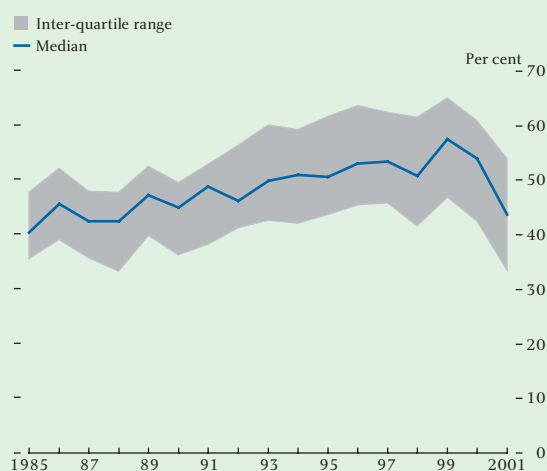
Sources: Standard & Poor's and Bank of England.

(a) Direct holdings and holdings in collective investment schemes.

Financial Services Authority (FSA) regulations require UK life insurance companies to have a sufficient surplus of assets over liabilities (referred to as the regulatory minimum margin) under current investment conditions and following possible future declines in asset values, including a fall in equity indices of up to 25%.

At times during the review period, and particularly in late January, market participants talked of further

sales of equities by UK life insurance companies, possibly motivated in part by the need to continue to meet these requirements as equity markets fell.

Many of the sales were said to have been executed in the first instance by selling futures contracts on the FTSE 100 index, consistent with a rise in volumes of contracts traded on LIFFE in late January. Purchases of futures would offset losses on cash equity holdings as a result of further declines in the overall market.

Market contacts also reported greater trading of FTSE index options. One strategy that life insurance companies were said to have employed was the simultaneous purchase of an out-of-the-money put option, to protect against significant further declines in equity prices, and sale of an out-of-the-money call option, in order to reduce the net cost of the protective put by giving up gains if the market were to rise significantly.

Insurers may also be exposed to falling bond yields if the bonds that they hold are of shorter maturity than the savings products or annuities on which they have guaranteed the returns. One way to hedge against this risk is through purchases of long-maturity swaptions, giving the right to receive a fixed return over a defined future period. Implied volatilities of 20-year euro and sterling swaptions exercisable in ten years' time rose in late January, with market contacts referring to further buying of swaptions by European and UK insurers and pension funds (Chart B).

Chart B
Implied volatility of 10-year/20-year swaptions in selected currencies
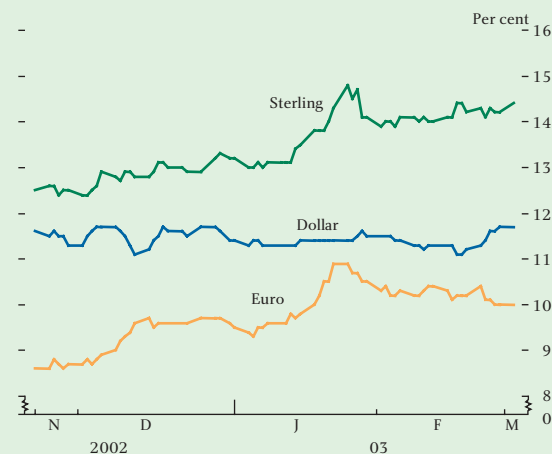
Source: Bloomberg.

(1) 'Share ownership: a report on ownership of shares as at 31 December 2001', *National Statistics* (2002).
(2) 'Insurance companies', pension funds' and trusts' investment', *National Statistics*, January 2003.

below the level of its assets, bond-holders become more confident that the debts will be repaid and hence will tend to require a lower credit risk premium.[1] There is evidence of similar debt restructuring in the United States and the euro area: for example, income gearing of US non-financial companies has fallen from its high in 2001 and US firms took on little net new debt in 2002, with balance sheet adjustment continuing through Q4.

Developments in market structure

Over the period, Continuous Linked Settlement of foreign exchange transactions has continued to grow, with an associated reduction in foreign exchange settlement risk; preparations for dematerialisation of money market instruments and their settlement in CREST have continued; CRESTCo has published details of a new means of settling repo transactions against general collateral, which could bring a welcome reduction in intraday flows and credit exposures between settlement banks and their customers; and major UK banks have increased the share of UK Treasury bills in their stock of liquid assets.

Continuous Linked Settlement

Both the volume and the value of foreign exchange transactions settling through Continuous Linked Settlement (CLS)[2] rose over the period. On 18 February, CLS Bank International (CLSB) settled trades with a gross value of just over US$1 trillion (Chart 23). The average daily value settled in February 2002 was US$618 billion compared with US$339 billion in November 2002, as reported in the previous *Quarterly Bulletin*. Comparing this with the Bank for International Settlements' (BIS') 2001 triennial survey of foreign exchange and over-the-counter derivatives suggests that CLS now settles just under half of the value of foreign exchange transactions undertaken by major banks.[3] Market participants expect that business will continue to increase this year, for a number of reasons. First, more non-European branches of CLS members will be submitting trades to CLSB.[4] Second,

Chart 23
Daily settlement volumes and values in CLS[a][b]

Source: CLS Bank International.

(a) Each trade consists of two sides.
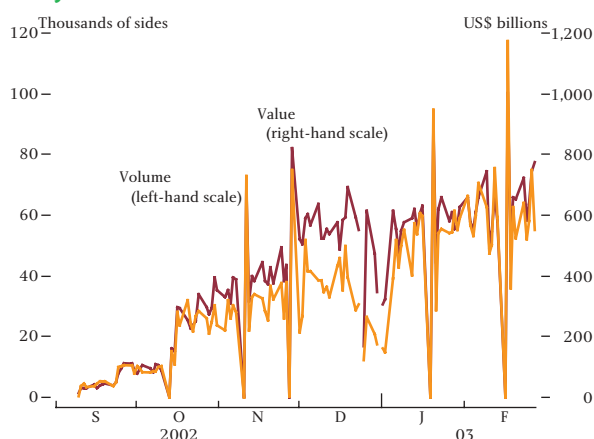(b) 14 October, 11 November, 28 November 2002, 20 January and 17 February 2003 were US holidays, which accounts for the very low levels of trades settled on those days.

more institutions are expected to become third-party members of CLS, settling foreign exchange trades via CLS members. Third, four new currencies are expected to become eligible for settlement through CLS—the Norwegian Krone, Swedish Krona, Danish Kroner and Singapore Dollar. Finally, CLSB has announced proposals to enable settlement of foreign exchange trades carried out by third-party customers of custodian banks, such as investment funds. These will require foreign exchange market participants to adopt a common identifier for such funds. The 2001 BIS triennial survey estimated that 10% of global foreign exchange turnover was related to such securities trading.

Market liaison committees

The introduction of CLS is one issue that has been discussed at the Foreign Exchange Joint Standing Committee (FX JSC), one of the three market liaison committees which the Bank chairs. The others are the Money Markets Liaison Group (MMLG) and the Stock Lending and Repo Committee (SLRC). They exist to provide a forum for discussion between market practitioners and the authorities in the respective markets.[5]

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(1) See Cooper, N, Hillman, R and Lynch, D (2001), 'Interpreting movements in high-yield corporate bond market spreads', *Bank of England Quarterly Bulletin*, Spring, pages 110–20 which includes a summary of the Merton framework.
(2) Continuous Linked Settlement, operated by CLS Bank International, was launched on 9 September 2002. It reduces foreign exchange settlement risk significantly by settling bought and sold currencies on a 'payment-versus-payment' basis. See the *Bank of England Quarterly Bulletin*, Autumn 2002 (pages 257–58) and Winter 2002 (pages 365–66), and the *Financial Stability Review*, December 2002 (pages 82–85).
(3) The latest (April 2001) BIS survey reported the average daily foreign exchange turnover of the largest market participants ('reporting dealers'), which includes all those currently settling trades through CLS, to be US$689 billion. However, CLSB data show both sides to a foreign exchange trade, whereas the BIS data are adjusted to show one leg of the trade only. Therefore to compare the two sets of data, it is necessary to halve the CLSB data.
(4) Some settlement members are currently using CLSB to settle only foreign exchange trades submitted by their European branches. Others are settling their entire global business through CLSB.
(5) For more information on the work of the FX JSC over the past year, see the article 'A review of the work of the London Foreign Exchange Joint Standing Committee' in this *Quarterly Bulletin*. For more information on the MMLG and SLRC, see *Quarterly Bulletin*, Winter 2001, pages 431–33. The minutes of the meetings of the Bank's market liaison groups are available on the Bank's web site at www.bankofengland.co.uk/markets/

FX JSC has also recently addressed the issue of undisclosed principal trading in the context of the Non-Investment Products (NIPs) Code. And contingency planning has been a major focus for both FX JSC and MMLG, which have been considering the needs of the various markets in London, including information flows, communications between firms and back-up sites, and liquidity needs. Conference call facilities have been set up and rehearsed for both FX JSC and MMLG members. MMLG has also made non-binding recommendations as to the appropriate rate to be applied to unintended long and short balances in the sterling money markets following major market disruption.

As well as contingency planning, subjects discussed by SLRC in recent months have included short selling, voting of lent stock, CREST stock lending statistics and a publication about securities financing.

Other issues discussed by MMLG have included the calculation of the Sterling Overnight Index Average (SONIA),[1] the use of gilts in the London Clearing House's RepoClear service, the Financial Services and Markets Act (and, linked to this, the NIPs Code) and the dematerialisation of money market instruments.

Settlement of sterling money market instruments

Work continues to dematerialise money market instruments (certificates of deposit, commercial paper, Treasury bills and bankers' acceptances), allowing them to be issued and settled in CREST from September 2003. At present, money market instruments are settled through a separate settlement system, the Central Moneymarkets Office (CMO), operated by CRESTCo and supported by a physical depository at the Bank of England. Following the planned changes, they will be settled in the same way as other CREST securities with delivery-versus-payment (DvP). Although CMO offers same-day issuance and settlement, it entails intraday payment system exposures. Payment for transfers of money market instruments are made by the CREST settlement banks on behalf of their CMO member customers. Such payments by settlement banks are not assured and CMO does not offer DvP, leading to large intraday credit exposures among members and their bankers.

Work on these changes is proceeding in three main areas. First, HM Treasury is preparing the necessary amendments to the Uncertificated Securities Regulations 2001 to allow non-material equivalents of money market instruments to be settled in CREST.

Second, in January, CRESTCo published details of the arrangements for the migration of money market instruments from CMO to CREST.[2]

Third, the Bank is considering the responses to its November consultation on standardised *pro forma* terms of issue for money market securities in CREST.[3] It intends to put out a revised version for further market consultation shortly and to publish a final version in early summer.

CREST settlement of repo transactions

Linked to the changes needed for the settlement of money market instruments, CRESTCo is also planning a new settlement mechanism for repos of CREST securities, including gilts, equities and money market instruments.

In general, repo transactions are either motivated by lending of specific securities with cash taken as collateral, or by lending of cash with a basket of any securities meeting defined criteria taken as 'general collateral' (GC). In CREST, settlement of cash-driven repos against GC often occurs using the delivery-by-value (DBV) function, by which CREST delivers to the cash lender a basket of securities to a specified current market value and meeting pre-defined criteria (for example, gilts) selected from the account of the cash borrower, using an automated algorithm. Since they were first developed in the Central Gilts Office settlement system in the mid-1980s, DBVs have settled at the end of each day and unwound at the start of the next day, making them most suitable for overnight GC repo transactions.

But, at present, DBVs are also used to settle term GC repo transactions, with the parties agreeing to enter into a series of DBVs on consecutive days. For the cash borrower, this has the advantage that the DBV algorithm automatically selects the GC securities to be delivered each night according to what the borrower has available in its CREST account.

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(1) A weighted average of rates on unsecured, sterling overnight cash transactions brokered in London between midnight and 4.15 pm each day reported to the Wholesale Markets Brokers' Association.
(2) This document can be found on CRESTCo's web site: www.crestco.co.uk/home.html#news/cmo-migration
(3) This consultation document was publicised in the *Quarterly Bulletin*, Winter 2002, page 368.

But so-called 'term DBVs' have important and in some ways undesirable consequences for the operation of the payment system. When DBVs unwind each morning, real time gross settlement (RTGS) and delivery-versus-payment mean the cash borrower must finance the repurchase of its securities intraday. Repurchases of gilt DBVs are facilitated by the self-collateralisation process in CREST. The borrower's purchase of its securities is financed by its settlement bank via an automated repo facility which enables the cash borrower to borrow from the settlement bank against the collateral of the returning securities. The settlement bank in turn finances the purchase from the Bank of England via a linked, automated repo facility, in which the same securities act as collateral. All repos must unwind by close of business.

Term DBVs therefore give rise to large intraday flows of securities and cash between counterparties, their settlement banks and the Bank, together with large intraday exposures between the Bank and settlement banks (always fully collateralised); between settlement banks and cash borrowers in DBV (typically partly collateralised); and between cash lenders in DBV and their settlement banks (unlikely to be collateralised). These flows could magnify the impact of any disruption to CREST or to the related payment arrangements.

From mid-September 2003, CRESTCo plans to make available to members a new type of transaction designed specifically for the settlement of such term GC repo transactions. This transaction—called 'RPO'—will be available for all securities settled in CREST, including money market securities.[1]

Some of the planned key features include: the ability for members to select up to ten lines of stock for each repo transaction, including any mixture of security types; the automatic creation of a repurchase instruction in CREST for the return of stock on an agreed date; and the flexibility to substitute securities and terminate specific lines in a repo transaction and to 'roll over' existing repo transactions.

Like term DBVs, RPOs would preserve for cash lenders some flexibility to substitute collateral securities each day. But, unlike term DBVs, the RPO transaction

between the parties to the repo would remain intact until maturity. There would be no need for large intraday movements of cash and securities, which should bring some reduction in intraday credit exposures among settlement banks and their customers.

The Bank supports the principle of the new transaction facility. It has allowed its counterparties to settle two-week gilt repo transactions using term DBVs since they became a part of its daily open market operations in 1997. It is currently considering the practicalities of also allowing the proposed new RPO transaction in the settlement of these operations.

Banks' holdings of liquid assets

Sound and well-functioning sterling repo markets are also central to the liquidity management of the large UK banks. Most banks are involved in maturity transformation, exposing them to liquidity risk. One important way of mitigating this risk is to hold a stock of high-quality, marketable assets which can be sold or repoed to raise funds if a bank faces a liquidity squeeze. As 'banker to the banks', the Bank has a keen interest in the stock of liquid assets of the major British banking groups (MBBG), currently monitored through the sterling stock liquidity regime (SLR).[2] Assets eligible for inclusion in this stock correspond to those eligible in the Bank's open market operations and for intraday liquidity.

The composition of the stock held by MBBG banks has altered significantly in recent years. Over the review period, the most marked change was the increase in Treasury bills, reaching a peak of over £11 billion (Chart 24). This has coincided with an increase in the value of Treasury bills outstanding. At present, there is no established market in Treasury bill repo, but the dematerialisation of money market instruments may stimulate this.

Over a longer period since 2000, holdings of gilts[3] have declined but holdings of euro-area government securities have increased. These became eligible for stock liquidity purposes following the Bank's decision to accept them as collateral in its daily open market operations and for intraday liquidity in late 1999,

(1) Further details can be found in CREST's white books *Enhancing CREST—Extending repo facilities in CREST* and *Money market instruments and repo facilities in CREST: Member trialling strategy* to be found at www.crestco.co.uk/home.html#news/cmo-migration
(2) The Financial Services Authority requires the major UK banks to meet stock liquidity requirements. See also Chaplin, G *et al* (2000), 'Banking system liquidity: developments and issues', *Bank of England Financial Stability Review*, December, pages 93–112.
(3) Including outright holdings and net (reverse repo less repo) repo positions.

Chart 24
**Major British banking groups' holdings of
highly liquid assets**
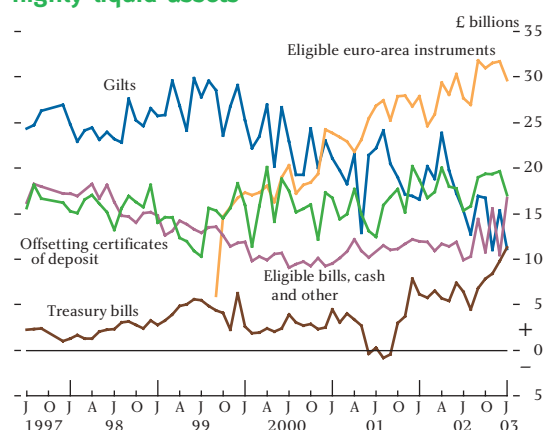
Source: Financial Services Authority.

underlining the close relationship between how banks
choose to manage their liquidity, central bank collateral
requirements and the regulatory liquidity regime.[1]

Bank of England official operations

Changes in the Bank of England balance sheet

The largest change in the Bank of England's balance
sheet between 27 November 2002 and 26 February
2003 (Table C) was an increase in foreign currency
assets and liabilities. (See the box on page 18 for an
explanation of the main elements of the Bank's balance
sheet.) On 21 January, the Bank auctioned €1 billion of
euro-denominated notes maturing in 2006 as part of its
euro-denominated note programme, begun in 2001.
Cover at the auction was 4.1 times the amount on offer,
and the average accepted yield was 2.986% (some
7 basis points below the three-year swap rate). This
increased to €5.0 billion the nominal value of
three-year notes outstanding in the market. A second
auction of €1 billion of the 2006 note is scheduled for
18 March 2003.[2]

The Bank maintained unchanged the nominal value of
its euro-denominated bills outstanding at €3.6 billion

(€1.8 billion of bills with three-month and €1.8 billion
of six-month original maturities), rolling over maturing
bills at auctions held monthly during the period.

By contrast, the sterling components of the Bank's
balance sheet changed little over the period as a whole.
But there were large fluctuations, particularly over
Christmas and New Year, in line with the usual seasonal
increase in demand for bank notes (Chart 25).

Chart 25
Notes in circulation and the stock of refinancing
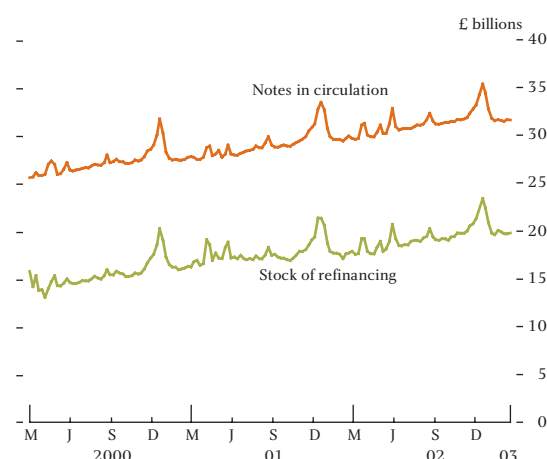
Growth in the note issue at the end of December led to
a corresponding increase in the stock of money market
refinancing provided through the Bank's daily open
market operations. This was one reason for an increase
in the daily liquidity shortages in late December and
early January as the higher stock turned over.
Additionally, the average size of daily shortages
increased in December as a greater share of refinancing
was provided overnight rather than at a two-week
maturity, causing the rate of turnover of the stock to rise
and its average maturity to fall (Charts 26 and 27). The
Bank offers overnight funds if counterparties fail to clear
the shortages in full at its main rounds of two-week
operations at 9.45 and 14.30.[3]

Table C

Simplified version of Bank of England consolidated balance sheet as at 26 February 2003[a]

Liabilities	£ billions [b]		Assets	£ billions [b]	
Bank note issue	31	(32)	Stock of refinancing	19	(20)
Settlement bank balances	<0.1	(<0.1)	Ways and Means advance to HM Government	13	(13)
Other sterling deposits, CRDs and the Bank of England's capital and reserves	6	(5)	Other sterling-denominated assets	4	(3)
Foreign currency denominated liabilities	11	(10)	Foreign currency denominated assets	11	(10)
Total (c)	**47**	**(46)**	**Total** (c)	**47**	**(46)**

(a) Based on published Bank Returns. The Bank's full financial accounts for the year ended 28 February 2003 are due to be published in May.
(b) Figures in brackets as at 27 November 2002.
(c) Figures may not sum to totals due to rounding.

(1) Chart 28 below shows the types of security used as collateral in the Bank's daily open market operations.
(2) Shortly after this publication went to print.
(3) Overnight funds are offered to counterparties at 15.30 at a rate normally 1 percentage point above the official
repo rate and, if the shortage still remains at the end of the day, to settlement banks at 16.20 at a rate normally
1.5 percentage points above the repo rate.

Components of the Bank of England's balance sheet

A central bank's principal liabilities are unique: bank notes and banks' settlement or reserve accounts that together form the final settlement asset (central bank money) for payment in an economy. Central banks vary in their choice of assets. But they are typically of high quality so that, consistent with a stability-oriented monetary policy regime, the integrity of central bank money is assured. In many cases, a portion of assets is rolled over at short maturities in order to implement monetary policy decisions and to accommodate fluctuations in demand for central bank money, aiding banking system liquidity management.

The Bank of England's balance sheet reflects these key characteristics. Its principal sterling liabilities are:

● *Note issue.* This grows approximately in line with nominal GDP growth[1] but also fluctuates from day to day and seasonally with the public's demand for bank notes, for example, around bank holidays.

● *Settlement balances.* Settlement banks are obliged to maintain a minimum balance of zero on their Bank of England settlement accounts at the end of each day; any unauthorised negative balance would need to be collateralised with eligible securities and would normally be charged a penal rate of interest. In practice, the settlement banks prefer their end-of-day balances to be slightly above zero in order to cover themselves against uncertainties in their daily cash flows. Consequently, the Bank of England targets a small positive level of aggregate bankers' balances within its overall forecast of the banking system's net liquidity position each day.

● *Customer deposits.* In the course of its banking business, the Bank takes sterling, foreign currency and gold deposits from government, central bank and other customers. The United Kingdom Debt Management Office (DMO) also maintains a sterling account at the Bank of England.

● *Capital and reserves.*

● *Cash ratio deposits (CRDs).* Deposit-taking institutions in the United Kingdom are required to place cash ratio deposits, equal to 0.15% of their liabilities on deposit at the Bank of England. These deposits are non-interest bearing and enable the Bank to finance its unrecovered costs associated with its monetary policy and financial stability activities.

The Bank's principal sterling assets are:

● *Ways and Means.* The 'Ways and Means' is an advance to HM Government, held constant since April 2000 when responsibility for Exchequer cash management transferred to the DMO.

● *Other sterling-denominated assets.* The Bank holds a portfolio of fixed-income securities, principally gilts.

● *The stock of refinancing (SoR).* This stock largely consists of short-term reverse repos of government securities arranged by the Bank of England in its open market operations (OMOs).

The SoR serves two purposes. First, it is a short-term asset in contrast to the long-term nature of the Bank's note issue liability. That maturity mismatch allows the Bank, through its choice of repo maturity dates, to keep the banking system in a net short liquidity position and to act on most days as the marginal provider of central bank money at the MPC's official repo rate.[2]

Second, the SoR is used to accommodate fluctuations in demand for central bank money, in normal circumstances mainly demand for bank notes.

The Bank also has foreign currency denominated liabilities and assets:

● *Euro bills and notes.* The Bank has euro-denominated liabilities arising from its issues of euro bills and notes.[3]

● *'TARGET' portfolio.* The Bank invests part of the proceeds of its euro notes issuance in a portfolio of €3.6 billion high quality euro-denominated securities, used daily to raise euro liquidity intraday via custodians and national central banks in the euro area. The Bank then uses these funds to provide intraday liquidity to participants in the CHAPS Euro payment system, which is connected to TARGET, the European cross-border RTGS payment system.

● *Foreign currency denominated assets.* The Bank holds and manages its own portfolio of foreign currency reserve assets.

Table C on page 17 shows a consolidated version of the Bank of England's balance sheet at a high level of aggregation. In practice, the Bank of England is required by the Bank Charter Act 1844 to separate the note issue function from its other activities. Accordingly, for accounting purposes, the balance sheet is divided into two accounting entities: Issue Department and Banking Department. The Issue Department comprises solely the note issue and the assets backing it. The Banking Department comprises all the other activities of the Bank of England.[4]

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(1) Changes in the velocity of circulation of narrow money also affect the rate of growth of the note issue (see *Inflation Report*, November 2002, page 9).
(2) See *The Bank of England's operations in the sterling money markets*, May 2002, for more details. Very occasionally, the market may have a net long liquidity position (ie a surplus). On these days, the Bank allows settlement banks to reach near-zero settlement account balances by inviting counterparties in open market operations to place money with it in a short-term repo transaction.
(3) Details of the issue of euro securities can be found at www.bankofengland/pr99002.htm
(4) Details of the Issue and Banking Department balance sheets can be found in the Bank of England's *Annual Report*, the weekly Bank Return and Table B1.1 of the Bank of England's *Monetary and Financial Statistics* (all available at www.bankofengland.co.uk).

Chart 26
Average maturity of stock of refinancing and average daily shortage

■ Average daily shortage (right-hand scale)
— Average maturity of stock of refinancing (left-hand scale)
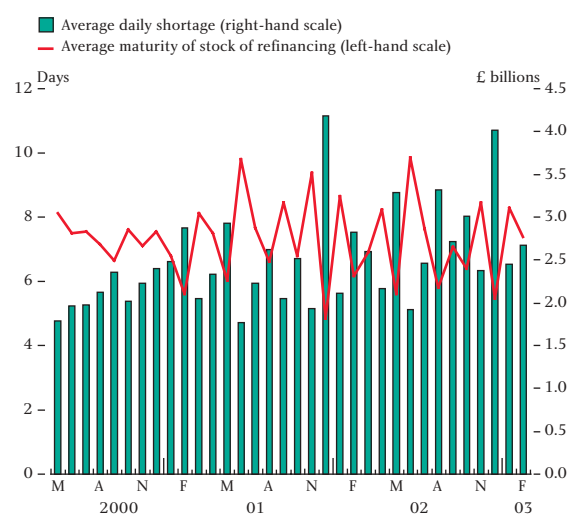
Chart 27
Refinancing provided in the Bank's open market operations

■ Average overnight refinancing
■ Average 14.30 refinancing
■ Average 9.45 refinancing
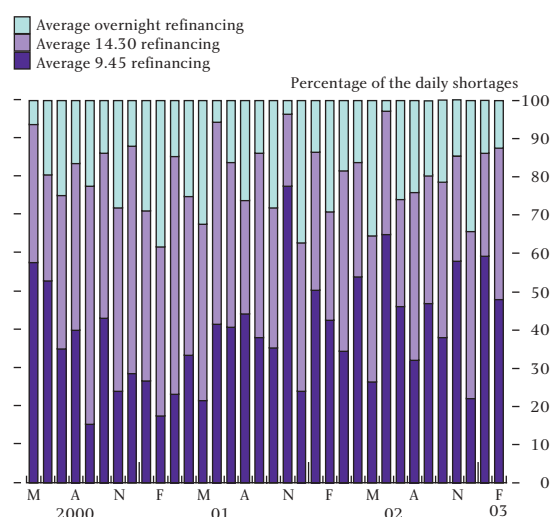
More extensive use of the Bank's overnight facilities in December reflected tighter conditions in the short-dated sterling money markets. For example, the average spread between SONIA[1] and the Bank's official repo rate was +33 basis points in December, compared with -19 in January and -10 in February. And in December, the average spread between two-week GC repo rates and the Bank's official repo rate was -9 basis points, compared with -17 in January and -14 in February.

Greater use of the Bank's overnight rounds in December also skewed the composition of the collateral securities repoed to the Bank towards gilt DBV (Chart 28). Counterparties are unable or reluctant to deliver other collateral types after the first round of daily OMOs due to timetable constraints in other settlement systems.

(1) See footnote 1 on page 15.

Forecasting the liquidity shortage

Seasonal changes in the demand for currency, and their precise day-to-day pattern, can pose challenges for the Bank's forecasting of daily system liquidity shortages.

Chart 28
Instruments used as OMO collateral

□ Bills
□ Euro-denominated securities
■ Gilts
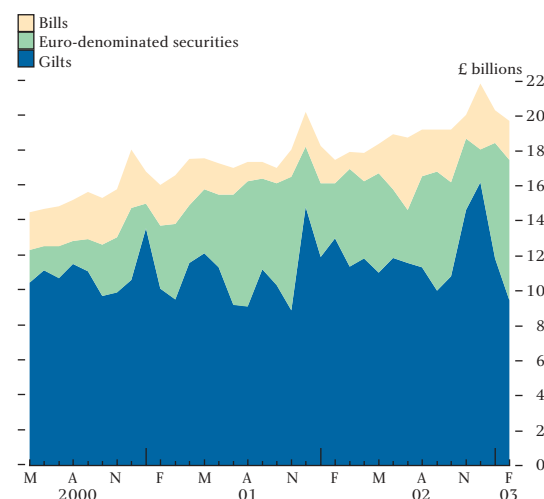
If the Bank were to supply liquidity equal to the full amount of the forecast shortage at 9.45 but forecast bank note demand that day was later revised downwards, settlement banks would be left with settlement bank balances above desired levels. In order to minimise the risk of oversupply, the Bank usually holds over £200 million of the banking system's forecast liquidity need from the 9.45 to the 14.30 round. On 23 December, the Bank announced that it would increase that amount to £400 million, to allow for greater seasonal uncertainty in the change in the note circulation. This was reversed on 13 January.

Table D illustrates that there were larger-than-usual revisions to the 9.45 liquidity forecast in December—reflecting greater uncertainties in the notes forecast—but that there was little change in the accuracy of the final, 16.20 daily forecast.

Table D
Intraday forecasts versus actual shortages

Mean absolute difference (standard deviation), £ millions

	9.45 forecast		14.30 forecast		16.20 forecast	
Dec.-Feb. 2001/02	98	(97)	42	(45)	26	(29)
Mar.-May 2002	92	(149)	51	(136)	41	(137)
Jun.-Aug. 2002	91	(98)	40	(43)	29	(34)
Sept.-Nov. 2002	48	(42)	33	(43)	24	(31)
Dec. 2002	142	(141)	63	(64)	27	(25)
Jan. 2003	79	(82)	41	(56)	24	(25)
Feb. 2003	93	(81)	54	(61)	49	(37)

Market-based estimates of expected future UK output growth

By Ben Martin and Michael Sawicki of the Bank's Monetary Instruments and Markets Division.

This article derives some simple market-based projections of future output growth from a Taylor monetary policy rule, yield curves and inflation surveys. The results can be used as a timely cross-check on output growth expectations from other sources. We find that over the recent past the projections have been plausible in magnitude against both recorded outturns and survey expectations.

Introduction

Financial market data reflect, among other things, market participants' views about the future of the economy. That information is of interest to monetary policy-makers who, because of lags in the policy transmission mechanism, need to set policy with regard to future inflation and output. This article focuses on information from the yield curve which, subject to some caveats described below, can be thought of as containing information about financial market expectations of the future profile for the official interest rate and so the future state of real activity and inflation. Our aim is to provide a quantitative measure of these implicit expectations of future output growth using yield curve estimates and a simple monetary policy rule.[1]

Simple monetary policy rules

Over the past decade there has been considerable interest in the use of simple monetary policy rules to analyse central banks' behaviour. Monetary policy rules provide a framework for relating variations in the policy-makers' instrument to deviations of policy objectives from trend or target. These simple rules can be used to provide a useful summary of the economy in terms of a familiar variable, for example, the level of the policy rate. Stuart (1996) discusses simple policy rules, and Hauser and Brigden (2002) describe them in the context of the Bank's assessment of monetary conditions.

The policy rule is sometimes specified in terms of a monetary aggregate, for example the McCallum (1988)

rule, but the rule that we focus on in this article is an interest rate rule suggested by Taylor (1993). His article says that the level of the official policy rate in the United States could be characterised as reflecting the rate of inflation relative to target and the level of output relative to potential (the output gap). As a simplification of the monetary policy process, the Taylor rule has become popular for monetary policy analysis among academics, policy-makers and commentators. However, it is important to stress, as Taylor did, that monetary policy-makers do not follow rules that can be summarised in an equation (simple or otherwise). King (1999) describes Taylor rules as '…not a mechanical rule to guide policy, but a vehicle to clarify issues'.

The standard way of using the Taylor rule is to derive a value for the policy rate in any given period from contemporaneous values of the output gap and the deviation of inflation from target.[2] But it could be re-arranged to derive, for example, the implied output gap, given policy rates and inflation. This rearrangement is interesting because there are independent measures of what market participants think future policy rates and inflation outturns will be. If policy rates were expected to rise, and market participants believe that the policy response is characterised by a Taylor rule, then this must either be in response to higher inflation or rising output. In this framework, if the market did not expect inflation to rise, then higher expected policy rates must be a response to rising output expectations. So if market participants think that a Taylor rule is a reasonable characterisation of policy, it would be possible to obtain a plausible and timely market-based measure of implicitly expected future GDP growth.

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(1) We focus on the information in fixed-income markets, but information from other asset prices is also important for monetary policy. See Clews (2002).
(2) In practice, output and inflation data may not be contemporaneous because of publication lags.

Reversing the Taylor rule

The Taylor rule can be written as follows:

$$i_t = i_t{}^* + a(y_t - y_t{}^*) + b(\pi_t - \pi_t{}^*)$$

In this equation i_t is the official policy rate in period t, y_t is the logarithm of the level of output and π_t is the annual rate of inflation. The 'starred' variables are intended to summarise some notion of the economy's equilibrium. The inflation target is denoted by $\pi_t{}^*$. The other starred variables are conceptually attractive but less easy to quantify. The variable $y_t{}^*$ is the logarithm of the potential level of GDP. This is the level of output at which firms in the economy are working at their normal-capacity output, and are under no pressure to change output or product prices faster than the expected rate of inflation.[1] The variable $i_t{}^*$ summarises the idea of a neutral level of the nominal interest rate at which policy is neither tight nor loose. In the Taylor rule, it is by definition the interest rate at which inflation is at target and output is at potential.

The nominal interest rate is approximately equal to the real interest rate plus the expected rate of inflation.[2] This is known as the Fisher relationship and describes how nominal debt contracts build in compensation for inflation. Using this relationship, the nominal interest rate will be at a neutral level if inflation expectations are at target, and real interest rates are at some steady-state level, a condition that would be satisfied on a balanced growth path with unchanging consumer preferences.

The Taylor rule can be reversed to give the output gap in terms of interest rates and inflation all couched in terms of expectations of their future values:[3]

$$E_t\left(y_{t+1} - y_{t+1}{}^*\right) = \frac{1}{a}E_t\left(i_{t+1} - i_{t+1}{}^*\right) - \frac{b}{a}E_t\left(\pi_{t+1} - \pi_{t+1}{}^*\right)$$

This expression could be used to obtain a quantitative measure of the implied output gap, given a value for the neutral nominal rate of interest, but the size and sign of the output gap would depend crucially on the value chosen for i^* (as well as the coefficients a and b).

Instead, the approach adopted here is less ambitious. To derive a measure of expected output growth, we assume that the trend rate of growth of potential output and the inflation target are constant. If the regime is credible, steady-state inflation expectations should also be constant at target.[4] These assumptions lead to the following expression for the growth rate, where we have written $g_{t+1} = y_{t+1} - y_t$ for actual growth and g^* for trend growth:

$$E_t\left(g_{t+1}\right) = g^* + \left\{\frac{1}{a}E_t\left(i_{t+1} - i_t\right) - \frac{b}{a}E_t\left(\pi_{t+1} - \pi_t\right)\right\}$$

This expression says that expected future growth can be decomposed into the expected growth of potential output and expected cyclical deviation of growth from trend. If interest rates are expected to rise rapidly, and inflation is not, then, in this framework, there must be an expectation of strong output growth. If, for the same expected profile of interest rates, inflation is also expected to pick up, then this characterisation of policy reaction means that output is expected to grow less rapidly.

Although this approach avoids having to calibrate the neutral nominal interest rate, it is still necessary to take a view about the trend growth rate of potential output, how to measure expected future policy rates, inflation expectations, as well as the constants a and b. This is the subject of the next section.

Calibration

This section describes how we proxy expectations of future policy rates and the inflation term structure. No one method is ideal, so we calculate several variants using different data sources. This allows us to generate a range for growth expectations defined by the minimum and maximum values given by our variants.

Expected future interest rates

One ingredient is a market-based measure of the expected future official policy rate (or rather its expected rate of change). In the absence of uncertainty, the expectations theory of the term structure says that

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(1) For more on these issues, see Monetary Policy Committee (1999).
(2) If inflation is uncertain, nominal interest rates will also incorporate an inflation risk premium.
(3) $E_t(\cdot)$ is the expectations operator on information known in period t.
(4) On a balanced growth path the steady-state real rate of interest should also be constant if the per capita net growth rate is constant. Then from the Fisher equation, the neutral nominal interest rate should also be constant. By looking at the rate of change of the output gap (the growth rate of actual output above that of potential output), the neutral nominal rate of interest and the inflation target drop out of the calculation. Then the deviation of expected growth from trend is determined by expectations of the rate of change of the policy rate and of inflation.

forward interest rates equal expected future interest rates.[1] Therefore it would be desirable to obtain forward rates that correspond to future two-week Bank repo rates. But in practice there are no instruments that allow us to calculate these forward rates precisely and we have to calculate forward rates based on other available instruments. The Bank currently calculates and publishes two types of nominal UK yield curve (and corresponding forward curve). The first, the government liability curve, is based on general collateral repo agreements and yields on conventional gilts. The second, the commercial banks' liability curve (CBL) is based on interbank loans, short sterling futures contracts, forward rate agreements and swap contracts settling on six-month Libor.[2] Both curves have advantages and disadvantages: for example, the CBL curve is derived from more liquid markets, but embodies some credit risk not present in the official interest rate.

In practice, derived forward interest rates will not necessarily equal expected future interest rates. Uncertainty, investor risk aversion, credit risk and liquidity will all introduce a premium, which implies that forward rates will not be an unbiased expectation of future interest rates. Brooke, Cooper and Scholtes (2000) describe the Bank's approach to inferring interest rate expectations from the various instruments described above. In this article we acknowledge, but do not adjust for, the presence of these premia. Since we are primarily interested in the slope of the forward curve, this assumption will only be a significant problem if the premia vary rapidly with maturity.

Inflation expectations

We use two sources to obtain a measure of the slope of the inflation term structure. One is the UK index-linked gilt market (details of this can be found in Scholtes (2002)).[3] The other source is the Consensus Economics survey. Neither measure is ideal, as surveys are not as timely as market data, and inflation expectations from the index-linked market are not available at very short maturities. Implied inflation rates derived from index-linked gilts relate to RPI, as did the Consensus survey before April 1997. All these factors

mean that we have to be careful about how much weight to place on the individual Taylor rule projections. Our preferred approach is to look at all possible measures and use these to generate a range of forecasts.

Constants and coefficients

The model requires a quantitative estimate of the trend rate of growth. We replace trend growth with the average growth of real GDP since 1955, so g^* equals 2.5%.

Taylor (1999) notes that simulation studies suggest weights of $a = 1.0$ and $b = 1.5$. For the United Kingdom, Nelson (2000) estimates a weight of $a = 0.5$ on output and $b = 1.3$ on inflation for the period 1992–97. We take Taylor's weights as the central case, plus or minus the gap between his weights and Nelson's estimates to give an illustrative range.

Results

Time series of growth forecasts

We construct monthly time series of implied growth forecasts, using interest rate expectations either from the CBL curve or the government liability curve.[4] Inflation expectations are derived either from the index-linked gilt market, or from the Consensus Economics survey of inflation expectations.[5] The range between the minimum and maximum of forecasts, based on the two measures of interest rate expectations, two measures of inflation expectations and three choices of Taylor rule coefficients, is our forecast band for output growth.

We can compare this forecast band with the growth outturn recorded in the subsequent year over the period since the Bank was granted operational independence. This is shown in Chart 1.[6] Overall, the profile of the band is not dissimilar to outturns. Compared with final outturns of GDP growth in the latest available vintage of data, the Taylor rule measure has, on average over the sample, been pessimistic. However, GDP data are revised over time. And the magnitude of this downward bias becomes considerably smaller when we compare the reverse Taylor rule forecasts with the preliminary ONS

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(1) Forward rates are the interest rates for future periods that are implicitly incorporated within today's spot interest rates for loans of different maturities.
(2) These data are available at www.bankofengland.co.uk/statistics/yieldcurve.
(3) Data on implied inflation rates are also available at www.bankofengland.co.uk/statistics/yieldcurve.
(4) Prior to March 1997, the estimated government liability curve does not extend to the shortest maturities. See the appendix.
(5) The method for obtaining these is described in the appendix.
(6) The comparable growth forecast is quarter on four quarters earlier. Note that the labels on the chart refer to the reverse Taylor rule forecasts from the previous year.

Chart 1
One year ahead growth expectations versus outturns

Percentage changes on a year earlier

Chart 2
Projection band for 2002 versus Consensus growth forecasts

Percentage changes on a year earlier
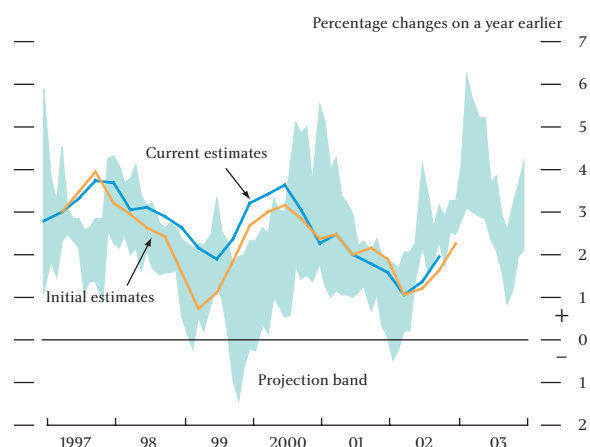
estimates of GDP growth, which would reflect more closely what was known by markets at the time.[1][2]

Comparison with Consensus forecasts over 2002–03

As another metric of forecast plausibility we can also compare the Taylor rule growth projections with the monthly Consensus Economics surveys for output growth expectations over the current and next calendar years.

Charts 2 and 3 compare the reverse Taylor rule forecast band for average GDP growth in 2002 and 2003 with past Consensus forecasts for these years. We can see that our market-based forecasts were slightly less optimistic about UK prospects in 2002 than Consensus for the first half of 2001. Our implied forecast became more optimistic around the turn of 2002, but subsequently moderated, in particular falling around the time of the large falls in world equity markets around July. By the end of 2002, our forecast band pointed to a slightly higher outturn than was expected by Consensus in the final months of 2002. Our market-based projections have also been fairly close to, though more variable than, the Consensus forecasts for 2003, with the width of the forecast band primarily explained by the divergence between our two measures of the inflation term structure.

Term structure of growth expectations

As a case study, we can specifically look at the evolution of views about the UK economy since mid-2001.

Chart 3
Projection band for 2003 versus Consensus growth forecasts

Percentage changes on a year earlier
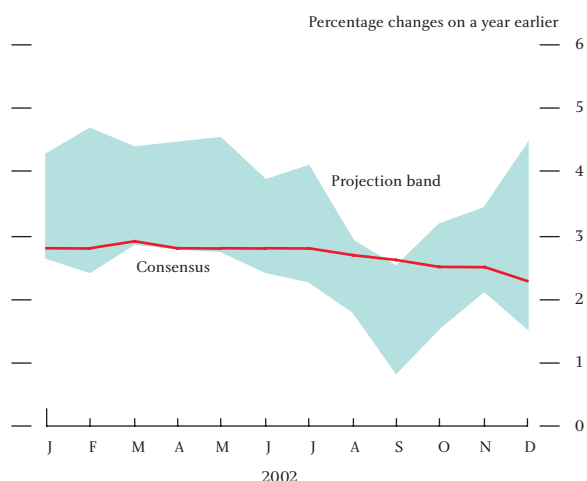
The February 2002 *Inflation Report* noted that 'Expectations of future short-term sterling interest rates rose from mid-November onwards…in line with the steepening…of the yield curve in the United States and the euro area. This suggests that investors have become more optimistic about a global economic recovery.' Chart 4 shows UK government forward curves at four *Inflation Report* publication dates in the past two years.

Chart 5 tracks the evolution of growth forecasts for the next four quarters in months corresponding to those in Chart 4, using inflation expectations from index-linked gilts and interest rate expectations from the government liability curve (the measure based on surveys of inflation expectations shows a similar picture). As the UK yield

(1) We could eliminate the bias altogether by adjusting our assumption for trend growth. Relative to initial GDP estimates, we would need to increase our assumption for g^* by slightly more than 0.1 percentage points.
(2) Vintages of GDP(E) data are available from the real-time database at www.bankofengland.co.uk/statistics/gdpdatabase/ For details about its construction, see Castle and Ellis (2002).

Chart 4
GC repo/gilt two-week forward curve

Per cent

6.0

15 May 2002

5.5

13 Feb. 2002

5.0

4.5

7 Aug. 2002

4.0

14 Nov. 2001

3.5

3.0
0.0

Nov. Feb. May Aug. Nov. Feb. May Aug. Nov. Feb. May Aug.
2001   02   03   04

Chart 5
Term structure of quarter-on-quarter GDP growth rates

Per cent

1.25

Feb. 2002

1.00

0.75

May 2002 Aug. 2002

Nov. 2001

0.50

0.25

0.00

Nov. Feb. May Aug. Nov. Feb. May Aug. Nov. Feb. May Aug.
2001   02   03   04
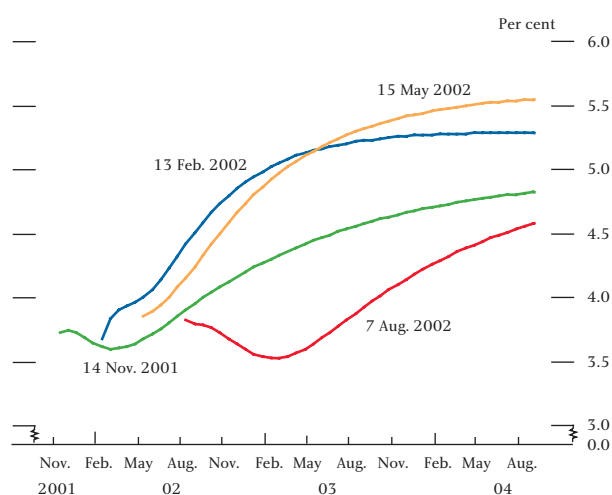
curve steepened between November 2001 and February 2002, with the profile of inflation expectations broadly unchanged, the implied term structure of growth rates became initially steeper. From February to May 2002, a steepening of the inflation term structure caused the implied growth forecasts to moderate. Finally, a flattening of the yield curve caused the growth profile to weaken further in August 2002.

Conclusion

This article has derived some simple market-based projections of future GDP growth based on a Taylor rule, yield curves and inflation surveys. The results can be used as a timely cross-check on output growth expectations from other sources. We find that over the recent past the forecasts have been plausible in magnitude against both recorded outturns and survey expectations.

Appendix

Data

This section describes the specific assumptions made to construct the reverse Taylor rule forecasts outlined in this article.

Interest rate expectations

We use monthly averages of instantaneous forward rates derived from the UK government liability curve or commercial banks' liability (CBL) curve at one to eight-quarter horizons. The Bank's method for estimating UK yield curves is described in Anderson and Sleath (2001). We acknowledge, but do not adjust for premia. We use interest rate expectations from the CBL curve for output growth forecasts going back to January 1993. From March 1997, we also produce forecasts using the government liability curve.

Inflation expectations

We use two methods to obtain a measure of the slope of the inflation term structure. First, using monthly averages of data from the UK index-linked market, we interpolate between the latest observed outturn for RPIX inflation and the shortest available inflation forward. Alternatively, we use information from Consensus Economics surveys for inflation expectations. We have two surveys available. The monthly Consensus survey gives us year-averages for expected inflation in the current and next calendar years. We obtain the slope of the inflation term structure by linear interpolation from the last observed RPIX outturn through these two survey observations. Alternatively, we obtain the slope of the inflation term structure from the quarterly Consensus survey, which gives us a more detailed quarter-by-quarter profile for expected inflation. However, this survey is less timely.

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Monetary policy and the zero bound to nominal interest rates

By Tony Yates of the Bank's Monetary Assessment and Strategy Division.

Some commentators have recently discussed the possibility that certain countries may experience a period of general price deflation. In such a situation, nominal interest rates may reach their lower bound of zero. This article concludes that the evidence available suggests that such a situation is highly unlikely to occur in the United Kingdom. It reviews what the academic literature has to say about the scope for alternatives to cutting interest rates in the improbable event that nominal interest rates do reach zero.

1   Introduction

In order to control inflation, modern central banks typically influence private sector interest rates by adjusting the short-term nominal interest rate at which they lend to banks. However, these private sector interest rates cannot fall below zero: no one would make a loan at negative interest rates because they could earn a better return by holding cash. (Cash pays no interest, better than a negative interest rate.) Monetary policy makers face a risk that, if there were a sufficiently large fall in demand, nominal interest rates would have to be pushed to zero. At that point, if the economy required any more stimulus, some other kind of policy would be needed. An additional fall in demand would cause actual and expected future inflation to fall further, and real interest rates—the difference between nominal interest rates and expected inflation—would therefore rise. The rise in real rates would cause an additional fall in spending. That would reduce inflation and expected inflation by yet more and cause real interest rates to rise again, and so on. This extreme scenario was first identified by Wicksell (1898) and is often known as a 'deflationary spiral'. The risk that modern economies could succumb to an episode of this kind has become the focus of more intense scrutiny because nominal interest rates are currently low by historical standards.

This article assesses two strands of recent research: one that has sought to evaluate how material the risk is that interest rates could be pushed to the zero bound, or that the economy could enter a deflationary spiral; and another that has focused on what other policies might be available in the event that interest rates reach zero.[1]

2   What is the risk that interest rates could hit the zero bound?

One approach to estimating the risks of hitting the zero bound, or of entering a 'deflationary spiral', is to look at episodes in economic history or in other countries. Interest rates approached the zero bound in the United States in the 1930s (see Chart 1).

Chart 1
US and Japanese interest rates, 1931-present
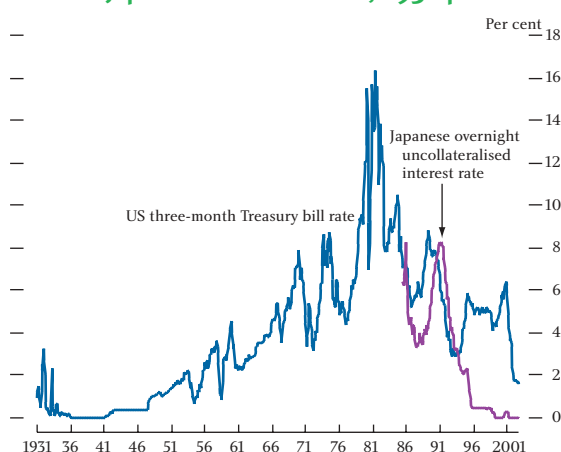
But that episode was the product of a set of economic circumstances and a monetary regime—the objectives that the central bank followed—that differed greatly from those of today and in ways we cannot quantify with any certainty. Without being able to replay history with today's monetary policy framework, and in an economy

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that resembles today's economy, we cannot infer anything very precise from episodes like this in the past. Looking at other countries' experience today (for example, that of Japan)[1] is fraught with the same difficulty. However, we might reasonably say the following: history tells us that episodes of zero interest rates are rare, and those that have occurred were the product of economic circumstances that are unlikely to apply in the case of the United Kingdom today.

An alternative way to gauge the risk of hitting the zero bound to interest rates is to build a model of the economy. We can then buffet this economy with the kinds of shocks that resemble those that affect actual economies, and observe what happens to interest rates as the central bank in the model economy sets about controlling output and inflation. This is an approach that has been followed by, among others: Cozier and Lavoie (1994), Fuhrer and Madigan (1997), Black *et al* (1998), Orphanides and Wieland (1998), Wolman (2000), Reifschneider and Williams (2000) and Hunt and Laxton (2001).[2] The results from these studies are summarised in Chart 2.[3]

Chart 2
The time spent at the zero bound under different average inflation rates

Black, Coletti and Monnier (1998)
Cozier and Lavoie (1994)
Hunt and Laxton (2001)
Orphanides and Wieland (1998)
Reifschneider and Williams (2000)

Chart 2 plots estimates of the time an economy spends at zero interest rates as a percentage of the total time the model economy is simulated on the vertical axis, against the average inflation rate that the central banks in these model economies are assumed to target (on the horizontal axis).

Despite the different results in the studies in Chart 2 a consensus of sorts emerges:[4] that the proportion of time an economy will spend at zero interest rates when pursuing inflation objectives of 2%–3% is likely to be small. With 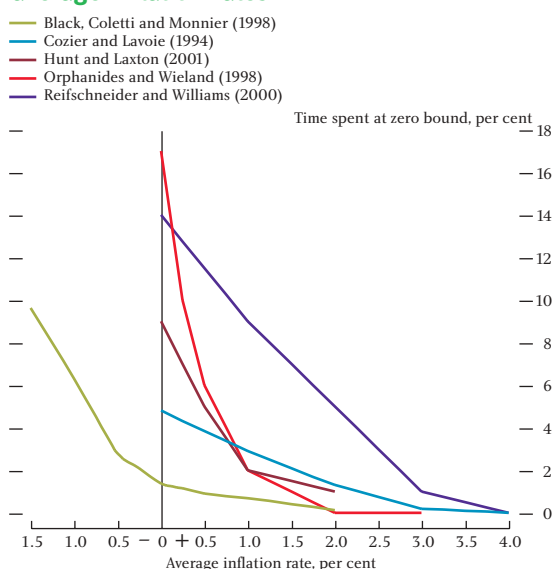a 2% inflation target, Chart 2 suggests that the economy would be at the zero bound in the region of 0%–5% of the time; as this rises to 3%, estimates of the time spent at the zero bound fall to something between 0% and 1%. We might therefore infer from this that the risks of hitting the zero bound to interest rates are small.

Note that experiencing zero nominal interest rates is not in itself costly. But the time spent at zero interest rates indicates time during which central banks will be deprived of the usual tool for stimulating the economy. Whether this turns out to involve costs depends on how much interest rate stimulus central banks would have liked to inject. Time spent at the zero bound could prove to be entirely costless. At the other extreme, if the economy suffered a sufficiently large fall in demand, it could succumb to a deflationary spiral. The studies summarised in Chart 2 suggest that the risks of entering a deflationary spiral—where interest rates never escape the zero bound, and output and inflation fall continuously—are very small indeed. For example, Hunt and Laxton (2001), report that at an average inflation rate of 2% there is virtually no chance of the economy entering a deflationary spiral.[5]

These statistics provide a useful starting point for an analysis of how policy should address the zero-bound problem. But how reliable are estimates of this kind, and what can we infer from them? The estimates will of course be as uncertain as the assumptions on which they

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(1) For commentaries on the recent Japanese situation, see Ahearne *et al* (2002), Posen (2002 a, b).
(2) Some of the results in Hunt and Laxton (2001) are also presented in a box authored by Hunt in Chapter 2 of the *IMF World Economic Outlook*, May 2002, page 93, entitled 'Can inflation be too low?', within the essay 'Monetary policy in a low inflation era', by Terrones and Sgherri.
(3) Note that some of the numbers in this chart are approximate, based on estimating numbers presented graphically in the original studies.
(4) Note that these studies attempted to describe different economies. Hunt and Laxton (2001) simulate the Japan block of the IMF MULTIMOD model; Reifschneider and Williams (2000) present simulations of the Federal Reserve Board model of the US economy; Orphanides and Wieland (1998) is a model of the United States; Black *et al* (1998) and Cozier and Lavoie (1994) use models of the Canadian economy.
(5) The risk of entering a deflationary spiral is proxied by recording the proportion of simulations that included zero-bound episodes where the economy was not stabilised. The statistics recorded in Chart 2 itself, on the other hand, are based on calculating time spent at the zero bound as a proportion of total simulation time, but only for those simulations in which the economy was stabilised, and therefore did not enter a deflationary spiral.

are based, so this article turns next to examine some of these assumptions more closely.

Estimates of the risk of experiencing a zero interest rate episode will depend crucially on what is assumed about how often the economy experiences falls in demand, and how large these shocks tend to be. The larger the recessionary shocks a central bank must offset, the greater the risk of hitting the zero bound. Getting an estimate of the average size of shocks from historical data involves distinguishing between the effects of previous policy regimes on variables like inflation and output, which will no longer be relevant, and genuine disturbances, which will. We might observe that in the past output and inflation have fallen, but we do not know if that happened in spite of policy, or because of it. We can attempt to separate out the influences of policy and genuine recessionary shocks on output and inflation in the past, but our techniques for doing this will give us estimates that we must treat as uncertain. In most cases, the shocks used in the simulations reflect the differences observed in the past between the predictions of model and actual outturns for data. But the models are not perfect descriptions of the economy. And so the 'shocks' estimated in this way will not match the news that prompted central banks to act, but will mix in problems that the model has in fitting the data. Finally, even if we can get a good estimate of the size of recessionary shocks in the past, there is no guarantee that this will be a good estimate of what will happen in the future.

To estimate the risk of hitting the zero bound we also need an estimate of the equilibrium real interest rate. The higher the equilibrium real interest rate, the higher the equilibrium nominal interest rate associated with a given inflation target.[1] The higher the equilibrium nominal interest rate, for a given inflation rate, the lower the risk, therefore, of hitting the zero nominal bound, since higher nominal interest rates make more 'room' for interest rate cuts to respond to shocks as they hit the economy. The equilibrium real interest rate is not directly observable. And estimates of it vary greatly. For example, estimates of the equilibrium real rate that

inform the studies in Chart 2 vary by at least 3 percentage points.[2]

This amount of uncertainty about the equilibrium real rate translates into a great deal of uncertainty about the risks of hitting the zero bound. We can get an idea of this simply by using Chart 2. Raising the equilibrium real interest rate by 1 percentage point has the same effect on equilibrium nominal rates (and therefore the risk of hitting the zero bound) as raising the inflation objective by the same amount. Using the Reifschneider-Williams simulations, adding plus or minus 1 percentage point to the real rate (equivalent to adding plus or minus 1 percentage point to the target inflation rate) would change the estimate of the time spent at the zero bound when targeting 2.5% inflation from about 3% to around zero, or to about 7%, respectively.[3]

The risk that a fall in demand pushes interest rates to the zero bound will also depend on how the economy translates that fall in demand into changes in inflation and output. Therefore, our estimates of the risk of hitting the zero bound are also going to be uncertain to the extent that we are uncertain how well the model economies (like those on which Chart 2 is based) describe the real ones.

Preventative policies and the risk of hitting the zero bound to interest rates

The risks of hitting the zero bound are likely to be overstated for at least one reason. Experiments of the kind reported in Chart 2 illustrate the consequences of central banks sticking rigidly to particular interest rate reaction functions, and of the private sector expecting the central bank to do just that. This is a necessary abstraction but it may be misleading. These 'reaction functions' are a mechanical way of describing how the central bank in the model economy reacts to news; they typically assume that interest rates are increased by some fixed amount in response to some given increase of current inflation above the target, or of output above potential, and *vice versa*.[4] There are many ways in which the simple, mechanical reaction functions used

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(1) Crudely, lenders want first to be compensated for the amount by which a nominal loan is eroded by inflation, and second, they require some real compensation for postponing consumption. The greater the real reward they demand, the greater the total nominal compensation they will demand.

(2) Orphanides and Wieland (1998) assume a value of 1% for the United States; Black *et al* (1998) assume a value of 4% for Canada.

(3) These are very crude guesses indeed. It is possible that equilibrium real rates themselves may be related to inflation, so a calculation like this is not as simple as suggested. And because the amount by which an increase in inflation reduces time spent at the zero bound itself depends on the starting inflation rate, so will the amount by which an increase in equilibrium real rates reduces the time spent at the zero bound.

(4) These are known as 'Taylor rules', after Taylor (1993), who first pointed out that reaction functions of this kind captured some of the features of the movement of actual central bank interest rates.

fall short of a description of policy in reality.[1]   Most germane to the discussion here is that if the central bank is faced with a particularly large shock to demand that threatens to push interest rates to zero, central banks will have the option of cutting rates more aggressively in response to the initial shock, relative to the interest rate suggested by a typical reaction function. Central banks are therefore likely to be able to stabilise the economy more effectively than the simple rules used to compute the statistics in Chart 2 allow. Moreover, if it is open for central banks to cut rates more aggressively, arguably the private sector will expect them to do that and expected inflation will fall by less in response to the initial shock, which will mean that demand will turn out higher than otherwise.

So one form of preventative action open to policy is to be prepared to make aggressive interest rate cuts when a zero-bound incident threatens. But, it is argued, the chance of hitting the zero bound (for a given distribution of shocks, and for a given inflation rate) can also be reduced by a central bank resolving in normal times—when a zero-bound episode is not threatening—to make less marked changes in interest rates in response to news.

This sounds like a contradiction, but it is not. The argument was first made by Goodfriend (1991).[2] It runs as follows: the likelihood of hitting the zero bound depends on how much central banks have to move short interest rates to affect aggregate demand and counter the effects of a recessionary shock. The degree to which a change in short interest rates affects aggregate demand depends in part on how much a change in short rates is passed on to other, longer-maturity interest rates, which are relevant for a good deal of consumption and investment spending. Longer-maturity interest rates depend on expectations of short rates over the future. The more a change in short rates is expected to persist into the future, the greater the impact it will have on long rates and aggregate demand. A smaller change in short rates would therefore be needed initially to offset any decline in demand.

So, to recap, the more gradually a central bank moved interest rates in general, the smaller the amount of interest rate stimulus needed to counter any particular fall in demand, and, therefore, the less likely it would be that a central bank pursuing some given inflation target would be pushed to cut rates to the zero floor.

This kind of policy would therefore involve making a sacrifice in normal times (moving rates by less in response to most shocks, which would lead to inflation and output being more variable) in order to make it more likely that interest rate policy would still be available when the economy suffered a large fall in demand (by increasing the responsiveness of the economy to interest rates).

Reifschneider and Williams (2000) suggest an ingenious, but somehow unlikely, procedure for setting rates that would reap the benefits of the Goodfriend-Woodford interest rate policy in the face of a severe shock without paying the costs in normal times. The idea is that interest rates would not be set unduly gradually in normal times, so the benefits of normal interest rate policy would accrue. But when a zero-bound episode threatened, the central bank would first cut rates aggressively, and then announce that the rate cut would endure for longer than would normally have been the case had the economy not faced a zero-bound episode. Making a policy like this work in practice would be a challenge. There are two reasons why the benefits claimed for it might not be reaped. First, there is no simple, benchmark policy reaction function of the kind used to build models of the economy like those in Chart 2. Policy-setting typically involves weighing up information from many different sources and in ways that could vary over time. For this reason it is quite possible that the private sector would not fully appreciate the significance of the announced change in policy: if there is no simple rule to describe past policy, the contrast between some new policy and what went before is likely to be less apparent. Second, making an aggressive cut in rates and committing to keep rates lower than would otherwise be the case may be a commitment that is too complex to be readily communicable and therefore not easily verifiable, and, for that reason also not believed.

This discussion of the impact of expectations on policy underscores the benefits—in terms of the likelihood of hitting the zero bound—of the central bank's policy intentions being believed. We can observe, broadly, that the more faith the private sector has in the central bank's ability and inclination to pursue its announced targets, the less interest rates have to be cut to counter the effect of a fall in demand. If the private sector expects rates to be cut, expected inflation will be higher than otherwise, and real rates therefore lower, and that

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(1)   For a description of how policy decisions are arrived at in the United Kingdom, see Bean and Jenkinson (2001).
(2)   It was later formalised by Woodford (1999).

itself will boost spending and inflation. In turn this means that more credible central banks would be better able to weather large shocks without hitting the zero bound to interest rates.

It might appear that we could conclude from estimates like those in Chart 2 that there exists another form of costless, preventative policy: that economies could realise a benefit by targeting a higher rate of inflation and reducing the risk of hitting the zero bound. In fact, we cannot conclude this. Targeting higher inflation, as Leigh-Pemberton (1992), King (2002) and others have pointed out, incurs significant costs. It is precisely to avoid these costs that the Government has mandated the Bank of England to target a relatively low rate of inflation.

Having discussed how policy can prevent a zero-bound episode occurring, the next section evaluates alternative ways of stimulating the economy when interest rate cuts are not possible.

3 Alternatives to stimulating the economy by cutting interest rates

Several alternative means of stimulating the economy have been suggested.

Stimulating the economy using fiscal policy

Although interest rates cannot be cut further at the zero bound, the authorities could boost demand by loosening fiscal policy (cutting taxes, raising expenditure). Indeed, in most developed economies, the United Kingdom included, policy is such that there are 'automatic' fiscal boosts at work when private demand falls. As economic activity contracts, expenditure on benefits tends to increase and tax revenues from wages and profits tend to fall, providing a boost to aggregate demand. No additional change in taxes or spending would necessarily be needed.

Using discretionary changes in fiscal policy—for example, cutting announced tax rates, rather than simply allowing a recession to cause tax revenues to fall—is also an option. But the benefits of varying spending plans and tax rates (lower inflation and output variability) have to be weighed against the costs. It is the desire to avoid these costs that motivates the UK Government's fiscal

rules. Such rules make spending and taxes more predictable, and therefore make it easier for firms and consumers to plan for the future. Raising spending and lowering taxes to stimulate the economy could interfere with the provision of public services. Moreover, unlike monetary policy, fiscal policy is not administered through one single 'rate'—there are many taxes and many different types of spending. The administrative and legislative difficulties of varying these in an appropriate way make fiscal policy a sluggish instrument with which to stimulate the economy. Nevertheless, having access to a sluggish instrument would clearly be preferable to having no instrument at all.

Increasing liquidity through central bank purchases of illiquid private sector assets

Conventional money market operations aimed at stimulating the economy are thought not to work at zero nominal interest rates.[1] Such operations involve the central bank entering into a trade with the private sector: buying short-term bonds or bills and offering cash in exchange. At zero interest rates, this involves exchanging assets that are very similar. Neither cash nor bonds bear interest and neither is subject to any default risk. The trade leaves the private sector no better or worse off than before and so open market operations like this at zero interest rates do not stimulate spending in the economy.

Goodfriend (2000)[2] has suggested that the central bank could stimulate the economy by buying assets less similar to cash than normal: illiquid assets like infrequently traded bonds, or even claims on the private sector like shares or corporate bonds. An exchange like this would involve the private sector giving up an illiquid asset and taking a more liquid one, cash, in return. When we say that cash is more liquid than other assets we mean that it can, for example, be more readily transformed into something else that the owner wants. Money can be swapped for goods directly: other assets generally cannot. Having something that is more readily (more cheaply) turned into a good that can be consumed is valuable. Following an exchange of cash for illiquid bonds or shares the private sector would have more 'liquidity' and would therefore be better off. This would stimulate spending. By announcing that the central bank is prepared to engage in operations in formerly illiquid assets, these assets would themselves

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(1) And, as Auberach and Obstfeld (2003) point out, when interest rates are not expected to rise in the future.
(2) Kiyotaki and Moore (2001) set out the economic theory behind this policy proposal. This kind of policy has some similarities with current monetary policy in Japan, which has seen the Bank of Japan buy long-dated government bonds. It is signalled as a possibility in remarks by Bernanke (2002).

become more liquid. That would cause their prices to rise, make private sector holders of those assets better off, and increase demand. Higher levels of spending would raise expected inflation and lower real rates, stimulating demand further, and so on, until a point was reached when normal interest rate policy could be effective again.

A policy of this kind would present three challenges. First, since the effectiveness of open market operations of this kind is uncertain, it would be difficult to judge how large purchases would have to be to achieve the desired amount of stimulus to aggregate demand. Second, the central bank would have to be careful to make purchases that increased the liquidity of all assets, and not just some: that would risk affecting how investors allocated their portfolios between assets. Third, buying assets of this kind would expose the central bank (and therefore the public sector as a whole) to greater financial risk than normal open market operations. To see this, suppose that the central bank decided to buy portfolios of long-dated bonds that were not formerly traded in large volumes in financial markets. These purchases would be made at a time when, because the nominal interest rate component of the bond was zero, the price was high. If the policy were successful, nominal interest rates would rise, and, for this reason, the price of the bond would fall. On this count, a successful intervention would reduce the net worth of the central bank. On the other hand, a successful intervention would also increase the amount of liquidity in the economy as a whole, and increase the price of all assets, including those the central bank had purchased. This would lead to a rise in the net worth of the central bank. Which effect would dominate, and therefore whether the central bank would be better or worse off, is not clear. That may depend on what happened when and if the central bank reversed the purchases in the future. But it is clear that the value of the central bank balance sheet would be more uncertain if it engaged in open market operations of this kind, and that in turn could imply a drain on fiscal policy.

Exchange rate devaluation by intervening in foreign exchange markets

Some[1] have suggested that the central bank could stimulate the economy by intervening in foreign exchange markets and depreciating the exchange rate. A central bank could announce an exchange rate target that implied a depreciation and promise to buy assets denominated in foreign currency at the lower exchange rate. A lower exchange rate would give a temporary stimulus to the economy as foreign demand for home-produced exports would increase as their price in terms of foreign currency would fall.[2]

A central bank trapped at the zero bound and trying to devalue its exchange rate would be promising to sell its own currency in exchange for foreign currency assets. If the authorities were so minded, the only limit on reserves of its own currency would be how fast it could run the printing presses. It would therefore be in a more powerful position than central banks trying to promise not to devalue the exchange rate. In those circumstances, the central bank promises to buy its own currency in exchange for foreign currency reserves.

A central bank trying to defend an exchange rate that was 'too high' (relative to fundamentals) would find that it could not credibly promise to buy unlimited quantities of its own currency using foreign assets because its reserves of foreign currency were limited. Market participants would be aware of this and would therefore expect the exchange rate to depreciate despite attempts to defend it by the central bank, and that expectation would make it more likely still that the depreciation happened. The effects of expectations would work the opposite way for a central bank trying to bring about and defend (rather than avoid) a devaluation. There, the expectation that a central bank could print money to buy foreign exchange may mean that it would never have to do so.

However, an exchange rate devaluation of this kind may involve some drawbacks. In order to 'defend' the lower exchange rate, the central bank would have to make a credible promise to print unlimited quantities of its own currency to buy foreign assets. A promise of this kind would run counter to the original aims of monetary policy (monetary stability): a risk is that it would, for this reason, not be believed. However, if a promise like this were believed, another risk is that it would undermine the credibility of promises not to engage in these policies in normal times. When a central bank is mandated to follow an inflation target, that commitment rules out conducting unlimited quantities of market operations by running the printing presses. The

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(1) See, for example, Meltzer (1999), Svensson (2001) and McCallum (2000).
(2) Real interest rates would also fall temporarily, as consumers would expect temporarily higher inflation while the depreciation passed through into import prices, and this in turn would stimulate aggregate demand.

challenge would be to make a credible promise to stand ready to use potentially unlimited monetary financing during a zero-bound episode, while making a credible promise not to use tools like this in normal times.

An exchange rate depreciation would obviously affect the trading partners of an economy trapped at zero interest rates. Other things being equal, trading partners would experience lower aggregate demand for a short while. The success of this policy would therefore rely on the authorities in those countries not acting to try to undo the depreciation. If the fall in demand that hit the economy trapped at the zero bound had also affected its trading partners, it is likely that the foreign country would (other things being equal) not want to bring about an appreciation of its own currency, which would reduce demand in that economy (as the demand for its exports would fall). However, it may be that those countries would prefer to tolerate the tighter monetary conditions that an appreciation of their currencies would imply rather than see the 'problem' economy trapped at the zero bound, which could depress demand for their exports indefinitely.

Gesell money—a tax on money balances

Another proposal is attributed to Gesell.[1] He suggested taxing balances of cash. Recall that the reason interest rates cannot fall below zero is that the costs of holding cash are negligible. If there are no costs to holding cash, an investor will always prefer holding cash to a bond yielding a negative interest rate, even if the benefits that cash confers in terms of making transactions easier have been exhausted, since cash will generate a better return: zero. However, if cash balances are taxed, an investor may be prepared to hold bonds even at a negative interest rate to avoid paying the tax.

Policies of this kind would themselves impose considerable costs on the economy, because they would greatly erode the convenience value of cash. The problem for the cash tax collector would be to persuade anonymous holders of cash to register their balances to be taxed. Goodfriend (2000) proposed that the tax be collected at the point a note re-enters the banking system. Some technology that recorded how long a note

had been outside the banking system would be inserted into notes. Notes that had been circulating for longer outside banks would be subject to more tax. This would mean that 'old' cash that had been circulating for a while would be worth less than 'new' cash. (Old cash would be taxed at a higher rate when it re-entered the banking system.) Individuals would have to keep a careful note of the ages of currency they were offered, to make sure they had made a fair exchange: the cost of this policy is the burden that this extra monitoring would impose. Note too that unless the tax moved in synchronicity with the interest rate, this policy, even if introduced temporarily, would impose the same costs that inflation itself brings about. Both erode the real value of cash and encourage the private sector to waste resources economising on cash balances. Money taxes would therefore work against the original purpose of monetary policy and these costs would have to be set against the benefits of any stimulus.

Increasing private sector wealth through money transfers

Another policy that has been proposed is to print more money and to transfer it to the private sector. To recap, normal open market operations involve the central bank and the private sector exchanging cash for bonds, making mirror-image changes in the public and private sector portfolio of assets. However, a money transfer would involve printing money and giving it to the private sector, taking nothing in exchange. If this money were valued by those that received it, they would feel wealthier, and their spending would rise.[2]

There are many difficulties that a money transfer of this kind would entail. Literally distributing money among the population in a way that does not impose costs on the economy by affecting the current distribution of income and wealth is likely to be administratively infeasible. One possibility is that money is printed to finance a tax cut, given some level of government expenditure.[3]

A policy of this kind would affect the credibility of monetary and fiscal policy. On the one hand, a successful money transfer could enhance the credibility

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(1) The intellectual pedigree of this idea is traced by Goodfriend (2000) in a helpful footnote on page 1,008 of his paper. Both Buiter and Panigirtzoglou (1999) and Goodfriend point out that Keynes credits Gesell with the original idea. Buiter and Panigirtzoglou (1999) point out that Gesell-like schemes have been tried, for reasons not connected with the zero bound, in Alberta in Canada, and in Austria in the 1930s.
(2) If private individuals expected that the increase in their nominal money balances would lead to an immediate price level increase that left their consumption possibilities unchanged, or if agents anticipated that debt transfers to them would be financed by future taxation, they would not feel any better off after the money transfer.
(3) This is, however, contrary to the provisions of Article 101 of the EC Treaty.

of policy if it were to mean that deviations of inflation from its target were smaller than otherwise. On the other hand, monetary financing of this sort is typically a feature of very high inflation regimes, regimes that often have very unsound public finances. A risk is that the authorities would be suspected of engaging in monetary financing in normal times, not just when interest rates were held at the zero bound.

At some point, if deflation set in, the fall in the price level would increase the real value of money holdings without the authorities printing any money.[1] Existing nominal money holdings would be worth more in terms of goods. So some kind of stimulus would come from that source, though how much and how soon is not clear. Waiting for deflation would also bring with it contractionary effects, as Bean (2002) and King (1994) explain.

Selling options to underpin a promise to keep interest rates at zero

Tinsley (1999) proposed that a central bank sell options to underpin a promise to keep interest rates at zero in the future. Suppose that interest rates were at the zero bound, but expected to be there only temporarily. Suppose too that a central bank would achieve a better outcome for inflation and output if it could convince the private sector that interest rates would be held at zero for longer. This would lower longer-term nominal rates and stimulate aggregate demand, perhaps sufficiently so that the zero constraint on interest rates no longer binds, or binds for a shorter length of time. Tinsley (1999) pointed out that if a central bank had difficulty in convincing the private sector that rates would indeed be held lower for longer, it could enter into (options) contracts with it that would penalise the central bank were interest rates to rise above the promised level. It is possible that long rates may have a premium built into them because of the uncertainty about the path of nominal rates in the future. Tinsley argued that committing to contracts of this sort could reduce that uncertainty and lower long rates for this reason too.

It is worth making three remarks about Tinsley's proposal. First, if holding interest rates at zero for a long time were consistent with meeting the central bank's mandate, then only a central bank with a credibility problem—one that was not expected to follow its mandate, or one whose mandate was unclear—would benefit from entering into contracts of this sort.

Second, a policy of this kind would be no help if the fall in demand was so severe as to mean that short-term interest rates were not only at zero but expected to be there indefinitely. Third, it is likely that only very large penalties would dissuade a central bank from raising interest rates if better inflation and output control would result from it (since the social return from doing so is likely to be large). Holding such large potential liabilities (large potential penalties if interest rates are raised) on its balance sheet may be undesirable in itself.

4   Summary and conclusions

Recent low levels of interest rates have led some to speculate about the risks of interest rates being driven down to the zero-bound constraint, and of the economy entering a deflationary spiral. The risk is underscored by the current experience of Japan, and by that of the United States in the 1930s. Although we cannot infer anything very precise from these episodes about how significant the risks of hitting the zero bound are elsewhere (since we cannot easily abstract from the many specific aspects of the regimes or the economies of 1930s' United States or present-day Japan), we might conclude nonetheless that the circumstances that brought about these events are not likely to repeat themselves in the United Kingdom.

Studies that simulate models of economies and central banks pursuing inflation targets suggest that the risks of hitting the zero bound are small, and the risk of entering a deflationary spiral is very small indeed. These studies are forced to simplify the behaviour of central banks that pursue inflation objectives by positing simple policy reaction functions that do not accurately describe actual central bank behaviour. They therefore overstate the risks of hitting the zero bound, since they cannot allow for the possibility that the central bank could make significant pre-emptive cuts in interest rates to avoid hitting it.

Many alternatives to conventional interest rate policy have been suggested, were the zero bound to be reached. Automatic fiscal stabilisers are typically always at work (an increase in expenditure on benefits, and a fall in tax revenues) and will still work when interest rates are held at zero. The central bank could inject liquidity into the private sector by buying illiquid bonds or private sector assets, or intervene in foreign exchange markets to devalue the exchange rate and stimulate the export sector of the economy. It could in principle

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(1) A point first made by Pigou (1943).

attempt to tax cash holdings, engage in money transfers, or enter into financial contracts with the private sector to underpin a promise to keep short nominal rates at zero for a period of time, and thereby reduce long rates.

These policies are largely untried in modern times, may expose the central bank to risks, or impose other costs on the economy. Against this, simply the expectation that these policies are workable parts of the central bank armoury could be beneficial. For example, the expectation of a successful open market operation to buy private sector assets could increase expected inflation and reduce real interest rates directly, boosting aggregate spending in the way needed, even if nominal interest rates looked likely to head towards the zero bound.

The largely untried and uncertain nature of alternatives to cutting interest rates prompted Fuhrer and Sniderman (2000) to observe that 'prevention is likely easier than cure' (page 845). Since the risks of hitting the zero bound in pursuit of an inflation target like that in place in the United Kingdom are likely to be very small, we might nevertheless conclude that there is enough 'prevention' built into the UK monetary framework.

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The measurement of house prices

By Gregory Thwaites and Rob Wood of the Bank's Structural Economic Analysis Division.

House prices are an important consideration in assessing macroeconomic developments in the United Kingdom. But the special characteristics of housing—heterogeneity, infrequent sale and negotiated prices—give rise to important issues that complicate their measurement. There are several valid concepts of house prices—such as the average transaction price, the price of a typical house and the housing stock deflator—each of which is useful for a different purpose. Users must therefore be careful to match the measure they use with the concept of house prices they are interested in. Furthermore, all the available measures are volatile, so high-frequency changes in house price inflation should not be expected to persist.

Introduction

House prices rose by around 25% in 2002. This led to an increase in the value of the housing stock equivalent to around 85% of annual household disposable income, which more than matched the falls in household equity wealth. A rise in house prices increases the amount of money that new buyers and people trading up must borrow to fund house purchases, as well as the amount of equity available to existing homeowners to borrow against. The resulting mortgage equity withdrawal (MEW)—extra borrowing secured on housing that is not spent on additions to the housing stock—can be used to fund consumption, pay down other debts, or purchase financial assets. In the year to 2002 Q3, MEW amounted to £38 billion, equivalent to 5.3% of disposable income over this period. House prices also feed directly into the RPI, through measured physical housing depreciation (which represents the cost of maintaining the quality of the housing stock) and mortgage interest payments: physical housing depreciation accounted for around one third of annual RPIX inflation in December 2002. So house prices are an important consideration when assessing macroeconomic and financial developments in the United Kingdom.

But, as with many economic statistics, their measurement poses significant conceptual and practical problems. There is a range of available measures of house prices, and these can give conflicting or misleading signals about levels of or changes in house price inflation. This article discusses how house prices are measured, and how the available measures should be interpreted.

Why are house prices difficult to measure?

Houses are both durable goods and tradable assets. They provide a flow of rents to the owner, or housing services to the occupier, and there is an active secondary market in which houses can be bought and sold. But the price of housing is harder to measure than that of most other goods and assets, because of three key distinguishing characteristics.

First, and most importantly, dwellings are heterogeneous. No two dwellings are identical, if only because they cannot occupy quite the same location. This means that we cannot always reliably predict the sales price of a given dwelling from the price of another.

Relatedly, we cannot easily observe the market price of a given dwelling without it being sold. Dwellings are typically transacted at a price reached through negotiation or at auction, so the advertised price can be a poor guide to the eventual selling price. In contrast, other goods have advertised list prices, and many financial assets are traded on exchanges with quoted bid and offer prices. Professional assessors can be employed to estimate the price of a house, but this is expensive and can be a poor guide to the eventual sales price.[1]

(1) See Goolsby (1997) for a discussion of the systematic biases found in previous studies.

Our set of price observations is therefore usually restricted to transactions prices, so changes in the types of houses transacted will affect the mixture of prices we can observe.

Finally, houses are generally sold infrequently: over the 1990s, the number of private dwellings sold per year was around 7% of the stock. At this rate, each house would be sold on average approximately once every 14 years. So the most recent price observation for a given house will be on average 7 years old, and will therefore be an unreliable guide to the price it would fetch today.

A simple average of transactions prices in a given period has a clear interpretation: the mean price of houses sold in that period. This is a useful measure if one wants to estimate the value of turnover in the housing market (which will be related, for example, to stamp duty receipts and estate agents' turnover). But we may equally well be interested in the value of the total housing stock or the price of a representative house, in which case this simple average may be misleading.

Different types of house may be transacted at different rates or at different times. So the mean transacted price will be an unreliable guide to the mean price of all houses: changes in this mean price over time may reflect changes in the mix of houses being sold rather than in the value of the stock of dwellings. Suppose, for example, that detached houses are typically more expensive than terrace houses. If the proportion of detached houses sold in a given period rose, a simple average of transacted house prices would increase even if the price of both types of houses were unchanged.

Quality adjustment

Constant-quality measures of house prices try to standardise, and make comparable over time, the information available in the data, to overcome the limitations of simple averages. Three main methods are used for this: hedonic regression; mix adjustment; and the repeat-sales method.

Hedonic regression

The price of a house depends on its location and its physical characteristics. Hedonic regression is a way of estimating the value the market places on each of these attributes. For example, hedonic regressions can be used to estimate the market value of a bedroom, a garage, or a particular location. These estimates are then used to

construct the price of a synthetic house with a representative amount of each characteristic.

In terms of the previous example, a regression model could estimate the implicit market values of 'detachedness' relative to 'terracedness' in each period. If the model is correctly specified, the estimated prices of each characteristic, and therefore the estimated price of a house with fixed characteristics, will not be affected systematically by changes in the composition of the sample. (See the box on hedonic regressions for more detail on this method.)

Mix adjustment

Mix adjustment is an alternative approach to hedonic regression for removing the effect of changes in the characteristics of the sample (the 'mix'). House price observations are grouped into sets or 'cells' of observations on houses with similar location and physical attributes. In terms of the previous example, the sample could be divided into two cells—detached houses and terrace houses. In practice, the level of detail in existing mix-adjusted indices is much greater. For example, the mix-adjusted index produced by the Office of the Deputy Prime Minister (ODPM) contains over 300 cells, and the level of detail extends to a cell exclusively for second-hand, semi-detached houses with six rooms bought by first-time buyers in the North-East region.

Once all the data in the sample have been allocated to a cell, the mean prices in each cell are calculated. These mean values are then weighted (see below for a discussion of how the weighting method affects the interpretation of the average). The resulting weighted mean cell price is the 'mix-adjusted' price. A change in the composition of the sample will alter the number of observations in each cell. But if the cells are defined sufficiently precisely, so that all the elements of the cell have similar prices and price trends, then such compositional changes will not systematically affect the mix-adjusted house price.

Chart 1 shows the effect that mix adjustment has on the data in the ODPM house price index. The mix-adjusted index rose about one third faster than the simple average of the data over the 1980s, suggesting that the sample of transacted houses shifted towards relatively cheap houses over this period (possibly due to large sales of council houses). The mix-adjusted index rose more slowly than the simple average over the following

Hedonic regressions

The hedonic or characteristics approach to price measurement is based on the hypothesis that goods in themselves do not provide utility; instead utility is assumed to be derived from the properties or characteristics of goods (see Lancaster (1966)). By extension, the price of any good can be thought of as summarising the prices of its underlying characteristics. For houses, it follows that the price of a house will depend on the purchasers' valuation, or implicit price, of each characteristic and the quantity of each characteristic in the house (eg its size, location, number of bathrooms, bedrooms etc). In general, both qualitative (eg house location) and quantitative (eg floor size) characteristics will be relevant to the overall price. The implicit prices can be used to calculate the price of a house with a standard set of characteristics, which represent the type of house the price index is designed to track.

The implicit prices of characteristics cannot be observed, because the normal unit in which transactions take place is a complete house. Hedonic regressions overcome this by using a sample of house prices and the associated house characteristics to estimate the implicit market price of a unit of each characteristic. Estimation is complicated by two factors. First, there is no objective criterion that can be used to determine exactly which characteristics are relevant to the overall price of a house. Second, the way in which a characteristic contributes to the house price is not always obvious. For instance, does each successive bedroom contribute equally to the house price, or does a third bedroom contribute less than the second or first bedrooms? Judgments on these issues will determine the specification of the hedonic regression.

The table below shows that the hedonic regressions employed in the construction of the Halifax and Nationwide house price indices differ to some extent in the judgments they embody: each is based on a somewhat different set of characteristics, and some characteristics contribute to the house price in different ways. For instance, both lenders assume that the number of bathrooms affects the price of a house. But the Halifax index treats each successive bathroom as contributing the same additional amount to the house price, whereas the Nationwide index makes no distinction between a house with two bathrooms and one with three or more.[1] Such discrepancies may give rise to differences in the two indices' estimates of the rate of house price inflation. In particular, the inclusion of a variable in one equation but not another is likely to affect the coefficients on other variables in the equation and therefore possibly the price of the typical house. It is difficult to determine how large these effects would

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(1) The method used to construct the Halifax index is discussed in some detail in Fleming and Nellis (1984), available on request from the Halifax.

Chart 1
Ratio of simple average to mix-adjusted ODPM indices
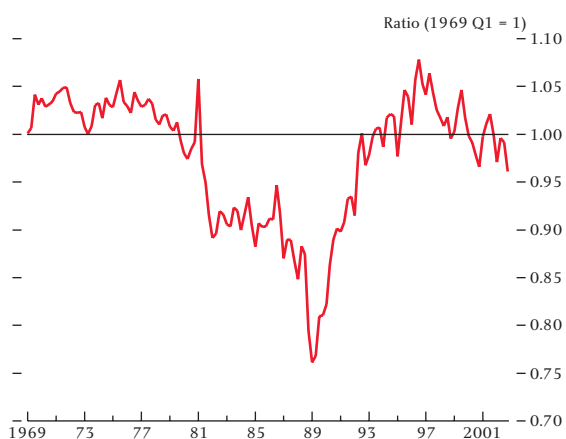
five years, as the sample shifted back towards higher-value house types. So a simple average such as the Land Registry index would generally have understated constant-quality house price inflation over the 1980s, and overstated it over the 1990s.

Repeat sales

Both the hedonic regression and mix-adjustment approaches require a large number of dwelling characteristics to be recorded if they are to be reliable. In some cases this information is not readily available. Instead, there may be information on the history of transactions for a large sample of dwellings, which allows us to examine the price changes of individual houses.

Characteristic	In the Nationwide regression?	In the Halifax regression?
Detached house	✓	✓
Terrace house	✓	✓
Detached bungalow	✓	✓ uses one bungalow dummy variable rather than two
Semi-detached bungalow	✓	
Purpose-built flat/maisonette or new converted	✓	✓ uses one flat dummy variable rather than two
Converted flat/maisonette	✓	
Tenure	✓	✓
Number of bedrooms	✓	✗
Number of habitable rooms	✗	✓
Double garage	✓	✗
Number of garages	✗	✓
Number of garage spaces	✗	✓
Parking space or no garage	✓	✗
Central heating type	✓	✓
Floorsize (sq. ft.)	✓	✗
Number of acres	✗	✓
More than one bathroom	✓	✗
Number of bathrooms	✗	✓
Number of toilets	✗	✓
Garden	✗	✓
Subject to a road charge	✗	✓
Property age	✗	✓
New	✓	✗
Region	✓	✓
ACORN[a] classification	✓	✗
Parliamentary constituency	✓	✗

(a)   A classification of residential neighbourhoods.

definition of a typical house, whereas the Nationwide index uses a definition that changes periodically, usually each year. The Halifax 'standard house' is defined by the characteristics of the average house on which the Halifax approved a mortgage in 1983. The Nationwide 'standard' house is, in general, defined by the characteristics of houses in rolling averages of the Survey of Mortgage Lenders, the Land Registry and Nationwide transactions. The Halifax index is, as a result, more sensitive than the Nationwide index to price movements in—for example—the North, because its weighting scheme places greater weight on price information from that region. Both indices are constructed from separate estimates for every period of the characteristics' prices, so the relative prices of characteristics are free to vary from one period to the next;[2] and both draw on price data from houses on which these lenders have themselves granted mortgages.

be, but even if the Halifax and Nationwide used the same data and definition of a typical house, their estimates of the price of a typical house would be likely to differ.

The Halifax and Nationwide indices are also constructed differently from the estimated prices of characteristics: the Halifax index uses a fixed

In times of uniform market-wide inflation, differences in the standard house will probably only have a very small effect on measured inflation rates because all houses will be increasing in value at similar rates. But at times when inflation rates diverge between regions or house types, there can be some effect on measured inflation rates. The extent of the effect will depend on the sensitivity of each index to the various segments of the market.

(2) Both of the lenders' indices are based on separate hedonic regressions for each period's data. This is the least restrictive method that could be used, but it could cause what might be considered strange results: the price of a characteristic, say the price of a bathroom, could change sharply from one period to the next. An alternative approach would be to constrain the relative prices of characteristics to be constant for several periods, but allow them all to vary by a similar amount.

Observing the sale prices of a given house at two points in time will give an estimate of general house price inflation between these two transactions. With a sufficient number of estimates from partially overlapping periods, we can estimate, say, yearly house price inflation. For example, if one group of houses was sold in 2000 and again in 2002 at prices 15% higher, and another group suggests that prices rose 10% between 2001 and 2002, we can infer that prices rose by around 5% between 2000 and 2001. No repeat-sales indices yet exist for the United Kingdom, but they have been estimated on US data.

All these methods have disadvantages. Both hedonic regression and mix adjustment require that all the characteristics of the house that may affect its price are

controlled for. If some were omitted from the hedonic regression or cell structure, a change in the distribution of these characteristics over time would create inaccuracies in the estimated change in the price of a constant-quality house. For example, if fitted kitchens became more common, but were not recorded as a characteristic of the houses in the sample, the price index would rise too quickly: higher prices from the inclusion of fitted kitchens would be mistaken for an increase in the price of a constant-attributes house. To the extent that the existing house price indices do not measure such quality improvements as they become more prevalent, they would overstate the rate of constant-quality house price inflation. Furthermore, if these unobserved attributes were more common in properties sold at certain phases of the cycle (for

example, if the top end of the market were relatively active during booms) then the amplitude of fluctuations in house price inflation may be understated or overstated accordingly. In other words, hedonic and mix-adjusted indices will suffer from the same problems as simple averages if they do not control for all relevant, varying characteristics.

Repeat-sales indices are based on individual houses' inflation rates. Changes in the sample mix of price levels would not affect the estimate of inflation, but variation in the mix between houses with different inflation rates would affect the estimates of simple repeat-sales indices. For example, if detached and terrace houses appreciate at 0% and 5% per year respectively, a shift in the sample towards terrace houses will increase the estimated average inflation rate, because no account is taken of the characteristics of the sample. Furthermore, the estimated appreciation rate will also be biased if the property changes in condition or is altered between the two price observations. Hybrid hedonic repeat-sales indices remove this problem by controlling for the characteristics of the sample, or by treating past sales prices of the same house or nearby houses as control variables in hedonic regressions.

The meaning of 'average' house prices

Once the data have been standardised to remove the effect of variation in the sample, the question remains: which house or group of houses should the index represent? The levels and inflation rates of house prices in the United Kingdom are widely dispersed—the prices of similar dwellings in different locations can vary by a factor of more than seven (see Chart 2)—so this is a key question. There are two main issues.

First, what constant notional house or set of houses should the index try to represent? Should it be typical of the flow of transactions, or the stock of dwellings? The two will vary to the extent that different kinds of houses are transacted at different rates.

Second, should the more expensive houses in thisset receive more weight, commensurate with their share of the expenditure on or value of the set? We can choose to represent the price of a house with typical characteristics, where all houses in a set have equal weight in determining what is typical: this is called 'transactions weighting' or 'volume weighting'. Alternatively, we can represent the price of a representative collection of houses, where more

Chart 2
Distribution of average transacted flat and maisonette prices in localities in England and Wales in 2002 Q3
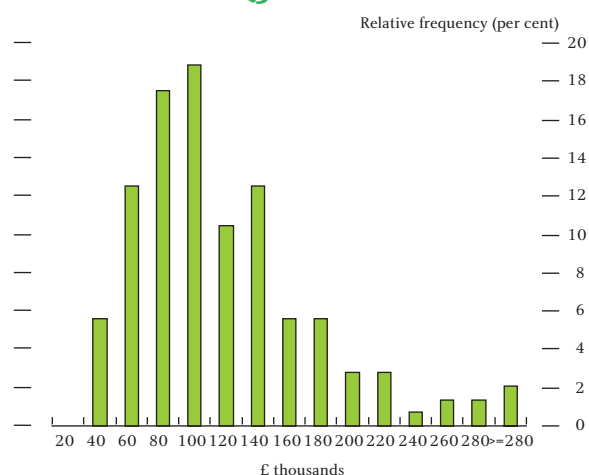
Source: Land Registry.

expensive houses have an accordingly higher weight: this is 'expenditure weighting' or 'value weighting'. These two measures will in general behave differently.

To see this, suppose that there are equal numbers of detached and terrace houses in the housing stock. If the price of expensive detached houses were rising at 10% per year, whereas the price of cheap terrace houses were falling at the same rate, the inflation rate of the 'typical house', in which each type would have equal weight, would be zero. But the cost of purchasing the entire housing stock, or a representative share in it, would be rising: the extra cost of the detached house would outweigh the lower cost of the terrace house, even though the prices were changing at the same rate, but in opposite directions.

In other words, when the price index is constructed to reflect the value of the reference set (ie the value of the housing stock or typical housing transactions), rather than the value of a typical member of the reference set, expensive houses are given more weight. If all houses were appreciating at a common rate, both price indices reflecting value and volume weights would appreciate at this rate. But if low and high-value houses were to exhibit different price trends, the inflation rates of volume and value-weighted indices would diverge.

## How do the existing measures of house prices fit into this framework?

There are several available measures of UK house prices. The four longest-established UK house price indices are produced by the Office of the Deputy Prime Minister

(ODPM), the Land Registry and the mortgage lenders Halifax and Nationwide. More recently, the housing web sites Hometrack and Rightmove have augmented this set. In addition to these indices, the Royal Institution of Chartered Surveyors and the House Builders Federation undertake qualitative surveys of changes in house prices.

Chart 3 shows that the four longest-established indices have similar long-term trends. The differences in their estimates of house price inflation will depend on the samples they are based on, and how these samples are transformed to produce the indices.
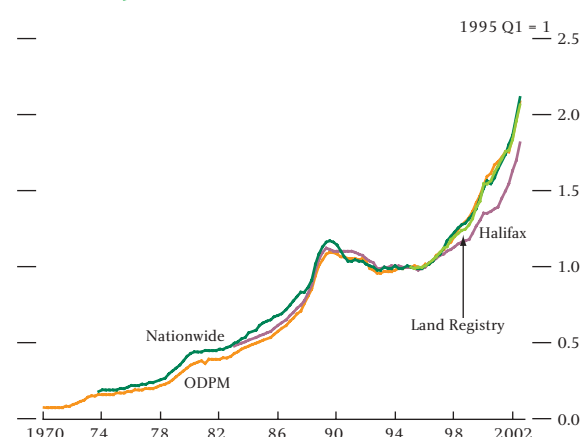
(a) Nationwide (pre-1991) and Land Registry indices seasonally adjusted by the Bank of England.

Table A shows that, while some indices are weighted to represent a flow of transactions, others represent a stock of dwellings. This will cause the indices to diverge to the extent that the average transacted house is different from the average house in the stock, and the price trends between them vary.
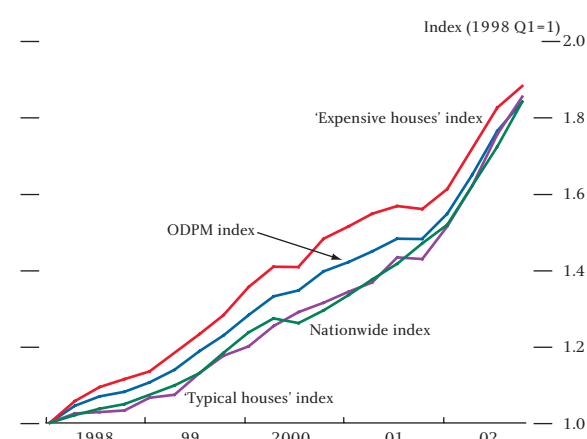
Both the Halifax and Nationwide indices represent the price of a typically transacted house—they are ‘volume-weighted’ indices of typically transacted house prices. The Halifax typical house has the mean characteristics of the houses on which this lender approved mortgages in 1983, whereas the Nationwide index weights are derived from rolling averages of the Survey of Mortgage Lenders, Land Registry and Nationwide samples. In contrast, the ODPM index is ‘value weighted’—it is effectively a deflator for typical housing market transactions.

To demonstrate the practical effect of the difference between volume and value weights, Chart 4 shows two subindices based on the most expensive quartile and the middle-priced 50% of the cells in the ODPM index, which can be interpreted as indices of ‘expensive’ and ‘typical’ houses. As expected, the volume-weighted Nationwide index seems to track the typical house

Chart 4
Levels of ‘expensive’ and ‘typical’ house price indices, the ODPM index and the Nationwide index

Table A
UK house price indices

Index	Sample	Standardisation method	Seasonally adjusted?	Weights used	Weighting method
ODPM (a)	5% sample of Council of Mortgage Lenders' eligible completions	Mix adjustment	No	Rolling average of UK transactions	Expenditure
Halifax	Loans approved for house purchase	Hedonic regression	Yes	1983 Halifax loan approvals	Volume
Nationwide	Loans approved for house purchase	Hedonic regression	Yes	Rolling average of Survey of Mortgage Lenders, Land Registry and Nationwide transactions	Volume
Land Registry	100% of sales registered in England and Wales	Simple average	No	None	Expenditure
Hometrack	Survey of approx. 4,000 estate agents' estimated local average prices	Mix adjustment	No	England and Wales housing stock	Expenditure
Rightmove	Sellers' asking prices posted on web site	Mix adjustment	No	England and Wales housing stock	Expenditure

(a) The ODPM is in the process of expanding the Survey of Mortgage Lenders data set on which its index is based, and will shortly switch to a variant of the hedonic regression method.

index more closely than does the value-weighted ODPM index, which moves more in line with the 'expensive' index.

The Land Registry index is based on a 100% sample of housing transactions in England and Wales, so it should not be subject to sampling error.[1] But, as Table A shows, the index is not mix adjusted, so variations in the mix of transactions affect the level of the index. Chart 5 shows that a seasonally adjusted, partly mix-adjusted version of the Land Registry index is smoother than a seasonally adjusted version of the published simple average. Had the latter been used as a guide to the price of a constant-quality house rather than as the average price of transactions, it would have given a misleading picture on many occasions. For example, the seasonally adjusted inflation rate of the headline index fell in 2001 Q4, while that of the mix-adjusted version rose.

Chart 5
Simple average and mix-adjusted Land Registry indices
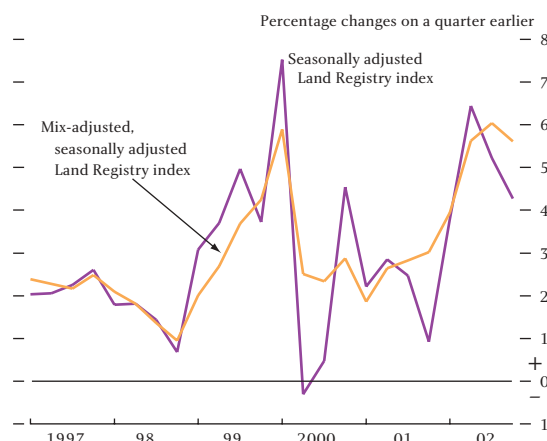
Chart 6 shows a timeline for a typical house purchase. The indices in Table A measure house prices at different points along this timeline, so indices nearer the

Chart 6
House purchase timeline and house price indices
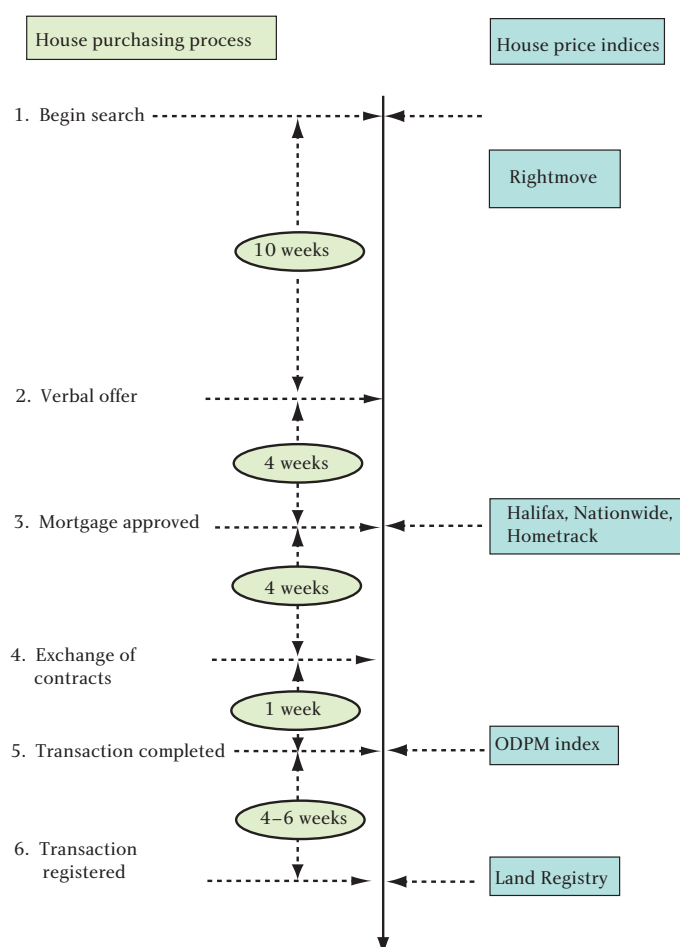
Sources: Bank of England and ODPM.

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(1) Note that the latest observation of the headline Land Registry index is usually revised upwards in the following release. For example, the 2002 Q3 observation was revised upwards when the 2002 Q4 data were released. The requirement to pay Stamp Duty, from which lower-value properties are exempt, delays the arrival of some observations in the sample. So data arriving late in the sample tend to have above-average prices, causing the upward revision.

beginning may be likely to detect a change in house prices first: the house prices appearing in the January Halifax index will not appear in the ODPM index until February. But the lagged comovement of the indices will be weakened to the extent that the sale price of a given house changes throughout the process. For example, prices may be renegotiated between mortgage approval and completion stage.

Aside from issues of measurement, a further complication is that not all of the indices are seasonally adjusted. The seasonal component of house price inflation is generally positive from February to July and negative in the rest of the year, and it can change sharply from month to month (see Chart 7). For example, the seasonal components of monthly Halifax and Nationwide inflation increase on average by 1.7 percentage points in February. So we should expect large increases in the monthly inflation rates of seasonally unadjusted indices in February, even when 'underlying' inflation is flat.

Chart 7
Seasonal factors in monthly Halifax and Nationwide inflation
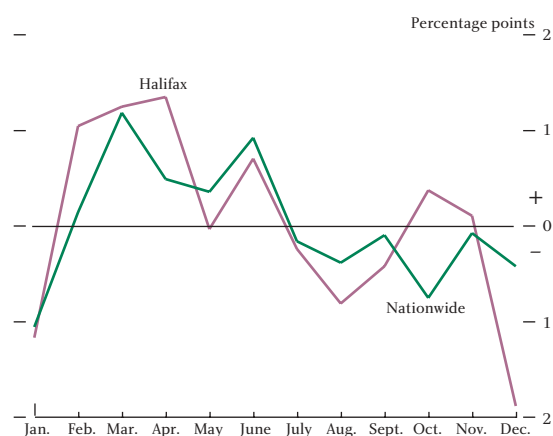
Finally, house price indices remain volatile even after they have been adjusted for seasonality and the mix of transactions. This does not necessarily reflect noise or

Chart 8
Changes in 'trend' and 'actual' monthly Nationwide inflation(a)
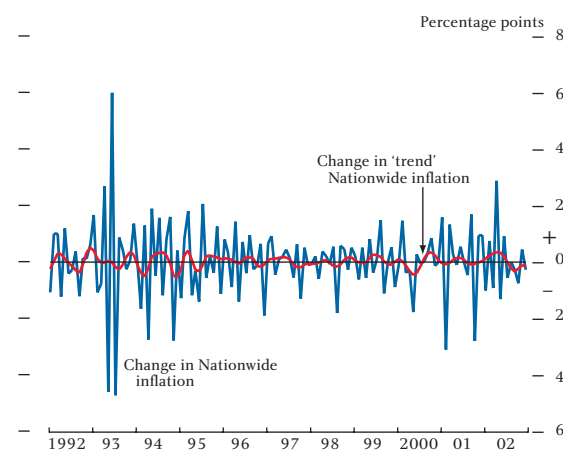
(a) Centred moving-average trend given by X-12 filter.

error in the indices: the 'true' variable they are measuring may also be volatile. However, policy-makers and commentators are frequently interested in the medium-term trend of house price inflation. As Chart 8 shows, most of the changes in monthly inflation each month do not reflect changes in an estimate of this trend, but are instead frequently reversed. This means that monthly changes in house price inflation do not individually contain much information about whether the medium-term inflation rate of house prices is rising or falling: several months of data are usually necessary to establish a change in the trend.

Conclusion

The heterogeneity of housing makes constant-quality prices difficult to measure, and means there are several valid concepts of 'house prices', each of which can behave differently. The indices available for the United Kingdom embody a variety of these concepts. Observers and policy-makers must be careful to match the measure they use with the concept they are interested in, and to ensure that the information in short-run changes in house price inflation is not overstated.

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House prices, consumption, and monetary policy: a financial accelerator approach

Kosuke Aoki, James Proudman and Gertjan Vlieghe

The Bank has a long-standing interest in the role of house prices in the transmission mechanism of monetary policy. Do house prices merely reflect macroeconomic conditions, or are there important feedback effects from house prices to other economic variables? There have been structural changes in the retail financial markets in the United Kingdom since the late 1980s. Following deregulation in the mortgage market, it has become easier and cheaper for consumers to borrow against housing collateral to finance consumption. What implications do these structural changes have for monetary policy?

In this paper, we model households' consumption and housing decisions taking account of the possible importance of credit frictions. Our hypothesis is that house prices play a role because housing is used as collateral to reduce the agency costs associated with borrowing to finance housing investment and consumption. Our motivation is based on three observations for the United Kingdom: (i) house prices and housing investment are strongly cyclical, which leads to substantial variation in households' collateral position over the business cycle; (ii) the amount of secured borrowing to finance consumption is closely related to this collateral position; (iii) the spread of mortgage rates over the risk-free interest rate varies with the collateral position of each household. These stylised facts suggest credit frictions and households' use of

their housing equity as collateral may be important in understanding the relationship between interest rates, house prices, housing investment and consumption.

Our model applies a financial accelerator mechanism to the household sector. When house prices fall, households that are moving home have a smaller deposit (ie net worth) available than they otherwise would for the purchase of their next home. When they have a smaller deposit, they obtain less favourable mortgage interest rates when renegotiating their mortgage, and have less scope for extracting additional equity to finance consumption. Fluctuations in house prices significantly affect the value of houses as collateral and therefore strongly influence borrowing conditions for households.

We show, by simulation, that the financial accelerator mechanism described above amplifies and propagates the responses of the economy to various shocks. We also consider the implications of recent deregulation in the mortgage market. Our simulation shows that cheaper access to home equity means that, for a given house price rise, more additional borrowing will be devoted to consumption relative to housing investment. This has important implications for how house price movements should be interpreted, because it implies that the relationship between house prices and consumption has changed over time.

Base rate pass-through: evidence from banks' and building societies' retail rates

Working Paper no. 170

Paul Mizen and Boris Hofmann

Nearly all central banks in the industrialised countries conduct monetary policy through market-orientated instruments designed to influence short-term interest rates. They reserve the right to supply the money market shortage at a price of their own choosing (the official rate), which then feeds through to short-term money market rates and the rates set by banks and building societies on retail products, such as deposit accounts and mortgages. For this reason, the official rate can be described as a lever that operates through short rates and longer rates to influence aggregate demand.

Ideally, official rate changes should be completely 'passed through' to market and retail rates over a reasonably short horizon. In practice, official rate changes may not be fully and instantaneously passed through to retail rates, but differentials may persist for a time. This paper explores some of the reasons why banks and building societies may face incentives to make discontinuous changes to rates. Our interest in this paper is the pass-through of official rates to bank and building society retail rates.

We consider the retail rate setting process as potentially asymmetric and non-linear. Our model allows for switching according to the size of and the change in, the difference between the current retail rate and its long-run equilibrium value. We make use of detailed monthly data on retail rates set by UK banks and building societies provided by the major clearing banks'

annual publications and the Building Society Commission over the period 1985–99.

Examining the relationship between the level of each retail rate by product and by type of institution we reveal complete pass-through to be the norm in the long run for deposit rates, but not for the mortgage rate. We then consider the non-linearities that exist in the dynamics, and this requires that we specify what drives the process of adjustment. We split the drivers into endogenous and exogenous categories. Drivers that were significant included the actual or expected change in the base rate, the yield spread for three to six-month horizons, and a measure of interest rate uncertainty based on option prices. Adjustment was unaffected by indicators of market competition, such as differentials between rates on similar products of banks and building societies, differentials between mortgage and deposit interest rates as a measure of margins, or activity in the housing market.

We conclude that the main driver of base rate pass-through is the change, or the expected change, to the official instrument. This creates faster adjustment when the 'gap', between the base and retail rates, is growing in absolute size. Both banks and building societies move significantly faster to close 'grouping gaps'. Although the response is quantitatively different for each retail product and for banks versus building societies, the direction of change is the same.

Leading indicators of balance-of-payments crises: a partial review

Working Paper no. 171

Michael Chui

During the 1990s, many countries, developed and developing alike, experienced severe financial difficulties, including balance-of-payments crises and systemic banking failures. Events such as the 1994 Mexican peso crisis and the Asian turmoil seem likely to have been a mixture of both. The scale and impact of these events have renewed interest in the existing literature and stimulated a large volume of new theoretical and empirical work to explain and/or predict crises, and to provide countries with appropriate policy advice to avert an impending crisis. While this paper gives a brief overview of the theoretical context, it concentrates on the empirical literature, with special emphasis on the search for potential leading indicators.

There are in general three different empirical approaches to analysing currency crises. The first is the 'signalling' method. In such models, the behaviour of a number of individual variables, such as the real effective exchange rate or the debt to GDP ratio, is evaluated against certain threshold levels. Once any of these indicators moves beyond its threshold, it signals a potential crisis in waiting. The 'optimal' threshold is selected on an indicator-by-indicator basis, so as to balance out the risks of failing to predict the crisis and giving a false signal of an impending crisis.

The second method borrows a technique widely used in the discrete-choice literature to analyse the probability of a currency crisis. The basic idea is first to sort different countries and time periods into two discrete episodes: a crisis and a tranquil period. Then, by mapping a set of possible indicators (chosen on the basis of *a priori* economic theory) into some known probability distribution function of these episodes, the likelihood of a currency crisis can be evaluated.

The third method is largely descriptive and often based on specific case studies. The primary concern of these studies is to establish structural relationships between particular variables and currency crises.

While most studies claimed to be successful in identifying leading indicators, the accuracy of their prediction deteriorates out of sample. The poor predictive power can be for several reasons: the difficulties in defining the dependent variable (or a crisis), changes in the structural relationships in an economy, overemphasis on some crisis-specific indicators, and other technical problems such as data quality and revision.

Nonetheless, whichever approach the research is based on, an interesting fact is that a particular set of indicators always emerges as informative in predicting an impending crisis. This includes indicators of real exchange rate overvaluation, liquidity problems, lending growth/boom and contagion. Focusing on the evolution of these indicators might usefully complement the whole set of indicators currently monitored for surveillance purposes.

Public demand for low inflation

Working Paper no. 172

Kenneth Scheve

This paper examines public opinion in advanced economies to assess the determinants of the macroeconomic priorities of individual citizens. Are views about macroeconomic policy objectives similar across different individuals or are there important divisions? Does opinion vary across countries, and, if so, what accounts for this variation? This paper uses survey data from 20 advanced economies to address these questions and presents three main empirical findings.

First, the distributive consequences of inflation and unemployment are key determinants of how individuals weigh different economic objectives. The basis of distributive conflict over macroeconomic priorities is in part grounded in the differential effect of macroeconomic performance on outcomes in the labour market. As suggested in previous research, those individuals more exposed to unemployment are less likely to place priority on low inflation. The existing literature, however, has failed to investigate empirically one of the key theoretical mechanisms through which macroeconomic performance generates distributive conflict: the ownership of nominal assets and liabilities. The analysis in this paper makes such an assessment and finds a robust connection between nominal asset ownership and macroeconomic priorities. Owners of nominal assets are more inflation averse, consistent with their exposure to unanticipated inflation.

Second, the findings also suggest that economic context has a substantial impact on the public's economic objectives in a way broadly consistent with the specification of utility/loss functions in the theoretical political economy literature. Rising and more volatile inflation is more costly, and the public places greater emphasis on low inflation as prices increase more rapidly. Similarly, as unemployment rises relative to the level consistent with stable inflation (NAIRU), reducing unemployment becomes a greater priority. These results are generally consistent with findings in the public opinion literature, though this study extends those results by relying on comparable data from 20 advanced economies.

Third, the findings in this paper suggest that there is significant cross-country variation in inflation aversion,

controlling for economic context and individual attributes, and that some of this variation can be accounted for by national-level factors that affect the aggregate costs of inflation and unemployment. The empirical estimates in this paper suggest that the demand for government revenue and the size and structure of the financial sector partially explain cross-country variation in inflation aversion, controlling for economic context and the individual characteristics of survey respondents. The negative correlation between the demand for government revenue and inflation aversion is consistent with the idea that if, for whatever reason, the inflation tax is less distortionary than alternative forms of additional taxation, individuals in countries with higher revenue needs may assess inflation to be less costly than in countries with lower revenue demands. The positive correlation between the extent of employment in the financial sector and inflation aversion is consistent with the argument that the financial sector, particularly firms engaged in traditional commercial lending with typically long-term assets and short-term liabilities, has a strong preference for price stability.

Overall, the findings in this paper suggest a number of questions for future research. A direct extension is to investigate the degree to which inflation aversion in particular countries changes over time. The results in the paper may also be useful in future investigations of the effect of monetary institutions on economic outcomes. Evaluating the effect of these institutions depends first on specifying preferences. This paper provides substantial evidence that there is sufficient variation in public macroeconomic priorities across countries that the specification of preferences may be substantially improved by understanding the relative inflation aversion of citizens. Future studies of why countries adopt the monetary institutions that they do may also be informed by the results in the paper. The role of distributive conflict among groups in society is central to the literature on this question. The findings in this paper suggest that those distributive conflicts are evident in the electorate, as well as among firms in various sectors of the economy.

Current accounts, net foreign assets and the implications of cyclical factors

Working Paper no. 173

Matthieu Bussiere, Georgios Chortareas and Rebecca L Driver

This paper examines evidence from 18 OECD economies to see whether current account behaviour is affected by a country's initial net foreign asset position. It uses as a starting point the underlying-balance approach to current accounts of the International Monetary Fund (IMF), which is based on the fact that savings minus investment in an economy must equal the current account by identity. It therefore models the current account using the determinants of savings and investment as an alternative to trade-flow models of current account movements. The emphasis of the approach is on the medium-run determinants of the current account, but at the same time, it explicitly allows for short-run, cyclical influences.

There are several explanations why initial portfolio allocations may explain current account behaviour. In an interesting paper published in 2000 in the *Quarterly Journal of Economics*, Aart Kraay and Jaume Ventura suggest that it is the current account response to temporary shocks that will be affected by existing portfolio allocations, assuming investment risk is high and diminishing returns are weak. Under these circumstances the marginal unit of wealth arising from a positive transitory shock will be allocated in line with existing portfolio choices rather than being invested solely in foreign assets as more traditional approaches suggest. Temporary shocks will therefore simply lead to portfolio growth, while permanent shocks will cause portfolio rebalancing. Although they provide empirical evidence that is compatible with such a 'new rule', Kraay and Ventura do not explicitly differentiate between temporary and permanent shocks. In contrast, this paper explicitly considers how existing portfolio allocations, proxied using net foreign asset positions, may influence reactions to both shorter and longer-run factors.

The current account is modelled by looking at both the long-run determinants of savings and investment and short-run, cyclical influences. It therefore provides a framework to differentiate between permanent and temporary shocks, based on economic criteria rather than purely statistical techniques. In addition, this method provides a framework that can be used to eliminate the impact of both global shocks (which in principle cannot affect the current accounts of individual countries) and the unobservable world real interest rate. The paper presents an estimate of a baseline current account model, of a model that considers fiscal policy composition effects and of a model that modifies the previous two to take into account initial net foreign asset positions, to proxy initial portfolio allocation.

The results suggest that initial net foreign asset positions affect the current account response to cyclical, but not longer-run, factors. The results are therefore broadly compatible with the 'new rule' under which the current account response to temporary shocks is influenced by existing portfolio allocations. One caveat to interpreting these findings solely in terms of the 'new rule' is that this paper uses net rather than gross foreign asset positions to proxy portfolio allocations. An alternative explanation for these findings might therefore be that credit constraints are larger in countries with negative net foreign assets. Under these conditions any procyclical movements in the availability of credit would modify the current account's response to the output gap in a way consistent with our findings.

Money market operations and volatility of UK money market rates

Working Paper no. 174

Anne Vila Wetherilt

It is widely accepted—both in the central bank and academic communities—that a key objective of a central bank's operational policy is to minimise persistent deviations of the relevant money market rate(s) from its policy rate. First, it is argued that excessive money market volatility might give the market confusing messages about the stance of monetary policy and is therefore to be avoided. Second, it is claimed that such short-term volatility may be transferred up the yield curve, which could affect asset markets and in turn have real economic effects. An important practical question is whether the choice of policy instruments affects this objective.

The past decade has witnessed a multitude of changes in the operational framework for monetary policy across developed countries. In the United Kingdom, important structural changes include the creation of the open gilt repo market in January 1996, the introduction of gilt repo in the Bank of England's daily open market operations in March 1997, and the introduction of a ceiling for overnight rates in July 1998.[1] The present paper examines whether these and other reforms to the Bank's money market operations have been accompanied by significant changes in money market rates and volatility. The paper also offers some guidance on how to measure the effectiveness of operational policy best.

The paper conducts an empirical study, using daily money market rates, ranging from the overnight to twelve-month maturity. We develop an empirical model that captures the key features of the data, in particular the time-varying nature of volatility. Using this framework, we analyse volatility of the key money market rates (the overnight and two-week rate). We then use this model to examine the relationship between short-term money market volatility and spreads. We also examine whether this volatility is transmitted up the

money market yield curve to affect longer maturity rates. Furthermore, we assess the speed of adjustment of interest rates along the money market yield curve to changes in official rates. We also investigate whether *not* choosing the overnight rate as a policy target has significant implications for money market volatility.

The research shows some evidence of a statistical relationship between key money market spreads and volatility at the very short end of the money market curve. The evidence is weak though, and does not extend to the longer end of the curve. First, we find no evidence of transmission of two-week volatility along the money market curve. Second, we find no evidence that allowing greater variation in overnight rates undermines efforts of the central bank to keep other money market rates in alignment with its chosen operational monetary policy target. Third, we demonstrate that spreads between the two-week market rate and the official repo rate affect both money market volatility and rate dynamics at the short end of the money market curve. The effects at the longer end are much weaker. In contrast, the overnight spread has little impact on money market rate volatility or dynamics.

Our tests further indicate that volatility of rates at the very short end of the UK money market yield curve has declined significantly since the early 1990s. The introduction of the gilt repo market in January 1996 was associated with lower money market volatility, although we have evidence that volatility had started to fall as early as mid-1995. The effects of the 1997 reforms of the Bank of England's open market operations are less discernible in the data. In contrast, the creation of a ceiling for overnight rates in June 1998 was associated with a reduction in volatility in end-of-day overnight rates.

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(1) The June 2001 introduction of a floor for overnight rates is outside our sample period.

Equilibrium analysis, banking, contagion and financial fragility

Working Paper no. 175

Dimitrios P Tsomocos

An analytical framework that can be used to examine financially fragile regimes and to show how financial crises develop is presented. An attempt is made to produce a rigorous yet tractable model of contagion and financial fragility. It integrates a range of well-known and widely discussed phenomena, such as bank runs, endogenous default and the liquidity trap, in a formal monetary general equilibrium model with missing financial markets.

The standard general equilibrium with incomplete markets model with money and default is extended by incorporating a competitive banking sector. Commercial banks are *heterogeneous* and are assumed to maximise expected profits subject to bank-specific state-dependent capital requirements. The non-bank private actors maximise utility of consumption subject to liquidity constraints. The model extends over two periods, and uncertainty is resolved in the second. Assets are traded in the first period and pay off in the second.

Trade in an equity market for ownership shares of commercial banks, as well as in the interbank credit market occurs in the first period. Commodity and non-bank private sector credit markets operate in both periods. Cash in advance is needed for all market transactions and both households and banks are allowed to default on their financial obligations. The government determines fiscal policy whereas the central bank sets monetary policy. Finally, a regulatory agency legislates the bankruptcy code and fixes capital requirements and time-varying risk weights.

Existence of *monetary equilibria with commercial banks and default* (MECBD) allows for positive default levels in equilibrium. Also, financially fragile regimes are compatible with the orderly functioning of markets. Existence is guaranteed provided that there are sufficient gains-from-trade in the economy. When financial markets are inactive, the rates of delivery are honoured by government via an organisation such as Federal Deposit Insurance Corporation.

A definition of financial fragility is proposed. An economic regime is financially fragile when substantial default of a 'number' of households and banks (ie a liquidity 'crisis'), without necessarily becoming bankrupt, occurs and the aggregate profitability of the banking sector decreases significantly (ie a banking 'crisis').

A version of the liquidity trap holds where banks engage in large asset trades, without changing interest rates in the non-bank private sector's credit markets, no matter how expansionary monetary policy is. Commercial banks do not channel the increased liquidity to the consumer credit markets but the asset market, and therefore increased activity is observed in asset transactions. So, commodity prices remain relatively unaffected.

The Diamond-Dybvig result is a special case of MECBD in which banks are *homogeneous* and *financial contagion* due to default is maximal. But if, on the other hand, loans are financed entirely by capital, there should be no spill-over effects. There is a trade-off between financial stability and efficiency, since stricter capital requirements generate higher interest rates and thus reduce efficient trade and limit banks' risk-taking behaviour.

It is also shown that under certain restrictions and binding capital requirements, equilibria are constrained inefficient. Therefore, if the government or the regulator intervened in period 0 through transfers, taxation or by modifying the capital requirements of the economy, it could achieve a Pareto improvement on the original equilibrium. Consequently, *optimal* regulatory policy exists, and it depends on the particular parameters of the economy.

Finally, the quantity theory of money proposition, in which both prices and quantities adjust in response to policy changes, holds. The term structure of interest rates is specified and accommodates both the expectations and liquidity preference hypotheses. Default influences the shape of the yield curve. Also, monetary, fiscal and regulatory policy changes are non-neutral only when interest rates are positive and the policy variables change disproportionately.

Within this framework, which displays several crucial characteristics of the financial system in its current form, it has been possible to show how financial fragility manifests itself *in the continuum*, and may not precipitate a financial crisis if the appropriate measures are adopted. Active regulatory policy may be used to improve welfare and alter the distributional effects of financial fragility.

Rational expectations and fixed-event forecasts: an application to UK inflation

Working Paper no. 176

Hasan Bakhshi, George Kapetanios and Anthony Yates

This paper tests a version of the rational expectations hypothesis using 'fixed-event' inflation forecasts. These forecasts can best be explained by describing the data we use. The forecasts are the prediction of fund managers surveyed by Merrill Lynch. Respondents are asked to forecast inflation, say, two years ahead. The following month they are asked for the forecast of inflation for that same date, now one year and eleven months ahead; the next month they are asked for their one year and ten month ahead forecast, and so on. Each month they are asked to forecast the annual inflation rate for the same date. The forecast event is fixed throughout, and the horizon of the forecast shrinks as the time line approaches the event. In the final month, respondents are asked to forecast the annual inflation rate one month ahead. This is what we term a forecast 'event', and we have 7 such events, and typically 23 forecasts, made every month over two years, for each event.

Our fixed-event forecasts allow us to test for whether expectations are unbiased in a similar fashion to the rest of the literature. But they also permit us to conduct particular tests of forecast efficiency—whether the forecasts make best use of available information—that are not possible with rolling event data. We present three efficiency tests. The first test is whether the forecast errors are uncorrelated with past forecast revisions: the intuition here is that under the rational expectations hypothesis (REH) current forecast errors should not be predicted by any past information, which includes past forecast revisions. The second test is whether this period's forecast revision is uncorrelated with last period's. This prediction follows when we note that the current forecast error comprises all future revisions, and combine it with our first test of the REH (that the forecast error is unpredictable). Under the REH, forecast revisions should only reflect news, not past revisions, nor in fact past data on anything at all. This test is particularly interesting since, unlike the first, and unlike tests with rolling event forecasts, it is not complicated by moving average error problems. Third, we test to see if the variance of the forecast errors declines as we get closer to the inflation outturn. Intuitively, it ought to be easier to forecast annual inflation six months ahead, when you already have half the data you need published, than forecasting inflation two years ahead. These tests also follow from our first: the forecasts and forecast errors can be re-written in terms of sums of future forecast revisions, which, if independent of each other, yield expressions for the variance of forecasts and forecast errors in terms of the variance of forecast revisions.

We find evidence of a positive bias in inflation expectations. But the evidence for inefficiency is much less clear cut: in particular, tests on forecast revisions that are robust to the serial correlation structure implied by rational expectations in our dataset do not show significant evidence for inefficiency.

The provisioning experience of the major UK banks: a small panel investigation

Darren Pain

Ideally, banks' provisions should capture expected losses. In practice, accounting conventions in the United Kingdom mean that provisions are set in a backward rather than forward-looking manner—specific provisions can only be made once the debt is shown to have genuinely become impaired and general provisions should cover losses that exist in the current loan portfolio but have yet to be identified. Provisions therefore correspond largely to realised loan losses.

Broadly speaking, the major UK banks' provisions ratios have moved quite closely together in the past. Most banks experienced a significant increase in provisions in the early 1990s—coinciding with a period of economic recession in the United Kingdom—while the provisions ratio fell back in the mid-1990s. Some important differences in movement are apparent. In particular, some of the major UK commercial banks experienced significant defaults on their Latin-American debts in the late 1980s. However, stripping out these problem country effects, provision ratios tended to vary more across time than across banks. This would seem to suggest that, over this period, the major UK banks' provisions arose more often from shocks hitting the banking sector as a whole than from idiosyncratic risks.

Banks' own behaviour may contribute to their vulnerability to such disturbances. In particular, banks may be prone to underestimate future losses in periods of economic expansion as lending criteria are relaxed or because concentrations of loan exposures increase. During subsequent economic downturns, this 'overlending' gives rise to a sharp increase in bad debts. As this may occur when bank income is itself weaker due to slower loan demand growth, such losses can actually reduce banks' existing capital. Further, during such recession periods banks may themselves be less able to raise new capital.

This paper investigates the possible influences on UK banks' loan-loss provisions (as a proxy for realised losses). Specifically, based on a small (unbalanced) panel dataset covering the period 1978–2000, regression analysis is used to examine the influence of macroeconomic variables and bank-specific factors on reported bad debt provisions. The main findings are that real GDP growth, real interest rates and lagged aggregate lending can indeed inform about banks' provisions. But bank behaviour is also important. In particular, increased lending to riskier sectors, such as commercial property companies, has generally been associated with higher provisions.

The impact of price competitiveness on UK producer price behaviour

Working Paper no. 178

Colin Ellis and Simon Price

There are relatively few papers analysing the price mark-up equation. This is despite the fact that the role of price-setting in macroeconomics has come strongly to the fore recently. The 'new' Phillips curve is interpreted as a dynamic pricing equation, where marginal costs are proxied by the output gap, or, perhaps more satisfactorily, by unit labour costs. Within the literature, it has usually been taken as given that there should be a role for competitors' (import) prices. Yet there is theoretical ambiguity, and identification is a neglected issue. This is important for policy, as 'competitor' is synonymous with 'foreign' in this literature, and we know from the New Open-Economy Macro literature that pricing behaviour of importers is important when we consider the monetary transmission mechanism. Evidence from the existing literature using single-equation estimates does suggest such a relationship exists, and if this is the case, there are implications for the monetary transmission mechanism.

To help better understand the economic processes at work, we examine UK producer prices. This sector is a natural one to examine, because most output is tradable and the relevant economic model is likely to be appropriate. We relax the customary assumption of Cobb-Douglas production technology. There is a potential identification problem, as in principle there may be two long-run relationships—one that we will call a long-run price relationship (LRP: not necessarily purchasing power parity in the sense it is normally understood), and the other the optimal mark-up. Cointegrating techniques are used in an attempt to resolve this identification problem. We also have a proxy for competitiveness, which is intended to match comparable import and domestic prices. Some evidence is found for the existence of two separately identifiable long-run relationships. The first of these is interpretable as the price mark-up (or, equivalently, factor demand) relationship, and competitors' prices can be excluded from it. The second equation can be interpreted as a long-run equilibrium price relationship equating domestic and foreign prices.

This raises the possibility that single-equation estimates indicating a role for foreign prices in domestic price determination may unintentionally mislead. The results are for producer prices and may not necessarily be extended to other indices. But they suggest the possibility that the structural price mark-up equation for UK manufacturing does not depend upon foreign prices. This relationship appears to equilibrate via labour demand or, in terms of our modelled variables, productivity. However, there is evidence for a separate link between import and domestic producer prices, which might be thought of as the general equilibrium long-run relationship, which equilibrates through all three variables in our system. Thus, there is a suggestion that the reason why single-equation estimates find significant effects in price equations is that they conflate the structural and general equilibrium relationships.

A Kalman filter approach to estimating the UK NAIRU

Working Paper no. 179

Jennifer V Greenslade, Richard G Pierse and Jumana Saleheen

In the second half of the 1990s, a period that was characterised generally by buoyant economic activity, unemployment in the United Kingdom fell continuously and reached its lowest level in over 20 years. In 2000, Labour Force Survey (LFS) unemployment stood at just over 5% of the labour force, which was nearly 2 percentage points below the lowest rate seen during the previous recovery. A key question then is at what level of unemployment will wage and price inflation begin to rise? This critical level of unemployment is usually referred to as the non-accelerating inflation rate of unemployment or NAIRU. If the unemployment rate falls below this level, it will put upward pressure on inflation and inflation will tend to rise (though effects from other variables may offset this pressure).

There are many possible methods that could be used to estimate the NAIRU. This paper adopts a statistical approach by applying Kalman filter techniques that allow the joint estimation of the Phillips curve and a time-varying measure of the NAIRU. We have used a variety of models (based on either price or wage inflation) and calculated time-varying NAIRU estimates from 1973 to 2000. According to these estimates, the NAIRU reached a peak in the mid-1980s and tended to decline thereafter. Such profiles are broadly in line with other UK estimates, often obtained from different approaches. Of course, the estimates presented in this paper should be regarded as illustrative and not interpreted as MPC estimates. In practice there are a range of labour market indicators that may be relevant for analysing inflationary pressures.

It is widely acknowledged that there is a great deal of uncertainty around NAIRU estimates, whichever approach is used. We illustrate this through the large standard error bands around our Kalman filter estimates. As a consequence, we would not place weight on any particular point estimate for the NAIRU. But even though there may be uncertainty about the level of the NAIRU, a range of specifications and assumptions tend to suggest that the NAIRU was falling through the 1990s (though we do not analyse the reasons for any fall in the NAIRU). Further, according to our models, it appears likely that unemployment at the end of the decade was below the NAIRU, suggesting some upward pressure on inflation from this source. Had the NAIRU estimates not fallen over this period, there would have been greater upward pressure on inflation from the labour market. So structural changes appear to have had a beneficial effect on UK inflation during this period.

However, the story does not end there. Our results suggest that temporary supply factors (captured by real import prices or real oil prices) are also likely to have played an important role in holding inflation down, especially in the 1997–99 period. Developments in import prices or oil prices, as well as movements in the unemployment gap, may therefore be important in assessing future inflationary pressures.

This paper has not touched on changes to the UK monetary policy regime, such as the move to inflation targeting at the end of 1992 or the granting of independence to the Bank of England in 1997, which may have had an impact on the formation of inflation expectations. It is possible that our NAIRU estimates are indirectly picking up any such changes, thus casting doubt on our estimates. But separate work including inflation expectations does not provide any strong evidence that this was a key factor for the United Kingdom.

The role of expectations in estimates of the NAIRU in the United States and the United Kingdom

Working Paper no. 180

Rebecca L Driver, Jennifer V Greenslade and Richard G Pierse

During the second half of the 1990s there were similarities in the performance of the US and UK economies. In particular relative to their recent past, both economies were characterised by stronger growth, falling unemployment and both low and more stable inflation. This combination led commentators to label the United States (where these developments were more pronounced) as the Goldilocks economy: one which was neither too hot, nor too cold, but just right. This paper examines the evidence for a change in the relationship between inflation and unemployment in the United States and United Kingdom between the 1990s and earlier periods. The paper contains a potentially important innovation by incorporating an explicit role for inflation expectations derived from survey measures.

All the results for the United States suggest that the non-accelerating inflation rate of unemployment (NAIRU) was steadily declining during the second half of the 1990s. However, inflation expectations are found to play a particularly important role in the United States and when expectations are included our results show that a declining NAIRU is not found solely in the 1990s. On the same basis, our results suggest that the timing of any change in the United Kingdom occurs somewhat later than in the United States. As our modelling strategy uses a reduced-form estimate of the NAIRU, we cannot identify exactly which factors trigger any changes. In addition, one important caveat is that there is typically a high degree of uncertainty surrounding NAIRU estimates. For this reason our results should be seen as illustrative rather than precise point estimates. Furthermore, these estimates should not be interpreted as MPC estimates.

There are two types of explanation for the combination of low inflation and stronger growth witnessed in the United States and the United Kingdom in the second half of the 1990s: favourable shocks or structural shifts. If it was the result of favourable external supply-side shocks, such as falling energy prices, supply potential as well as the relationship between inflation and excess demand factors will be unchanged. The alternative involves a lasting change in the relationship between inflation and excess demand, now known by the collective label of new paradigm economics. Here, such

manifestations can take two main forms. The first involves changes in an economy's supply potential, such as an increase in potential growth or a fall in the NAIRU, which alters the level of excess demand for a given level of actual demand. Alternatively, it could imply a change in the relationship between inflation and a given level of excess demand, for example due to changes in the behaviour of margins resulting from competition. Of course, the true explanation may well be a combination of both favourable supply shocks and structural changes; the paper allows a role for both.

The framework used here relates inflation to a combination of inflation inertia, demand-side factors (provided by the gap between unemployment and the NAIRU) and external exogenous supply shocks (provided by real oil prices and real import prices). Most of the underlying models for this framework assume that price-setters are forward looking, so expectations will be an important determinant of behaviour. However, explicit measures of expectations are not normally included in estimation. When the regime is stable, agents' inflation expectations can be modelled using the actual and lagged values of the variables in their information set, so including an explicit measure of expectations should not matter. However, when the regime has changed (either because of a policy shift or change in the competitive environment), it will be important to include inflation expectations explicitly. This channel has been largely ignored and we try to assess how important this omission may have been.

The evidence is obtained using Kalman filter techniques, which allow the joint estimation of the Phillips curve and a time-varying measure of the NAIRU. As well as representing one of the tools in the policy-makers' tool kit, the use of the Kalman filter has the advantage of providing some direct evidence on whether the NAIRU had in fact fallen in the second half of the 1990s. Such statistical estimates are independent of the correct identification and estimation of the structural factors underlying a fall. The latter are important for pinning down exactly how a fall may differ from past observed falls in the NAIRU. Of course, time-varying NAIRUs are one of several indicators that can be used to interpret movements in the labour market.

Procyclicality and the new Basel Accord—banks' choice of loan rating system

Eva Catarineu-Rabell, Patricia Jackson and Dimitrios P Tsomocos

The Basel Committee on Banking Supervision is proposing to introduce, in 2006, new risk-based requirements for internationally active (and other significant) banks. Under this regime capital requirements for many banks will be based on their own assessments of the probability of default of individual borrowers. These will replace the relatively risk-invariant requirements in the current Accord which are based on the broad type of lending. This paper examines the implications of this new risk-based regime for the cyclicality of capital requirements—in particular whether the choice of particular loan rating systems by the banks would make sharp increases in capital requirements in recessions more likely. This is an important policy question because substantial changes in capital requirements would increase the likelihood of 'credit crunches'.

All regimes with minimum capital requirements have the potential to generate procyclical effects because capital available to meet the requirements becomes more scarce in recessions as banks make provisions and write off defaulted loans. The new element under the proposed revised Basel Accord is the potential for capital requirements on non-defaulted assets to rise in recessions if banks downgrade loans. The paper finds that the extent of this additional procyclicality depends on the nature of the rating systems used by the banks.

A number of banks have carried out careful mapping exercises to ensure that their rating approaches are very close to those of the main rating agencies which are designed to be relatively stable over the cycle. Many other banks have adopted an approach based on a Merton-type model which uses information on the current share price and liabilities. Because this approach uses current liabilities, it is in some respects akin to a rating that is conditioned on the point in the cycle. We estimate the likely increase in capital requirements in a recession, depending on whether a bank is using one or other of these two rating approaches. Portfolios of corporate exposures are

constructed using information on the actual quality distribution of corporate loans made by some large banks. The extent to which banks would downgrade loans in their rating bands in a recession is estimated using transition matrices (for 1990–92) calculated from Moody's ratings and from ratings produced by a Merton-type model. We find that ratings based on Moody's approach lead to little, if any, increase in capital requirements for non-defaulted assets, whereas ratings based on a Merton-type model lead to a 40% to 50% increase.

This makes the question of which rating schemes banks will use very important. We use a general equilibrium model of the financial system to explore whether banks would choose to use a countercyclical, procyclical or neutral rating scheme. The model consists of three sectors (the household, corporate and banking sectors), two time periods with two possible future scenarios, and a financial market with one default-free asset and loans. Default is endogenous in the model. Capital requirements depend on the credit rating set by the bank, which is in turn based on the expected default rate of corporates. Expected default is also the key variable that affects the banks' decisions on how to allocate their portfolios between loans and other assets. This affects credit expansion in the economy. Demand for loans depends on the default rate and supply of loans on the bank rating and capital weight.

The results indicate that banks would not choose a stable rating approach. Bank profits would be higher if they adopted a system that produced ratings that varied over the economic cycle, because such a system would enable them to transfer the cost of recessions to the rest of the economy. Procyclical ratings could have macroeconomic consequences by encouraging overlending relative to risk in booms and reduction in lending in recessions. This underlines the need for banks to be given incentives to adopt more stable rating regimes to underpin their capital requirements. This consideration has been reflected in the current design of the Accord.

Report on modelling and forecasting at the Bank of England

Report to the Court of Directors of the Bank of England on the modelling and forecasting systems within the Bank, prepared by Adrian Pagan.[1]

Executive summary

Models and forecasts are important inputs into any decision-making process whether it relates to business or to monetary policy. In the UK context the model used in the monetary policy process needs to incorporate the views of the MPC about the way the economy functions, ie to be theoretically coherent, and also be able to replicate historical data on the UK economy, ie to be empirically coherent. It is hard to achieve both of these simultaneously and some trade-off needs to be made when selecting the model.

The report documents a range of models that have been or are being used in central banks and that resolve the trade-off identified above in different ways. Which of these models is selected will ultimately depend on the preferences of the MPC, but it is important that, for any degree of theoretical coherence, the degree of empirical coherence should be maximised. In the report this is characterised as the desirability of being on the frontier that shows the best possible combinations of theoretical and empirical coherence that are attainable, rather than being inside it.

At this point in time two core (or key) models exist in the Bank—what I have termed the macro model (MM) and the new macro model (NMM). The NMM is currently still under development. In my judgment the MM is not at the frontier. Its structure does not fully accord with the MPC's beliefs about the functioning of the UK economy and it has some well-documented difficulties in matching historical outcomes for a set of variables such as inflation and GDP growth. The NMM is likely to score more highly with regard to theoretical coherence but evidence on its empirical coherence was not available at the time of the writing of this report. Because the MM

is off the frontier there is a strong argument for replacing it with some alternative model.

Many attempts have been made to improve the empirical coherence of the MM. Bank staff have been very active in modifying the equations of the MM for this purpose. Some solutions have emerged but the report suggests that these have not completely resolved the issue of empirical coherence, particularly with regard to the inflation process. Problems in predicting inflation have been a worldwide problem in the mid to late 1990s and it seems that quite new perspectives may be required in order to produce good predictions of it from a model.

The level of technical proficiency displayed by the modelling and forecasting teams in the Bank is already very high and I have made only a few minor suggestions about how it might be augmented.

The decision to proceed with the development of the NMM may have had the (possibly unintended) consequence of diverting resources from the maintenance of the MM and, more importantly, meant that the response to failures of the equations of the MM was to make relatively small changes to them rather than to explore alternative paradigms.

The forecasting process is distinct from the modelling process. It involves a series of technical adjustments to correct difficulties experienced when using the equations of the core model for forecasting. These relate to past performance but also aim to anticipate difficulties that might occur in the forecast period. This system now seems to be working very well in the Bank and has had some noticeable success in correcting some of the difficulties encountered when forecasting with the MM model.

Some variables, particularly exchange rates, are very difficult to forecast, and a range of alternative methods has been experimented with. I feel that the methods used by the Bank in this context are 'state of the art'.

Although the Bank has a core model that is used for most policy analyses and forecasting, it recognises that such a model cannot handle all the situations that arise in actual decision-making, eg the impact on costs of 11 September 2001. Special models need to be developed to deal with such events. It also may be desirable to look at the evidence from a range of models rather than a single one when assessing policy options. This leads to the desire to have a diverse set of models, or what the Bank refers to as a 'suite of models'. In my opinion there is a good diversity of models for policy analysis within the Bank but I express some concern over whether this is true when it comes to the task of forecasting. A large number of auxiliary models are used in the latter activity, but they have tended to derive from a prior use in investigating policy issues rather than being selected for their suitability for informing the forecast. Consequently, I recommend that more attention be paid to the selection of the suite of forecasting models.

There has been much criticism of the fact that forecast errors in two year ahead forecasts have been consistently of the same sign and that there has been a 'bias' in these forecasts. In the report I analyse these outcomes and show that one should expect runs of the same sign in forecast errors and that the 'bias' is probably as small as one could reasonably expect.

The periods of time in which the forecast errors were worst coincide with the times in which there was an unusual pattern to MPC forecasts, namely one in which expected inflation and GDP growth were negatively rather than positively related. This suggests that greater attention should be paid to joint outcomes of inflation and GDP growth. At present the fan charts give this information separately on each variable and I would recommend that it should be an objective to produce fan charts showing their expected joint outcomes.

The Bank has been quite sensitive to the need to perform ex-post forecast evaluation. Analysis that has been presented to the MPC has ranged from summarising the outcomes to attempting to ascertain the reasons for the errors, eg by decomposing the forecast errors for inflation in terms of the forecast errors for the influences on inflation of earnings, the exchange rate, etc. I feel that the work in this area has been of high quality and certainly of adequate quantity.

Many problems have had to be faced and solved in setting up a modelling and forecasting system that would adequately serve the unique structure of the UK monetary policy decision process. It was inevitable that some difficulties would arise with the initial solutions and that modifications would need to be made. The current system seems to be working very well.

Terms of reference

In October 2001, I was asked by the Court of Directors of the Bank of England to prepare a report for them on the modelling and forecasting systems within the Bank. The terms of reference given to me were:

'The reviewer shall provide for the Court of the Bank a report on the statistical and economic modelling and forecasting work carried out by the staff of the Bank for the MPC and evaluate whether that work is 'state of the art'.' The review should in particular:

● focus on the technical aspects of the modelling and forecasting process, rather than the procedural and presentational issues addressed by the Kohn Report, and judged against the purposes set out for the monetary policy regime;

● cover the full range of modelling and forecasting approaches presently employed by the Bank and note where these methods lag behind best practice or are capable of improvement;

● identify any additional techniques or approaches that could usefully be employed; and

● evaluate the procedures for ex-post forecast evaluation.

During the period from October 2001 until June 2002 I visited the Bank on a number of occasions, interviewing many of the people involved in the forecasting and modelling process and attending meetings concerned with those activities. I also spoke to all members of the MPC about their impressions of the process. I would like to thank all those who responded to my requests for information and for going over the procedures in some detail.

Structure of review

To structure my review I found it useful to conduct the discussion in terms of six themes, rather than organising it specifically into the categories of the terms of reference. These are:

1 Representing the economy.
2 Modelling the UK economy.
3 Projecting the UK economy.
4 Diversification of representations and projections.
5 Assessing the quality of projections.
6 Communicating the models and projections.

Interpretation of terms of reference

To begin the review, it is necessary to interpret some of the terms of reference. Implicit in them is a recognition that it may be important to divorce the questions of how one constructs a representation of the economy from the way in which projections are built up. An important argument in favour of the divorce is that monetary policy makers often need to use models to enhance their understanding of an economy, and what the historical data say about interactions within it, rather than just using them to make a projection. Deciding on a useful representation is generally referred to as the modelling process, while the way in which a projection is done is generally termed the forecasting process. Though the term 'forecasting' is technically inaccurate, as it implies an unconditional statement about future outcomes, and so makes no reference to any assumptions that underlie the statements, eg concerning exchange rate behaviour, we will tend to use the terms projection and forecasting interchangeably, since it is such common usage.

A further element in the terms of reference that needs some clarification is the mention of 'state of the art'. Inevitably this demands a reference point. Three possibilities suggest themselves—relative to what is being done in academia, relative to what is being done in other central banks, and relative to what might be done given the constraints that are placed upon the Bank of England by the way in which monetary policy decisions and projections are made in the United Kingdom. The latter process seems to be unique in the world. Policy decisions are made by a committee that is composed of both executive and non-executive members of the bank (the 'internals' and 'externals' respectively). Moreover, under the legislation setting up the MPC, the projections that are recorded in the *Inflation Report* are those approved by the MPC; in practice this requirement has been met by having the projections as being those of the MPC rather than the staff of the Bank of England. The fact that this institutional structure is very different from others means that procedures have often evolved to deal with this fact. 'State of the art' might therefore mean that the processes should be such that the client—the MPC—is satisfied that the processes enable it to perform its tasks effectively. I suspect that one needs to look at the processes from all of these angles, and will do so in the report, although the third angle mentioned above seems to be the appropriate standard for final evaluations.

Models and decisions

To make decisions about the direction of a business requires information. Today the process of constructing that information often starts with a representation of the activities of the business in a spreadsheet that summarises its financial accounts. This spreadsheet is often termed a model. Often there is a 'core' spreadsheet which is linked to other spreadsheets, with the latter providing a greater degree of disaggregation of a given item, such as sales into different regions or branches etc. The 'core' spreadsheet would rarely stay the same over long periods of time, since the business will take on new activities, and new competitors will arise, so that the 'model' of the business to be found in that spreadsheet will need to adapt to the new environment.

The spreadsheet provides a large amount of information to the decision-makers concerning the current state of the business. However, when making decisions about the future direction of the business, it will be necessary to project the items in the core spreadsheet. This will generally be done through a number of other spreadsheets, each of which describes rules for the projection of each of the items. Such rules need to recognise that there are interrelationships between many of the columns of the spreadsheet, eg if the business has many products that are substitutes, it may be that a rise in the sales of one product line will mean a decline in the others. Moreover, in making any projections, account has to be taken of competitors' reactions, and allowances must be made for things not under the control of the company, such as developments in the macroeconomy, exchange rate movements and tax rates that might be levied by governments.

The spreadsheet numbers that come from this process are of course just a body of information into the decisions that are to be made. There is no automatic rule that maps the numbers into a decision, although it is quite likely that there would be some predictable reactions by the decision-makers to certain outcomes, eg a projected drastic decline in sales of a product could lead to a cancellation of that line.

The monetary policy decision process corresponds quite closely to the above description. To make decisions, the monetary policy makers need a representation of the entity that they are attempting to direct. Since this is the macroeconomy, the primary representation comes from the national accounts, and so it focuses upon the major aggregates such as consumption, investment, exports etc. But many other series may be linked into these elements, eg consumption may be disaggregated in many ways. Moreover, in the same way that the spreadsheet model of a business may vary over time in response to changes in a business and its environment, so too may the models employed by a central bank.

Monetary policy decisions also require a projection. This projection needs to recognise the interrelationship between many of the series and also has to take account of the reactions of the private sector to actions of the monetary authority, particularly through a change in its expectations. Finally, just as in any business decision, there are many things that are outside the direct control of the monetary authority; examples being the exchange rate and the international economic situation, although monetary actions may influence both to some extent. Consequently, separate projections of these influences must be made.

The similarity in process and structure means that there are also many similarities in the way that decisions are made in business and by monetary policy makers. In particular, in both cases the models and projections are meant to inform the decision-maker rather than being automatic determinants of the decision. But there are also some significant differences.

First, most businesses have good information on the current state of revenues and costs, so that the core spreadsheet will contain up-to-date information on the activities of the business. For a monetary policy maker this is rarely true. The quarterly national accounts are published with a substantial lag. This means that items such as current-quarter GDP may not be known at the time of a monetary policy decision. Indeed, the outcome for a number of past quarters leading up to the point in time at which a decision on monetary policy is to be made may not be known. Instead there will be a large amount of partial information upon such items, and an important task for central bank staff will be to 'fill in' the gaps. It is also the case that the quarterly national accounts are prone to revision and sometimes a model can be a useful device for assessing whether a particular revision needs to be treated with a good deal of caution.

Second, the degree of disclosure of both the projections and the reasons for decisions is very different. Company directors certainly face the discipline of the market, but they only formally appear before shareholders once a year. In contrast, a central bank continuously publishes

a large amount of information about its projections and its thinking about what is happening to the macroeconomy. Moreover, in the UK case, the Governor and other MPC members are generally subject to questions by committees of the Houses of Parliament a number of times a year.

Finally, the risks that surround a projection in the eyes of the directors and chief executive officer of a company are rarely disclosed to either shareholders or the market in any precise way. In contrast, at least for the Bank of England, projections are presented in each of the quarterly *Inflation Reports*, minutes of the decision-making meetings are published and risks to the projections are quantified in fan charts for inflation and GDP growth.

The brief description of decision-making given above highlights the need to build models and to make projections. Hence it is appropriate that the terms of reference I was given focused upon these aspects and their effectiveness for the decisions on monetary policy to be made by the MPC.

Representing the economy

Representing the economy requires setting up some modelling system. There are basically three components to such a system:

1 Deciding on a model of the economy.
2 Setting up processes for reviewing and modifying the components of the model.
3 Creating processes for deciding whether a new model should be entertained and formulated.

A 'state of the art' modelling system needs to address each of these items and we will consider each in turn. Before doing so, a brief history of modelling the economy is needed in order to classify the core models in use at the Bank of England.

Modelling strategies

The design of a model is like the design of a journey. One could simply meander around the countryside with the vague idea of arriving at a given destination, making choices about routes as one goes along. Alternatively, one could have an idea of a region that one might like to visit, say Provence, have a map in one's head of how one should get there, and then use sign posts as one goes along to achieve that objective. Greater degrees of precision can be applied in the choice of destination, eg

Aix-en-Provence rather than Provence, and more forward planning of the route to be followed can be done. In the ultimate scenario, one could imagine using an on-board computer to provide one with an optimal route that would minimise travel time given the information fed into it. These two elements, the specification of a destination and the selection of a method to get there, are the key factors that appear over and over again in the history of model design.

How should a model be constructed that is intended to be a good representation of those features that are of primary interest to policy-makers, such as the MPC? Under the MPC's remit the variable of primary interest is the inflation rate, but the level of economic activity clearly plays an important role in its thinking. Consequently, one needs to ask how one is to build a model of these two variables. When the first macroeconometric models emerged this seemed a rather straightforward question. With regard to economic activity, the national accounts provided a set of identities linking items such as GDP, consumption, investment and the trade balance. On the price side, following a long tradition in applied microeconomics, the price of domestic goods could be regarded as a mark-up over variable costs, while the price of imported goods reflected international prices and the exchange rate. Together these two prices combined to produce an aggregate price level. Thus it was envisaged that one would simply write down the equations underlying those series that were the building blocks of GDP and the price level, and then introduce extra variables as needed, eg the mark-up might vary with the state of the economy, making it necessary to measure the latter variable. This strategy meant that even more equations needed to be set out, so as to explain the variables included at an earlier stage. Therefore, starting from the original two variables that were to be explained—economic activity and inflation—such a modelling strategy meant that many more variables needed to be modelled. By the late 1960s the approach had led to models with hundreds and, sometimes, thousands of equations. In terms of a journey this would correspond to the meandering strategy.

Despite the misgivings of some, these models seemed to work rather well, and it was not until the early 1970s that they began to produce poor forecasts. A number of reasons were then suggested for this outcome. One blamed the oil price shocks of 1973, since, though the models had an extensive set of equations for describing demand, the other half of the economist's 'scissors',

supply, was either not present or was present in a very rudimentary way. Proponents of this view of the cause of forecast failure therefore responded by expanding the already large models to incorporate a supply side. This took many forms, of which the simplest was just to recognise that there were constraints placed on output by the quantity of factors in the economy, and so an expansion of demand did not lead to a rise in output unless extra factors could be found and mobilised. If this was not possible the demand dissipated, either into higher prices or into a deficit on the current account. Today such constraints are present in all macro models used for policy. Indeed, there is probably no single concept that is as much debated and measured in a myriad of ways by central banks as the 'output gap', a quantity designed to measure the state of excess demand.

A radically different interpretation of the forecast failure was that the breakdown of the models was caused by shifts in the parameters of the model as a result of the private sector changing the way it formed expectations about future developments; models that ignored such reactions would then seem to be unstable and, presumably, predict poorly. More specifically, it was those elements of econometric models that represented the dynamic responses to events which would be expected to change. This interpretation became known as the 'Lucas critique'. Its prescription was that microeconomic theoretical foundations needed to be invoked to explain expenditure choices and pricing behaviour in the macroeconomy. In practice, this was interpreted as meaning that models needed to be derived that emphasised optimal choices by economic agents. The dynamics of economies were then seen as being dependent on a fundamental set of 'deep parameters' that were embedded in the functions being optimised to derive decision rules. Only these might be regarded as constant, whereas the intermediate parameters of the older style model specifications would depend upon the nature of the regimes that agents believed they were in when making decisions. It seems fair to say that academics were extremely impressed by this argument and they promptly lost interest in the type of models that were then in use for policy analysis. This lack of interest still seems true today, although there is now an increasing trend to question whether the Lucas critique is of much importance when it comes to assessing whether the dynamics are particularly sensitive to the type of 'regime changes' that occur in reality (Rudebusch (2002)).

After this juncture, academics increasingly built empirical macroeconomic models that closely followed what was being done in the theoretical arena, in that decisions on expenditures were seen as optimal decisions by economic agents, based on the constraints they faced when looking into the future. The search also began for models that could describe observed price-setting behaviour as an optimal response. Intertemporal decision-making was central to these endeavours and that fact required a careful specification of how expectations about the future were formed. Mostly, expectations were taken to be fully rational; a better description might have been 'model consistent', as, in practice, they were taken to coincide with the predictions of the model that was being developed, rather than incorporating all available information, as implied by rationality. It was then a short step to recognise that uncertainty about the future had to be allowed for and this was handled by visualising the economy as being subject to various stochastic shocks which were imperfectly predictable. These models became known as dynamic stochastic general equilibrium (DSGE) models and they remain the dominant mode of macroeconomic modelling in academia today. In terms of our journey analogy, both the destination and routes were fully prescribed as the byproduct of some optimisation exercise.

Modellers involved in the policy process had a somewhat different reaction to the Lucas critique. While acknowledging the theoretical soundness of the case, they tended to ignore it in practice, perhaps due to a suspicion that any observed parameter instability came from more mundane factors, such as poorly understood specifications. Nevertheless, they were receptive to some of the main themes coming out of academia, if not the way in which these had been implemented. For some time they too had been concerned that the 'bottom-up' strategy of building models on an equation-by-equation basis often led to poor performance of the complete model. To discover the properties of the system, modellers had increasingly resorted to simulation methods and 'stress tests' to highlight weaknesses in the completed models. But, even though weaknesses might be revealed in this way, it was often harder to know how to respond to such information. In turn, this generated the feeling that there was a case for a more 'top-down' approach to modelling, and it was the latter that was the important contribution of the academics' research agenda. Still there was concern about going completely to a 'top-down' approach.

Unlike academics, the policy analysts had to work with models that were quite large. A major reason for this was that it would be unlikely that a small-scale model, which just incorporated (say) output, inflation, an interest rate and an exchange rate, would suffice for actual policy analysis, even though these small models might be useful for thinking about policy issues. The need to explain policy actions to the public inevitably meant that a greater degree of disaggregation was necessary.

It was also felt that simply imposing a top-down perspective on a larger model was unlikely to produce a good match to the actual dynamic behaviour of the variables. Moreover, it was a major computational task to implement such models; one that would have sorely challenged the capacity of a supercomputer of the 1980s. What one needed were models that were sizable and yet whose properties were relatively easy to understand, ie a central organising principle had to be found that could be used on the scale necessary for policy modelling. There was an example of such a successful development—the computable general equilibrium (CGE) models developed to analyse tax and tariff issues; these were large, but the answers they provided were relatively easy to understand. The reason why the outcomes of such a large dimensional system were simple to understand was that they could be conceptualised as coming from multiple markets, whose supply and demand curves had different elasticities which depended upon the parameterisation of the model. It was not quite as easy to find the same simplicity in macroeconomic modelling, since the key problems related to dynamic responses, and there was little theory regarding these that had widespread acceptance. Thus it was inevitable that there would be compromise; a downsizing of the models to obtain clarity was accompanied by the imposition of a top-down way of thinking, as well as the employment of a variety of different strategies when matching the models to the data.

These principles led to the development of what might be called hybrid models. Their core organising principle was the segmentation of the representation task into two stages: cast in terms of a journey the two stages corresponded to first selecting a destination and then choosing the route for getting there. In the first stage it was assumed that there was an equilibrium path along which the economy was seen to be evolving. This path might be either implicit or explicit. The second stage

involved stipulating the nature of the adjustment to the path, ie the route to be followed. This division enabled one to focus upon different ways of dealing with each segment rather than trying to deal with both at the same time; the latter being a strategy that was characteristic of the 'bottom-up' methods. Moreover, it enabled one to retain and emphasise in a precise way a concept that underlay a lot of the early work in macromodelling—the idea of a 'gap'—since a 'gap' could now be viewed as a deviation from an equilibrium path. We will distinguish between Type I and Type II hybrid models, based on whether the long-run equilibrium part—the destination—is treated implicitly or explicitly in the model. Models in which it is implicit will be termed Type I hybrid models; those in which it is explicit will be designated as Type II.

Within the dual approach characterising Type I hybrid models, the long-run relationships governing equilibrium growth paths were constructed from fairly loose economic reasoning. Thus it might be assumed that certain sets of variables were in a constant long-run relationship, for example consumption might be taken to be a proportion *(k)* of either income or wealth. Then, if one formed the ratio of consumption to wealth at a particular point in time, the extent to which it departed from *k* would be an index of the disequilibrium in consumption, and adjustments would be expected to take place to restore the balance. Accordingly, such long-run relationship were often used to produce measures of 'gaps' in the goods, labour and money markets. Some of the earliest work in this vein placed much emphasis on measuring a particular gap, namely that between the demand and supply of money, but interest in this particular gap has declined since its zenith in the mid-1970s. What was particularly attractive in this two-stage approach was that the idea dovetailed very neatly with an emerging econometric literature on 'co-integration', wherein variables might exhibit trending behaviour but the gaps between them might be trendless.

Finally, Type I modellers had to face up to the issue of how to describe the adjustment to an equilibrium position. Again, there was some assistance from econometric developments in the form of equilibrium correction mechanisms (EqCMs), ie equations that showed the speed at which the disequilibrium gap would be closed. Davidson *et al* (1978) made the case for these representations in a forceful way.

Data entered the construction of Type I hybrid models through the fact that there were a number of unknown parameters that characterised the equilibrium positions and the rates of adjustment. Thus the level of retail prices would be a combination of the level of domestic and imported goods prices or, as mentioned above, consumption might be a fraction of household wealth. These weights might be estimated from the data or imposed. Furthermore, following the arguments of Davidson *et al* (1978), the parameters of the EqCM model describing the adjustment mechanism were left to be determined by the data. The divergence between actual and equilibrium values of a variable could then be taken as a measure of the extent of disequilibrium, ie a gap that was to be closed. Based on these principles Type I hybrid models were developed in a number of central banks; current examples would be the area-wide model at the European Central Bank (see Fagan *et al* (2001)), the RIMINI model at the Bank of Norway, and the Economic Group Model at the Reserve Bank of Australia (see Beechey *et al* (2000)).

It is important to note that no long-run equilibrium path for any of the variables was computed in Type I models. Rather it was just the relationship that must hold between the variables that was described. Type II hybrid models took the further step of working with an explicit description of the equilibrium paths of variables. In this they were closer to the nature of DSGE models and, in fact, they utilised the same optimising framework as employed in DSGE models. But they shared with Type I models the characteristic that, once the equilibrium path was tied down by some theoretical specification, the data were largely responsible for the determination of the dynamic adjustment process to that path, ie the EqCM form was used and estimated. A major difference from Type I models though was that some decisions were influenced by expectations about the future, ie the models incorporated 'forward-looking behaviour', and it was this fact that required the existence and calculation of steady-state growth paths for their variables. The latter were needed since, in computing expectations of future variables, it was necessary to know the point to which they would eventually converge, ie the steady-state path. The derivation of equilibrium paths was therefore a key element in their *modus operandi*.

Because of the strong use of economic theory in Type II hybrid models, the outcome of experiments performed with these tended to be relatively easy to understand, in the same way as the solutions from CGE models were.

They also provided a completely consistent treatment of stocks and flows, eg if the stock of debt was accumulating it would ultimately affect (say) expenditures, since the debt-income ratio needed to be restored to realistic levels. Some of the earliest econometric models did not have such constraints, and so 'free lunches' abounded. Even in Type I hybrid models stock-flow constraints were never treated in an entirely consistent way. This treatment did, however, have a cost, in that certain assumptions needed to be made about key ratios such as the level of foreign debt to GDP, and these could become key determinants of the outcomes of the model. A good description of the structure of these models is in Powell and Murphy (1997), and variants have been used by the Singapore Monetary Authority in its Monetary Model of Singapore and the New Zealand Treasury (see Szeto (2002)).

Perhaps one of the most interesting features of Type II hybrid models was that they reflected academic models in their determination of the equilibrium or steady-state path, but retained a core feature of the older tradition in having separate equations for many of the variables of interest to the policy-maker. They were not uniform in design though and differed in the emphasis laid on a number of key points; in particular the degree to which decisions were made to depend upon expectations about future events. Future expectations were sometimes limited to financial markets, with decisions by consumers and investors being only partially forward looking, since it was felt that putting too much emphasis upon views of the future was probably unrealistic, and certainly did not accord with much survey evidence on economic agents' behaviour.

Hybrid models were probably most popular in the late 1980s and early 1990s. At that point a number of institutions and individuals began to argue that the economic theory used to form the equilibrium paths should also be used to describe the adjustment path, rather than simply allowing the data to determine the latter, ie the dynamics should be intrinsic to the model rather than being extrinsic to it. The first central bank to adopt such a philosophy was the Bank of Canada in its QPM model—Coletti *et al* (1996)—and this was soon followed by the Reserve Bank of New Zealand and its FPS model—Black *et al* (1997). Just like in the DSGE models that academics worked with, it was the imposition of theoretical principles that gave the models desirable properties. Unlike academic work however, the new policy models had a number of concessions to

perceptions about actual economic responses. First, it was recognised that not all decisions could be usefully viewed as optimal responses to an uncertain future. As had become evident from much empirical research, the academic models that incorporated such an assumption failed to match the dynamics evident in the data. Hence the policy models always incorporated some inertia in decisions, through the idea that these were often made by rule-of-thumb rather than optimally, although, as Nickell (1985) observed, it was generally possible to set up an optimisation problem that would rationalise a wide range of rules-of-thumb. These policy models also took a more restrictive view of the nature of shocks. Indeed, this had initially been true of academic models. Shocks were viewed as being either permanent or transitory, unlike in DSGE models in which one fully specifies a process for the shocks, and so they can have both permanent and transitory elements. Because these models have many similarities to DSGE models, but the nature of the shocks is not fully specified, I will refer to them as incomplete dynamic stochastic general equilibrium models (IDSGE).

These models also witnessed a change in attitude towards the role of data in describing the adjustment paths to an equilibrium. Historical outcomes shape these models but in an imprecise way. Often the adjustment path to an equilibrium tends to be imposed by the beliefs of the modellers and the monetary policy decision-makers. This makes sense if the relevant data are rather limited, as was the case in New Zealand after the reforms of the 1970s and 1980s. But there was also a feeling that the data might not accurately measure the variables of interest, and this failure to match theoretical constructs and data might lead to frequent changes in the model. Thus the QPM builders had this to say about their motivation for being cautious about the role of data in quantifying their model:

'… the inability of relatively unstructured, estimated models to predict well for any length of time outside their estimation period seemed to indicate that small-sample econometric problems were perhaps more fundamental than had been appreciated and that too much attention had been paid to capturing the idiosyncrasies of particular samples. There had been a systematic tendency towards over-fitting equations and too little attention to capturing the underlying economics. It was concluded that the model should focus on capturing the fundamental economics necessary to describe how the macroeconomy functions

and, in particular, how policy works, and that it be calibrated to reflect staff judgment of appropriate properties rather than estimated by econometric techniques'. (Coletti *et al* (1996, page 14)).

Modelling conflicts

As recounted above, the history of economic modelling can be regarded as one of attempting to solve a conflict between the distinct desires that a model should be both theoretically and empirically coherent. By the first we mean that the model outcomes can be explained by reference to some agreed-upon conception of the way in which the economy is thought to function, while the second relates to the ability of the model to explain the history of that economy. For many reasons it has proven impossible to satisfy both desires simultaneously, and therefore a trade-off is perceived to exist. One might conceive of this trade-off as a curve like that in Figure 1. At one end of the curve are theoretical models that have never been exposed to an historical data set, while, at the other, there are models that fit every quirk in the data set but whose outcomes are impossible to interpret. Being at either of these points is not particularly attractive to a policy-maker and so models used in the policy process have always been located along the interior points on the curve.

Figure 1
Trade-off between theoretical and empirical coherence for models
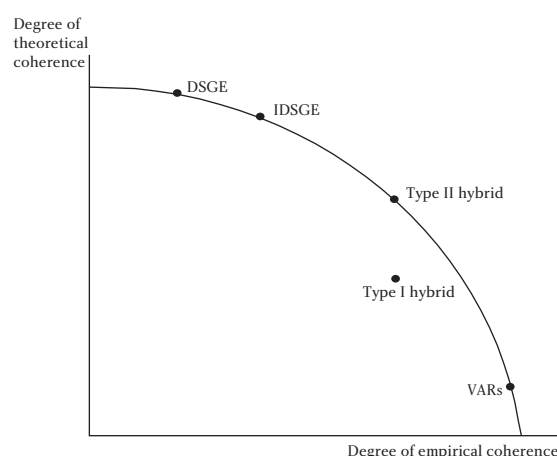
Of the categories of models listed previously, DSGE models tend to be closer to the left-hand end of the curve, while the early macro models were close to the right-hand end. Over time the curve has shifted outward and it has been possible to attain the same degree of empirical coherence with stronger theoretical constructs. Often this has simply been a reflection of the development of computer power: some theoretical

models that today appear to provide a reasonable match to the data could not have been solved 20 years ago. At any point in time, there will be a frontier of 'best-practice' models that shows the combinations of empirical and theoretical coherence that are attainable. There is no precise way of determining this frontier but sometimes opinions form about what is on and off the frontier. Thus, Type I hybrid models would now seem to be below the frontier, as one can achieve the same degree of empirical coherence with a clearer theoretical structure by using their Type II cousins.

However, just as with all trade-offs in economics, where a model is located on the best-practice curve is a function of the constraints that come from the institutional structure in which the models are to operate. For academics, best practice, or what is 'state of the art' for them, tends to be taken as being towards the left-hand end of the curve, although in recent times they have shown a greater interest in attaining empirical coherence. For policy modellers it has always been towards the right-hand end, although, as we have documented, the adoption of the hybrid class of models has moved the standard much closer to the centre of the curve, while the IDSGE models of some central banks lie even further up towards the left-hand end.

Modelling the UK economy

Since the formation of the MPC, the core model in use at the Bank of England has been the model variously called the medium-term macro model (MTMM) or the macro model (MM). It was first documented in Bank of England (1999) and updated in Bank of England (2000). We will refer to it with the acronym MM. In the past few years a new model has been under development as a potential core model. We will examine issues regarding the Bank of England's current core model and its prospective one under a number of headings that distinguish between the degree to which the overall framework is satisfactory and whether particular components of the model have any known inadequacies.

The overall design of the core models

The current core model (MM)

As we have detailed above, the current frontier for models in central banks would suggest that this is somewhere between Type II hybrid models and an IDSGE. I would classify the MM as a Type I hybrid

model since its equations can be thought of as having an EqCM structure, although this is not always obvious, and there is no explicit solution given for the steady-state path. One has to qualify the latter judgment by noting that there is mention in the 2000 model description of a version of the MM that does incorporate some forward-looking behaviour. However, published simulations of the model do not use such a device and it does not seem to have been used much in the monetary policy context. Thus, based on my classification, it would seem that the MM is not on the frontier and, in this sense, might be regarded as not entirely 'state of the art'. It seems highly likely that one could achieve the same empirical coherence with a stronger theoretical perspective that accords more closely with the conceptions of the MPC.

The question we might ask, however, is whether the MM is satisfactory when it comes to providing the information that the MPC needs for its decisions, ie perhaps it is off the frontier due to some constraints upon what is feasible. To determine an answer to this question it is natural to query the MPC on whether it is acceptable given the constraints or whether it might be regarded as being away from the frontier and thus capable of improvement. I received many opinions about this. Though there seemed to be a consensus that the model was not entirely satisfactory, there was much less consensus about what the perceived deficiencies were.

Some of the concerns stemmed from the fact that a number of the equations of the model had been known to possess deficiencies in fitting the history of the UK economy for some period of time—one can specifically mention those equations in the model describing price and wage movements and consumption. We will discuss this feature later in the report. It might be noted that the Bank of England is not alone in this regard. Many central banks have experienced difficulties in accounting for inflation and declining savings ratios in the 1990s, eg the Governor of the Bank of Canada, David Dodge (2002) says:

'With the low inflation target becoming increasingly credible, the whole nature of the inflation process seemed to change. The short-run response of inflation to measures of excess demand and supply appears to have fallen during this period. And the response of inflation to relative price shocks, such as changes in the exchange rate and energy prices, also seems to have declined.'

Though it is possible that these problems were worse at the Bank of England than in other central banks, it seems unproductive to engage in such comparative analysis when the relevant question should be whether adequate attempts were made to deal with any deficiencies when they became known. As this is a question pertaining to the methods for reviewing model performance, rather than to the question of overall design of models, I will examine it below.

We turn then to the question of overall model design, or theoretical coherence. Bank modellers and some MPC members felt that the MM was unsatisfactory, either because it failed to capture some linkages that were prominent in their thinking, eg an impact of profits upon investment expenditures, or because it was unlikely to produce trustworthy responses if one posed questions to it that involved the formation of expectations about the future. One can empathise with this latter viewpoint, since variables appear in it that are clearly forward looking, but which are modelled as depending simply on current outcomes. A good example of this would be equity prices, which are modelled as depending only on current nominal GDP (a proxy for dividends). Although we noted that there is mention of the potential for introducing forward-looking effects in some instances (although not for equity), the general feeling amongst modellers and some of the MPC members was that the way it had been performed was not very satisfactory, largely because it involved a grafting on to the model of a feature that did not fit well with its conceptual design. Since modellers in the United Kingdom have been world leaders in introducing such effects into large-scale macro models, it is perhaps a little surprising that the MM does not incorporate them when it is run in its standard mode. Perhaps this can be explained by an impression which I received that the original model was built under severe constraints at the time of the formation of the MPC. Although there was an existing model, it did not seem entirely suitable for the new monetary policy environment and so there was a need to modify it fairly quickly. At that time one could make the case that there had been more experience within the Bank with Type I hybrid models than with any other version.

As mentioned above, many reasons were given for regarding the theoretical structure of the MM as unsatisfactory. One of these, the preference for having a greater incidence of forward-looking elements in the core model, probably stems more from a desire for some flexibility and the need to increase the level of confidence in the model being used than because it was felt that the absence of such mechanisms was responsible for any of the model's failures to fit the data. Indeed, although we do not have a lot of comparative research on the relative properties of models that do and do not incorporate forward-looking behaviour, recent research (Rudebusch (2002)), might suggest that the loss is not very great. Nevertheless, just as one can lose confidence in an old car's reliability in the face of the need for increasing levels of maintenance to fix its defects, one can lose confidence in a model like the MM when many adjustments have to be made to improve its performance. Potentially, this loss of confidence can have an impact on decisions, since experiments with human subjects have shown that the accuracy of predictions is positively related to the mood of a decision-maker. Consequently, it seems important to support mechanisms that will instil confidence in the systems used to inform policy analysis.

From this perspective, complaints about the absence of forward-looking expectations in the MM are a symptom of a deeper malaise. Even if forward-looking expectations had been incorporated in a satisfactory way into the MM, it seems highly likely that other reasons would have been found for dissatisfaction with it, and these negative feelings would have grown over time. One of these reasons is that the underlying framework was too vague and this often meant that it was hard to interpret some developments. Another comes from the knowledge that the degree of confidence in any decision support system by a decision-maker is very much dependent on the extent of that decision-maker's participation in its construction. Understandably, the MPC's involvement in the original development of the MM seems to have been minimal, and the short tenure of MPC members will always mean that, at any one time, there will be few members who have had a direct involvement with that process.

Finally, as the 'gap' terms that are a feature of Type I hybrid models come under intensive scrutiny, they are often found to be unreliable indicators. When they are defined quite precisely from some theoretical model, there is a chance that a new measure can be produced by varying the theory that has been employed, but, when they are just loosely thought of as indicators of the extent to which one is out of equilibrium, this is much harder to do. Within the MM there is a preponderance of the latter type of measures. If the equations being

driven by these gap terms perform credibly, then the fact that the relationship is a loose one probably does not lead to any serious doubts about the nature of the model. But, once the equations begin to fail, there can be a rapid loss of confidence in the model, unless it is possible to discuss alternative measurements of the gap terms by reference to the workings of a model. The MM is just not rich enough to do this in a satisfactory way.

An alternative core model (NMM)

Overall, I think it was well recognised among both Bank staff and the MPC that the MM was not really 'state of the art'. But while this may produce some pressures for its replacement, any action in this direction may not happen immediately. One can drive an old car for many years, repairing it when it fails, before one is forced to concede that there might be advantages in buying a new model. Replacement is made to look attractive, however, when we have a preference for going on journeys with a precise destination and we are concerned about whether our current car would be capable of getting there in all circumstances. In the same way, constant repair of a model eventually leads to a demand that it be replaced.

Apart from the direct financial costs of developing new models, it needs to be recognised that it takes time to decide on any new framework and to develop it. Thus there has been a project in the Bank for the past two years to develop a new model that would hopefully resolve some of the issues that had arisen with the MM. I will term this new model the NMM (new macro model). At the time of writing ,this model is still not fully operational, so that I do not feel that I can make any detailed comments upon it, but some observations need to be made.

In terms of my categories above, the NMM is an IDSGE model and so is at the frontier of central bank models. Indeed, from what I have seen of its structure, it significantly advances that frontier. Moreover, unlike existing IDSGE models which tend not to have been judged by their ability to replicate a wide range of data, it is intended that this one will be so judged, ie it aims to move the frontier relating theoretical and empirical coherence outwards. In this respect it is again novel. Although the model is being developed to replace the MM, it is the case that the MPC will be the final arbiters of whether it becomes the core model rather than being a supplementary one.

Replacing the MM with the NMM is likely to solve one of the sources of disquiet about the MM, namely that the destination (long-run equilibrium) will be much clearer in the NMM than in the MM, and some of the adjustment paths will be specified as part of the model structure. Because it has a better articulated theoretical structure it also has the potential to measure gaps in a different way than the MM does, see Neiss and Nelson (2001) for an example. But these are all potential gains. Whether they become actual ones remains to be seen. One problem that may arise in adopting the NMM stems from the nature of the MPC. Given its diversity, and the short tenure of its members, it may be difficult to get assent to any model that imposes strong theoretical specifications. Leaving things rather loose, as in Type I hybrid models, enables the model to be flexible and to accommodate different views. One will need to balance the benefits and costs of each approach. In this context, it is noticeable that, for the two central banks that have adopted IDSGE models, the policy decision is invested in the Governor and the discussion of options is performed by an internal committee of bank officials, ie the decisions are taken by internals alone. Perhaps some thought should have been given to moving to a Type II hybrid framework, since this has many similarities to the IDSGE constructs but retains the familiar structure of the MM. It should be said, however, that at this point, it is unclear how the NMM is to operate in the forecasting process and it may well end up as being a very sophisticated version of a Type II hybrid model.

The equations of the core model

Since it is the EqCM approach that is the basis of Type I hybrid models like the MM, it is natural to focus upon its components when asking about the adequacy of the equations contained within the MM. Thus one might query the set of variables that is to appear in an equilibrium relationship, the weights to be given to them, and the influences upon the adjustment paths. The first two are about how to measure the 'gaps' in a model like the MM in a satisfactory way and the last is about how to describe and capture effects on the speed of adjustment back to equilibrium.

There are many equations in the MM and it is outside the scope of this report to comment on them all. At various times there have been difficulties experienced with the equations describing consumption, investment and earnings. However, owing to the primacy of the inflation forecast in monetary policy decisions, it is useful to look at the equations pertaining to that

variable as illustrative of the types of problems that have been encountered in the use of the MM. Although the variable of ultimate interest is RPIX inflation, inflation in published versions of the MM is built up in a number of stages from the GDP deflator, import prices and various taxes.[1] If any of these forecast badly, then it is likely that forecasts of RPIX inflation would be inaccurate. Around the beginning of 1998 the GDP deflator equation started to exhibit constant overprediction, thereby initiating a widespread debate within the Bank and the MPC about the causes of this. Since the GDP deflator equation in Bank of England (2000) has inflation in that price index being driven by capacity utilisation (CAPU), unit labour costs (ulc) and various dynamic adjustment terms, it is natural that the debate should focus around the nature of these variables.

In particular, the debate centred upon the measurement of demand pressure and there were very public disagreements over the appropriate way to do this—see Wadhwani (2001)—with a number of members of the MPC clearly feeling that the measure that appeared in the model was a very poor one. However, even if one concurred with this position, exactly what should be done about it is less obvious. Suggesting an alternative specification of demand pressure is not enough, since the new specification has to be put together as part of a complete system. Certainly some of the proposals would have necessitated the adding of extra equations to the model in order to explain the new variables that were to replace CAPU. My impression is that the Bank modellers resisted this tendency towards an expansion of model size, and so were reluctant to depart from a measure that was generated within the model. Given that a proliferation of variables was the catalyst for early models becoming very large and unwieldy, one has to sympathise with this resistance.

Did any of the suggestions made about measuring CAPU in a different way lead to important changes in the GDP deflator equation? It seems not. Apart from the difficulties that would accompany an expansion in model size, it emerged during the period in which I was performing the review that new statistics released on the capital stock significantly modified the existing series on CAPU. Indeed, to such an extent that the fit of the equation with the new series was a considerable improvement on the old one. However, there is now some doubt about the nature of these data revisions and they seem to have been withdrawn. This episode illustrates a fundamental quandary for all users of models—sometimes it is not the model that is at fault, but the fact that available data do not accurately measure the concepts used in the model that is the explanation of poor fit. It should be said that there are a number of other equations in the MM where the fit has improved as a result of data revisions.

Moving away from the debate over CAPU, the External MPC Unit[2] in particular was very interested in the role of world prices in determining the GDP deflator, and argued very strongly for such an influence. It is now the case that there will be separate equations in the MM describing changes in the RPIX and GDP deflator indices and that world prices will have a role in influencing inflation.

Is it likely that these modifications will solve the problem with the GDP deflator equation? I have some doubts over this. One can see the fundamental difficulties facing the modellers in a simple way. In many countries inflation tends to be a fairly persistent process and that fact often aids predictability. To look at how persistent it is in the United Kingdom, we fit a third-order autoregressive process to the inflation series and sum the three coefficients. A value for the sum of unity would mean an extreme form of persistence, whereas a zero value means a lack of it. To see how persistence varies over time, we employ a rolling regression of 30 quarters. Thus the first estimate of the sum uses the 30 quarters starting in 1980 Q4, the next the 30 observations arising from 1981 Q1 onwards, and so on. Figure 2 plots these for a number of series— inflation in the GDP deflator (PGDP), unit labour cost growth rates (ULC), world price growth (adjusted for the exchange rate) (WPXADJ), and two measures of capacity utilisation, the one currently employed (CAPU) and that used in Bank of England (2000), labelled CAPU2.[3] It is

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(1) A question that arises concerns what is the most useful degree of disaggregration. Opinion was divided on this. Some saw the existing degree as unnecessary. Another opinion was that a greater degree of disaggregation might be desirable. This was based on an interesting analogy with the situation in HM Treasury's model. Since the fiscal stance is the variable of most interest to the Treasury, this had led to a disaggregated tax system. It was argued that, because the MPC was entrusted with the task of achieving an inflation target, it might be appropriate for there to be a more disaggregated model of inflation. My feeling is that, unless the individual components had very similar equations describing their behaviour, the resulting model would be a little too complex for useful policy work.

(2) The External MPC Unit comprises Bank staff who have been seconded to assist the external members of the MPC in their research.

(3) The sample in Figure 2 runs from 1988 Q2 until 2000 Q1. The upper limit comes from the fact that the old capacity utilisation series was not available after the latter date.
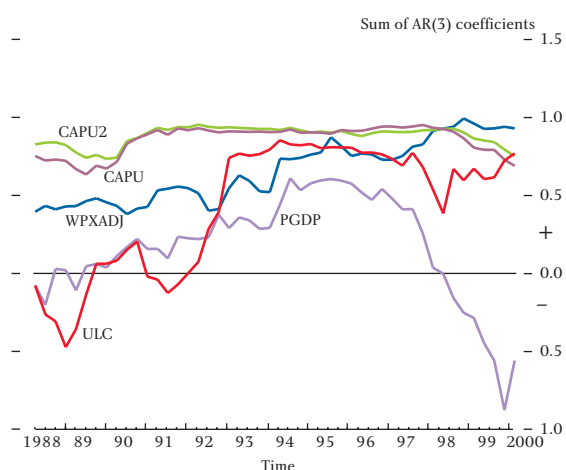
clear that, while there has been a very striking change in the degree of persistence of GDP deflator inflation from 1998, this is less true of any of the variables offered as explanators of it.[1] Without some convincing explanation for the decline in the persistence of the GDP deflator inflation, it seems likely that the equation will continue to cause problems. One possible explanation for the MM equation difficulties is that expectations of inflation do not have a direct effect on inflation outcomes, although there are good theoretical arguments for there to be such an effect. Given that expected future inflation may have declined since the late 1990s this could point to the need for such an extra variable to be incorporated into the current MM equations.

Is this decline in persistence also true of RPIX inflation? Wadhwani (2002) argued that it was and that there had been a large change after the MPC was formed. Figure 3 confirms this for seasonally adjusted RPIX inflation, although the changes occur a little later when one measures persistence as I have done rather than the way he did, which just involved the first-order autoregressive coefficient. Thus the comments quoted earlier by Dodge regarding changes in the inflation-generation process in Canada are certainly true in the United Kingdom. Such non-uniform structural changes place stresses upon the capabilities of a model like the MM to produce reasonable projections.

What should be done about an equation like that for the GDP deflator when it is clearly inadequate? In the first instance, new explanatory variables should be sought,
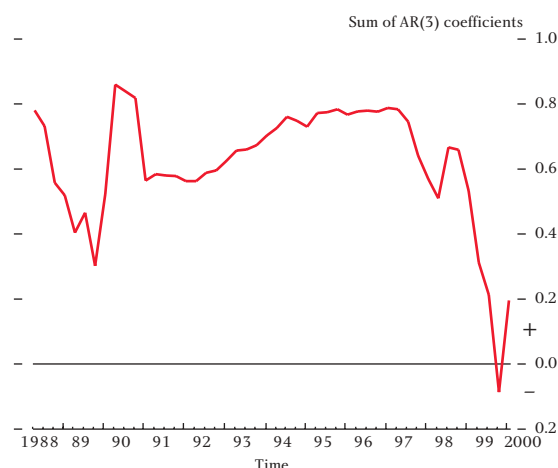
and there has certainly been a great deal of work done in this vein. A second option is to reconsider the nature of the specification, ie to build up a new theory of price determination. The changes in persistence suggest that some forces are at work that are not adequately captured by a modelling approach like that in the MM and point to the need to develop a new structural model. Finally, one might try to isolate the equation, so that its poor fit does not affect the projections of other variables in the model. In the current context, the link between the GDP deflator and RPIX would be severed and the latter would be modelled directly. Such a strategy seems a sensible one, and has recently been followed, although it may just be passing the problems on to the RPIX equation.

The modelling technology

Leaving aside the issue of the nature of specifications of the equations in the MM, one might ask whether the technology employed in designing and testing these specifications was the best possible. Since the dynamic relationships between the variables were left to the data to decide, it may be worth experimenting with the use of recently developed automatic model selection methods to achieve this, eg Pc-Gets (see Hendry and Krolzig (2001)). It was in fact noticeable that the dynamic specification of several of the equations had changed through time and some limited experimentation I had done suggested that the best dynamic structure might not have been chosen.

A second technical issue that was raised with me concerned the ability of researchers outside of the forecasting team to experiment with alternative

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(1) It is evident though that the new capacity utilisation series does show a greater decline in persistence than the old one.

specifications of equations that were in need of repair. There was a perception that this was not as easy as it might be. One clearly wants to place some limits on this activity. Too frequent changes to the model can be disturbing for both making and communicating policy decisions. Only after a considerable degree of experimentation and a number of demonstrations that the changes do 'make a difference' should the model be amended. Moreover, any claims to superior performance will need to be verified by the forecasting team, and that could easily absorb a significant amount of their time. But currently the barriers to performing such work by outsiders do seem to me to be inordinately high. Most of these may be unintended as they derive from the separation of the tasks of data management, model estimation and model simulation. It would seem that, if the new model is adopted, then there will be greater integration of these tasks, although whether that will make it easier for outsiders to perform experiments on the model is unclear.

The review component of the modelling system

Although the broad structure of the model has remained fairly constant, there is a continuous process of experimentation with the specification of its equations. At least since mid-2000 there have been a number of procedures in place for reviewing the performance of the model equations in the interval between *Inflation Reports*. Bean and Jenkinson (2001) give a general description of this process. After each *Inflation Report* there is a meeting to review issues for the next forecasting round and some of these will involve discussion of the parts of the model that might need attention. The results of any work commissioned as a result of that meeting are then considered at a model review meeting before the next forecast round. The final decision whether to introduce any new specifications is made by the MPC. Modelling issues are also dealt with as part of the process for setting the future research programme of the Monetary Analysis department. The department suggests topics to pursue and the MPC is able to accept, reject, modify and prioritise these. This review of model performance is an important part of any modelling process. As we pointed out in the introduction, models are not fixed in stone, so that regular reviews are an important part of their use.

The fact that there has been public controversy over the nature of at least one of the equations suggests that the review process may not have worked as effectively in the early years of the MPC. Although I feel that this should

be less of an issue with the current structure, there may still be room for some improvement. The review process is most effective if there is considerable and ongoing experimentation with either entirely new specifications of equations or even the introduction of new paradigms, eg in the modelling of the price-setting mechanisms. This is a costly activity. It rarely leads to major changes in the model but, nevertheless, needs to be done. I saw a number of examples of this experimentation process while undertaking the review, particularly in relation to the inflation equations and, as has been observed, these experiments have finally led to a new set of inflation equations within the MM.

In general, while there was a commendable willingness to experiment, there seemed to be an attitude that it should be done in a restricted way, viz by tinkering with individual equations in the MM rather than by looking at quite radical changes to them. My overall impression was that too few resources are being allocated to thinking about quite different ways of modelling sectors, such as the price/wage sector, and that most attention has been devoted to focusing on extra variables to add to an equation or different ways of measuring the gaps, ie 'tinkering' and 'patching'. This may well have been the outcome of a belief that 'new paradigms' came under the NMM research programme. Now, there is always an innate conservatism amongst modellers and users of models when it comes to contemplating large changes in them. In this instance it seems to have been accentuated by a conscious decision to shift resources from the maintenance of the MM to the development of the NMM. For such a policy to have minimal impact on the viability of the core model, it was necessary to have a realistic timetable for the introduction of the new model into the monetary policy process. For a number of reasons there did appear to be overoptimism on this score. First, because any new model team is likely to be composed of very talented and experienced individuals, there is always the temptation to divert them from the task of constructing the new model into meeting the current demands of the monetary policy process. Although there may have been some diversions of this nature, they do appear to have been minimal and have actually been useful in learning about the capabilities of the NMM. Second, as already alluded to, the NMM is very much at the frontier of the class of IDSGE models, and so many more novel problems needed to be solved than if one had just used one of the existing IDSGE models, such as QPM or FPS. Some of these problems come from the need to adapt these models to the needs of what is a unique monetary policy process, but not all.

Much new thinking about models often comes from those who are a little removed from the day-to-day operation of models. Within the Bank structure this has often (but not exclusively) meant people working for the External MPC Unit. I think the latter have been important in generating new ideas about individual equations, eg in the inclusion of world prices into the price relationships, and in suggesting new ways of measuring the output gap. This fact illustrates the importance of the team that is directly engaged in model development and maintenance being open to proposals and criticisms from researchers who are outside the team, whether that be the External MPC Unit or others in Monetary Analysis.

The process of new model development

No model used in the policy process ever remains static. New paradigms emerge elsewhere and should be constantly reviewed to ascertain whether they might be incorporated into Bank procedures. Sometimes these adjustments can be handled as part of the model maintenance program, eg it might be decided to change the way in which wage behaviour is modelled. Others, however, constitute more fundamental shifts, eg it is possible that future models used in banks may be DSGE models, as the growth of computational power has meant that these models are starting to approach a size and complexity wherein they might actually be used in policy analysis. Thus the ECB has produced an experimental version along these lines—see Smets and Wouters (2002). Moreover, one can imagine that one of the major restrictions of existing DSGE models, viz that decisions are taken by a single representative agent, will be removed and replaced by multiple agents. Since early versions of these latter models seem to have the ability to explain many of the characteristics of financial time series, they may be very useful in central bank work for understanding movements in financial asset prices, and in explaining 'puzzles' such as the 'forward premium bias'. One may need to gather new data in order to calibrate these models, but it may also be possible to use many existing data on options and forward market prices for that task. Because one of the crucial aspects in forecasting is what should be done about equity prices and exchange rates, such models may ultimately prove very useful for central banks.

This raises the issue of how one encourages thinking about such new models. Most central banks keep an eye

on such developments by ensuring that their staff attend conferences and seminars and produce summaries of these events that are distributed to other researchers. The quality of the summaries produced by Monetary Analysis staff is very high indeed. But I think something more will need to be done. Even if the NMM is not adopted as the new core model, I think the process of developing it was beneficial and has had, and will have, substantial spin-offs, in that it has suggested new directions for reconstructing the MM. If the NMM is adopted, I think it would be unfortunate if the process of thinking about new models was not done on an ongoing basis. One might envisage a small unit that performed this task. It would be best if it was constituted from researchers with a range of experience in forecasting and policy work with the core model, just as was true of the team building the NMM. My experience has been that the people most committed to developing a new model, and who are capable of going beyond simply modifying equations, are people who have worked on the existing core model and have become disenchanted with it. It seems important to channel these negative feelings into some positive directions.

The forecasting process

Although core models are the basis of any forecasting system, there are many issues to be considered concerning how one uses such a model in the process, and whether it is the only model to be used. As the latter aspect relates to diversification strategies, it will be left until the next section. Here we will consider the role of the core model in forecasting.

Forecasting with the core model within the Bank of England

Core models are never complete. There are always variables in them that are not modelled, but whose evolution will be an important determinant of outcomes. We generally refer to these variables as 'exogenous' to the model. International variables are an important example, but there are many others such as tax rates and some elements of government and private spending.[1] Even when forecasts of these exogenous variables have been assembled it may still not be possible to generate forecasts of the variables of interest from the core model. Because macroeconomic models are dynamic it is necessary to know the values of many variables

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(1) In the case of international variables, the forecasts are generally made with the assistance of models built outside the Bank, such as NIGEM. I will not comment on this part of the modelling and forecasting systems since few people identified the international forecasts as major contributors to any forecast failures.

appearing in them up to the point in time that the forecast is being made. Thus, if one was forecasting inflation and growth in the fourth quarter of 2001, it is necessary to know (at least) GDP for the third quarter of that year. But the lag in the national accounts means that this outcome will generally be unknown, and so a forecast has to be made of it. This is done by using information from a variety of sources, eg survey data of expected output changes by firms. Within the Bank these forecasts are referred to as 'constraints'.

After deciding on a future path for the exogenous variables and the constraints, ideally one would produce projections with the core model automatically. But, in practice, these forecasts are generally modified in a number of ways. The modifications involve augmenting the base model in some way, so as to increase its effectiveness in the projection process. We can distinguish four types of adjustments that are commonly made:

1 Switching adjustments.
2 Past performance adjustments.
3 Future belief adjustments.
4 Profile and alignment adjustments.

Switching adjustments refer to the decision to switch the status of a variable that is endogenous in the base model to one that is exogenous over the forecast horizon. Thus, interest rates are often set at the current value or are constrained to follow a path that is determined by market expectations. Exchange rates may be set at the current value rather than evolving in line with the gap between short-term interest rates—the so-called uncovered interest parity assumption. Expected inflation rates may come directly from survey data or be extracted from the evidence in (say) index-linked bonds.

Past performance adjustments are adjustments made to compensate for some deficiency in the equation that has become evident from the history of the model forecasts or fit.

Future belief adjustments are made to enforce a variety of beliefs concerning developments over the forecast horizon, eg that the equilibrium point towards which the base model is directing the forecasts should be modified or perhaps that the speed of adjustment to the equilibrium point should be varied. This may be necessary since the equations of the base model implicitly embody assumptions about the long-run equilibrium growth paths of the variables, and it may be

felt that these have changed from their values in the sample period. A good example of the need for such an adjustment in recent years was the behaviour of consumption. The equations of the MM would imply a constant ratio of consumption to income in equilibrium, but often this was felt to be an unrealistic reference point in the forecast period. Sometimes the prior information justifying the adjustment related to institutional events, such as building society deregulation, which were hard to capture in a core model, and off-model experiments were used to produce some estimates of the transitory rise in consumption, which were then added on to the base model forecast. Another example was the desire to make some allowance for the effects upon productivity and costs of the events of 11 September 2001.

Finally, profile and alignment adjustments need to be performed in order to either smooth out the adjustments or to make them sum to some fixed amount.

Other classifications of adjustments have been given. Wallis and Whitley (1991) distinguish between automatic and discretionary adjustments. This distinction seems to be less descriptive of forecasting today (certainly for the Bank of England) than it was a decade ago. Then it was more common to make some automatic adjustments, in particular those that ensured that a perfect fit was obtained to an average of the outcomes over a short period immediately prior to the beginning of the forecast period. These automated adjustments were contrasted by Wallis and Whitley with those often made by 'judgmental' forecasters. Adjustments to reflect past forecast failure today are much less automatic and involve a good deal of judgment; hence our distinction between what one is responding to when making the judgments rather than the method of adjustment.

When making any adjustment that has an important influence on the forecast, it should be a requirement that a strong economic argument be advanced to justify it. It is this constraint that should keep the number and type of adjustments under some degree of control; without it the model can easily become submerged by the adjustments. The point is made very forcibly by Siviero and Terlizzese (2001, page 10) who say:

'...forecasters are tightly constrained, when making arbitrary adjustments to their forecasts, by the need to be explicit about the economic reasoning used to support their results'.

The technology for performing the adjustments in a model like the MM relies upon the fact that one can adjust the predictions of a variable by adding on to each equation the requisite amount that is desired for the forecast to change from that of the base model. It can be shown that, for models like the MM, the estimated 'intercept' terms entering any of its equations that have been cast into an EqCM form are an amalgam of a number of factors. These include the growth rates in all variables that describe the long-run equilibrium relationships, as well as the magnitude of various other parameters summarising the long-run and dynamic responses. Thus, if changes had occurred in any of these quantities over the sample period, such changes would tend to show up as a poor fit when the equation is estimated.

Ideally, one wants to make some explicit allowance for that fact. If one knew where the changes took place, one would utilise a smaller sample of observations. If one knew that the changes were smooth, one might try techniques that allow for evolving coefficients. But often these methods still cannot compensate for the shifts that have occurred, and it may be most convenient to simply make some allowance for these effects by adjusting the intercept in this equation. The same argument applies if it is thought that the same quantities might change over the forecast horizon.

Broadly speaking, past puzzle and profile/alignment adjustments are now done by the Bank staff in preparing the benchmark (or 'central tendency') forecast, and the MPC will make future prior adjustments before the forecasts appear in the *Inflation Report*. Of course there are always exceptions to this—adjustments performed for the likely future impact of 11 September were naturally first computed by the staff, and then reported to the MPC for a final decision on whether to apply them in an unmodified form. It is also the case that many 'past puzzle' adjustments have been arrived at after an extensive discussion between the staff and the MPC.

These adjustments are not trivial. Indeed, they can mean major changes in the forecasts from what the core model itself would produce if no adjustments were performed at all. For example, in Wadhwani (2001), the compensating and prior adjustments made to forecasts for the GDP deflator equation were removed, resulting in the forecasts made for the August 2001 round increasing from 2.5% to around 5%. Thus it becomes very difficult to know whether a good (or bad)

forecasting record is the consequence of the core model chosen or the adjustment mechanisms.

It is clear that one would like the forecasts coming from the core model to be the basis of discussion when the monetary policy decision is made, as these have a very clear interpretation and, as experiments have shown, the ability to provide a clear explanation of a forecast leads to better decisions. But the reality is that some adjustments are made by all central banks, and so there are really two issues to be decided: whether there are better ways of adjusting the forecasts and whether there has been adequate documentation and explanation of those that have been made. From what I saw of the process of preparing exogenous variable projections and the derivations of the constraints, I would have no hesitation in saying that the latter of the two issues is done very well. Regarding the former, though there are always suggestions that one might make about adjustments for specific equations, there is nothing that I saw which made me feel that the current methods were deficient. I was certainly satisfied with the professionalism shown by the Bank staff in carrying out these tasks. The same thing can be said about the method by which 'past puzzle' adjustments were prepared. I found that the explanations given for why the adjustment had to be made were very clear, and there was good disclosure of which of the equations of the core model were being modified and how much the forecast was modified by these changes.

Future adjustments are very difficult to assess. One might prescribe some formal ways of doing this if it was the prior of a single individual that had to be incorporated, but, in the UK context, the opinions of all the members of the MPC need to be melded into a set of adjustments. This is clearly a task that is more of an art than a science. It is also the case that it is not always possible to make an adjustment that will agree with all priors. This tension was resolved for some time by the inclusion of Table 6.B in some *Inflation Reports*; this table effectively registered any dissent by MPC members from the published central tendency forecast. This does not seem to be an area where one can say much about 'state of the art' methods, as it is unlikely that one could even get the members of the MPC to write down precisely what their priors are. About all one can ask is whether the staff at the Bank do respond in an adequate way to these prior beliefs when implementing the adjustments. My own opinion is that they have done a good job. I do note in passing that the prior adjustments that have been performed do seem to have

resulted in an improvement in the forecasts of a number of the key variables, such as inflation and consumption, and this alone shows the importance of them.

It is often the case in other central banks that more use is made of switching adjustments than in the Bank of England, eg replacing the investment equation forecasts with data collected from a survey of anticipated expenditures. It may be that such predictors are not as reliable in the United Kingdom as elsewhere. The main use here has been in handling items such as the exchange rate and equity prices. In the core model the exchange rate would change according to the short-run interest differentials that emerge between the United Kingdom and foreign countries—the uncovered interest parity (UIP) condition. An alternative might be to keep the exchange rate at its current level (actually an average of the 15 days prior to the forecast is used). Wadhwani (1999) notes that the difference in inflation forecasts between these two assumptions is 0.4 percentage points for the two year ahead inflation rate of RPIX. Consequently, there has been some controversy over what is the appropriate way of handling the exchange rate. Keeping it fixed at its current value is not very appealing if one knows that the short-term interest rate in the United Kingdom will rise. But allowing it to change to the full extent of the differential runs counter to a huge body of literature which, if anything, suggests the opposite response from that predicted by UIP. Research has suggested that the reasons for this unexpected response is that market participants form biased expectations of future exchange rate movements and that policy responses may be a contributor to such an outcome—McCallum (1994). Currently, the MPC's response to this dilemma is to make the change in the exchange rate only a proportion of the differential, which is a cautious response to our limited knowledge of what drives exchange rates, and represents a compromise between assigning a zero weight (an unchanged exchange rate) and unity (UIP). It may be that, as we begin to work with richer models that more closely replicate actual market trading in financial assets—ie they are peopled by agents who engage in momentum trading and contrarian strategies as well as working on fundamentals—better ways may be found to allow for appropriate exchange rate responses to policy changes. At the moment, it would be hard to devise a core model that is reasonably simple and yet which accounts for the seemingly perverse responses, so my feeling is that the current method is as close to state of the art as one could reasonably ask for.

Diversification of representations and projections

Most central banks are interested in diversifying the set of models that they use for representing and projecting the economy. Sometimes this fact is referred to as the institution possessing a 'suite of models'. We will describe these models as auxiliary models. Bank of England (1999) documents a variety of auxiliary models that have been used at various times within the Bank. Some of the models described in that document, eg the Batini-Haldane model, seem to have only been used for special purposes, and the most common alternatives to the MM model now seem to be various types of vector autoregressive (VAR) models. Although an eight-equation VAR was set out in Dhar *et al* (2000), mostly they are much smaller than that. These models were constructed primarily with the intention of informing the policy discussions, eg a small supply-side VAR was recently used to address questions relating to the impact of supply-side shocks, but in recent times they have also been introduced into the forecasting process. In the latter vein, since 2001 a number of small models that had been developed in the Bank, and which could be used to forecast GDP growth and RPIX inflation, have been used in an automatic way to generate forecasts. The range of possible outcomes from such models might be used both as an indicator of the degree of uncertainty in the projections and also as a guide to possible risks for the benchmark forecast.

In analysing diversification strategies it is useful to draw a distinction between those models using much the same information as the core model and those that work with an expanded data set, ie we will find it advantageous to distinguish between:

1 Models that largely reprocess information that is in the core model.
2 Models that aim to expand significantly the information set from that of the core model.

Diversifying policy-analytic models

The core model cannot incorporate all available information without becoming impossibly large. The subset of information used in it therefore represents the modellers' best judgment about what is potentially most important for the central task of projecting inflation and economic activity. Even then, some information might need to be excluded, since it may be hard to embed in whatever equations are used in the core model and yet

leave it in a tractable form. Indeed, this is one argument for having a suite of models—it enables one to keep the core model reasonably compact. A good example would be the role of money. This rarely appears in core models today. In the MM it appears as a mechanism for describing a monetary policy rule, but this is only in the simulation mode. It does appear in household financial wealth, and the latter variable influences a number of expenditures, but it is not separated out. The question that arises is whether information on money (and, perhaps more broadly, credit) provides useful information for forecasting—see Hauser and Brigden (2002) and Nelson (2000a,b). To shed light on this question small models have been developed in the Bank that allow money and credit to influence expenditure and inflation directly. This seems to be an efficient way of incorporating information that is not explicitly in the core model into the forecasting process. It seems likely that this work will be expanded and I would agree that this is a desirable development.

When considering policy options there are situations where one wishes either to trace out the consequences of alternative scenarios or to study the likely equilibrium position of a variable such as the real exchange rate. A literature has developed around the latter under the title of estimating a fundamental equilibrium exchange rate (FEER). A model like the MM is not well suited to any of these tasks. It does not have the structure to generate a well-defined FEER and it is unable to handle convincingly questions that often come up in scenario analysis, such as the consequences of a rise in the risk premium on assets. It is clear that there has been a need for some time for a model that resembles the NMM in order to handle questions such as these. Consequently, even if it was decided not to proceed with the NMM in a forecasting environment, it would seem worth retaining it as a way of generating policy scenarios that are likely to hold over the medium run. In this frame of reference it is not so critical that there be a good match to quarterly data sets.

Diversifying forecasting models

As mentioned above, many auxiliary models are used for producing forecasts of output and inflation. Currently, there are 32 of these in use at the Bank—the range includes VARs, time-varying component models and factor models. Possibly the only type of model that does not seem to have been used in a routine way would be non-linear models such as threshold autoregressions. Although there is a little evidence that the latter may be

useful for forecasting over the longer time horizons that are of interest to monetary policy makers, they have not been widely used amongst central banks.

Where I think there can be room for improvement is in the way that the auxiliary models are being selected. To date those selected have largely been byproducts of previous enquiries into some phenomenon, and have not been specifically designed for forecasting. To give an example of this point, although there are quite a few VARs within the current set of auxiliary models, there is an underrepresentation of the type that has been found useful for forecasting in other central banks—viz Bayesian vector autoregressions (BVARs). These models try to solve a problem in forecasting with VARs stemming from the fact that, in their basic form, far too many parameters need to be estimated from limited amounts of data. The solution is to impose some restrictions (priors) upon the set of parameters in order to effectively reduce the size of that set to a smaller dimension. Although these restrictions are 'statistical' rather than 'economic', they have proven to be effective—see Robertson and Tallman (1999) for the Federal Reserve Bank of Atlanta's experience. During the period of my review some models were introduced within the BVAR class, but I feel that more work needs to be done on this.

More generally, if the suite of models philosophy is to attain its designated purpose, then some resources will need to be devoted to considering the question of what type of alternative models should be employed, rather than simply having them be a byproduct of some past usage. For example, based on the work of Clements and Hendry (1998), there is a presumption that models using an EqCM structure may be inferior to those that ignore the disequilibrium term whenever there are likely to be substantial changes in the equilibrium paths over time, and it seems likely that this has occurred over the past decade. Thus the type of models being chosen as the auxiliary set should properly be chosen for their potential forecasting prowess.

It also seemed to me that there is a strong case for focusing on fewer auxiliary models in the forecasting process. For those auxiliary models that are largely just reprocessing the information in the core model, in principle it is possible to determine exactly why there is a difference between the core model and auxiliary model projections, since the latter model is virtually nested within the former. Such an exercise is to be recommended. It will generally be desirable for auxiliary

models to be designed so as to exploit genuinely useful extra information to that in the core model. Currently, those models that either emphasise money as a determinant of activity and inflation, or that work with a very large number of time series that have been reduced to a small number of factors, are good examples of what I would regard as genuine auxiliary models.

There are other questions that also need to be settled. One is whether the best strategy for generating alternative forecasts is to do so automatically, that is with little human intervention, from a large range of auxiliary models. A competing proposal would be to produce forecasts from a single model that is much smaller than the MM (say five or six equations) but in which the type of adjustments used in the MM are applied. Such a model might have to treat a number of variables as exogenous and then use some forecasts of them. This sort of model is close to what has been used at the Reserve Bank of Australia for some years, and it now seems as if a variant will be developed for use as a supplement to the core model in use at the Reserve Bank of New Zealand. In this connection it may be pertinent to note that the latter is in the same class as the NMM, and so it may be particularly important to address this issue if the NMM becomes the core model.

If it is decided to retain the feature of automatically generating forecasts then I think one should investigate whether the automatic selection methods currently go far enough. For example, there seems no reason why specifications of these models should remain constant from period to period. Indeed, the best one at any point in time could be chosen based on some automatic criterion, eg see Swanson and White (1997) for some evidence that this may be useful for forecasting over longer periods. There are other questions that also need to be looked at rather carefully when doing automatic forecasts, eg what vintage of data (in terms of revisions) should be selected; whether parameters should be chosen to (say) minimise forecast error at an horizon of four to six quarters rather than the one quarter ahead criterion used by estimators such as regression; and even what the criteria for evaluating a good forecasting model should be. I would recommend that a small group be set up to look closely at what would be a useful range of alternative models. In doing so one should pay some attention to thinking about the use of 'economic' rather than 'statistical' priors upon the coefficients of the VARs, ie following Ingram and Whiteman (1994) and Del Negro and Schorfheide

(2002) one might utilise some priors from an existing economic model that embodies some of the beliefs of the Bank staff and the MPC. A good example would be to base the prior on the NMM, but it would be possible to think about using the MM for this purpose.

The literature on forecasting often emphasises one other point about the utility of producing a range of forecasts, viz that averaging of them may produce a better forecast than would be available from any individual one. But, as Hendry and Clements (2002) point out, this may actually produce inferior forecasts if the different models utilise the same set of information and some of these encompass others; whether it does or not depends a good deal on how much structural change has occurred over the sample. At the moment, with the exception of the factor models, one might expect that some of the auxiliary models used at the Bank will encompass others and so this might cast some doubt upon summarising the information from the existing auxiliary models as simple averages. At the moment, the auxiliary model forecasts are presented to the MPC both as averages and in raw form, although it seems more likely that most attention would be paid to the averages. Again, this is a reason for some careful planning concerning the nature of the auxiliary models.

The quality of projections

How well have the modelling and forecasting systems performed? Making a strong distinction between the 'pure' model forecasts that employ no adjustments of any sort, and those forecasts that emerge after the adjustment process, it seems highly likely that the 'pure' model forecasts of inflation and output change would have been rather poor. If this is true then the forecasting system has adjusted the 'pure' model projections in the right direction. Exactly how much of this adjustment can be attributed to the Bank staff, and how much to the MPC, is probably impossible to determine. Over most of the time since the formation of the MPC there was not a forecast prepared by the staff. Today, although the staff do prepare a 'benchmark' forecast, this forecast inevitably reflects past judgments by the MPC.

There has been a lot of comment upon the relationship of the published forecasts to the outcomes. This comment has dwelt on three items—the 'bias' in forecasts, the extent to which forecasts of inflation have been consistently higher than the outcomes, and, to a lesser degree, the patterns in the forecast errors.

It is worth examining each of these separately but it will prove efficient to analyse the issue of persistence first.

Persistence in forecast errors

To analyse forecast errors we need to state what type of forecast is being considered. There are a number of possibilities. Thus, one might concentrate upon the ability to forecast outcomes for the next quarter. More relevant to policy is the ability to forecast annual inflation either over the next year or perhaps in one or two years' time. It is these forecasts that have attracted most attention and their prediction errors have been summarised and briefly analysed in the August 2001 and 2002 issues of the *Inflation Report*. In the August 2002 edition it was observed that, over the period between February 1998 and May 2001, the two year ahead forecast of the annual inflation rate had resulted in an overprediction of 0.5 percentage points, while growth had been slightly overpredicted.

No analysis was provided of other characteristics of the errors, but in a number of speeches, an ex-member of the MPC, Sushil Wadhwani, has pointed to the fact that all the forecast errors in the two year ahead prediction of inflation have been overestimates. For the one year ahead forecasts, there have been nine overpredictions and five underpredictions. Thus it is clear that the forecast errors are very persistent. Technically, they are positively correlated, ie if there is a positive forecast error for one period it tends to persist for many periods.

Those drawing attention to this phenomenon seem to believe that such an event is highly unlikely. Is this true? In the August 2001 *Inflation Report* analysis of the MPC forecast errors it was mentioned (page 58) that the persistence of forecast errors was likely to be particularly evident 'when projections are presented as four-quarter rates of change'. I will support this claim, arguing that the probability of such runs is in fact quite high, even for a forecaster who actually knew the process that generated inflation. The reason arises from the interaction of the nature of the inflation data and the quantities that are being forecast.

What we know about the quarterly inflation rate is that it is often a very persistent process, ie the outcome in the current quarter is highly correlated with the outcome in the previous quarter.[1] A simple polar case that emphasises this persistence, and which is easy to analyse, is to assume that the quarterly inflation rate is a random walk. Then we consider a forecaster who forecasts with this model, and so is actually making the best possible forecasts. In the appendix it is shown that the correlation between the forecast errors varies depending on how far ahead we are attempting to forecast. If one is predicting quarterly inflation one quarter ahead it is zero; the correlation rises to 0.66 if we are predicting the annual inflation rate over the next year, and to 0.9 if we are predicting the annual inflation rate two years into the future. For the latter case, in four out of every ten realisations there will be six or more occurrences of forecast error of the same sign; and two out of ten times one will see eight in a row.

As should be stressed, in the experiment mentioned above the forecaster knows the actual model that generated the data, and so the forecast is of the highest quality. Yet runs of overpredictions and underpredictions are probable. The analysis in the appendix also indicates that we should see little in the way of consistent overprediction or underprediction of quarterly inflation rates one quarter ahead, a greater incidence of them when predicting the annual rate one year ahead, and a still larger one for the annual rate two years ahead. For the 18 quarterly forecasts made from August 1997 until November 2001, 10 of the forecasts were overpredictions and 8 were underpredictions, while the relationship between the one year and two year ahead forecasts was exactly as predicted by our simple model. Thus this simple analysis points to the fact that an observed run of overpredictions of inflation does not tell us much about the quality of the forecasts.

What about predicting GDP growth? There is much smaller persistence in the quarterly growth rates of GDP, so we might analyse it by assuming that the process being forecast has zero correlation rather than being a random walk. Then the forecast error correlation for the annual GDP growth rate one year ahead is 0.75, and it remains at this value when looking two years out. For the two year out forecasts there were six underpredictions and four overpredictions, which seems consistent with the degree of correlation that would be in the forecast errors.

Bias in forecasts

What about bias? In the August 2002 *Inflation Report* it was reported that the mean forecast error in inflation

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[1] As was seen in Figure 3, the correlation in RPIX inflation was around 0.75 until late 1997, but then began to decline.

two years out made over the period from February 1998 to May 2001 had been 0.5 percentage points, and that there had been a small average overprediction of GDP growth. The latter has varied a lot over time—in the August 2001 *Inflation Report* it was indicated that there had been an underprediction up to that point in time.

It is useful to adopt our simple model of persistent inflation to analyse such outcomes. Now it is assumed that the forecaster makes an average forecast error for the quarterly inflation rate of b, ie if quarterly inflation is actually 0.6% then the average prediction of it might be 0.62%, giving a bias of $b = 0.02$ percentage points. In the appendix it is shown that this bias would become $10b$ when predicting the annual rate one year ahead and $26b$ in predicting the annual rate two years ahead. Thus, even a very small bias in predicting the inflation rate on a quarterly basis means a large bias in the annual estimate two years out. If, for example, there is a bias of 0.5 percentage points per annum in the annual rate of inflation two years out, then this would be consistent with a bias of 0.02 percentage points in the quarterly rate. In fact, the latter is the average bias in the quarterly inflation projection over the period from 1997 until 2001. One might note that a bias of 0.02 percentage points in a quarterly inflation prediction seems extremely small. It might also be noted that, if inflation were not a persistent process, then the bias in any annual inflation rate would be $4b$. Hence, the decline in the persistence of RPIX inflation recorded earlier suggests that there might be smaller average errors after 1999, which is consistent with the analysis provided in the August 2002 *Inflation Report*.

The argument above should not be construed as saying that the models being used for forecasting are accurate or that they cannot be improved on. Our analysis was simplified by treating inflation as a random walk, although our conclusions would be qualitatively the same if we allowed for a more realistic level of dependence. Rather our aim was to illustrate in a simple way why it is difficult to use statistics on inflation predictions two years into the future to assess the quality of forecasting procedures. Indeed, it might be argued that an observed bias in the forecast of the annual inflation rate two years out of just 0.5 percentage points is a tribute to the abilities of the Bank staff and the MPC to offset known inadequacies in the models.

Patterns of forecast errors

There are also some joint patterns in forecast errors that have been commented upon. In particular, overprediction of inflation has been associated with underprediction of GDP growth in the forecasts prepared between August 1998 and May 1999. Explanations of this conjunction offered in the August 2002 *Inflation Report* have centred upon the strength of sterling and the fact that the pessimistic expectations generated by the Russian debt crisis, and the near-failure of the Long-Term Capital Management hedge fund, failed to materialise. These are certainly possible reasons for the observed patterns, but an analysis of the forecasts made during the period August 1998-May 1999 suggests that there may have been other factors at work. Figures 4 to 7 deal with this issue.

Each time a forecast was prepared, projections were made quarter-by-quarter for nine quarters into the future.[1] Hence, over the four forecast rounds between August 1997 and May 1998, the MPC made 36 projections of inflation and output growth. Figure 4 contains these 36 combinations of expected inflation and growth for the period between August 1997 and May 1998, in the form of a cross-plot of GDP growth against inflation. Figure 5 does the same for the period August 1998 to May 1999, and so on. Thus these graphs show the relationship that the MPC expected between inflation and output growth outcomes, and it does not relate to what actually occurred. Normally, we would expect a positive relationship between these two variables, ie higher expected growth would be associated with higher expected inflation. It is noticeable that this is true for all the years, except for the forecasts between August 1998 and May 1999. In this period of time the MPC expected a combination of high inflation and low growth. Now normally we would think that such a combination would be appropriate if the economy was being subject to supply-side shocks, eg a rise in oil prices, but that does not seem consistent with the story being told above for weak GDP growth. It seems more consistent with some comments that I received to the effect that, at the time of these forecasts, earnings growth seemed to be exceeding what would have been expected given the state of demand, and such an outcome might have been interpreted as a supply-side shock. I think this analysis shows that there are often insights available about errors in the forecasting process from looking at the inflation and growth forecasts

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(1) One of these is for the current quarter in which the forecast is made as it is unknown at the time of forecast.
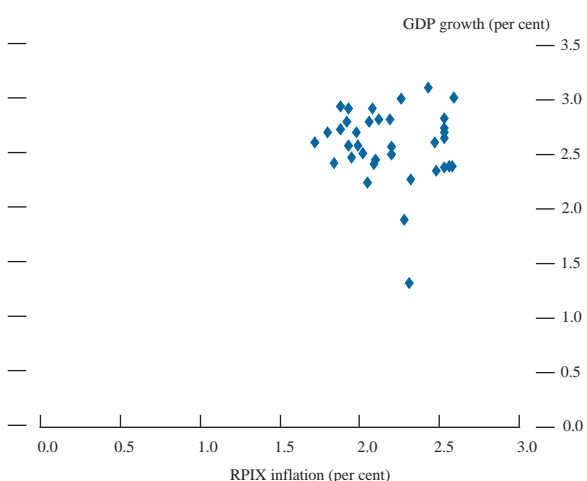
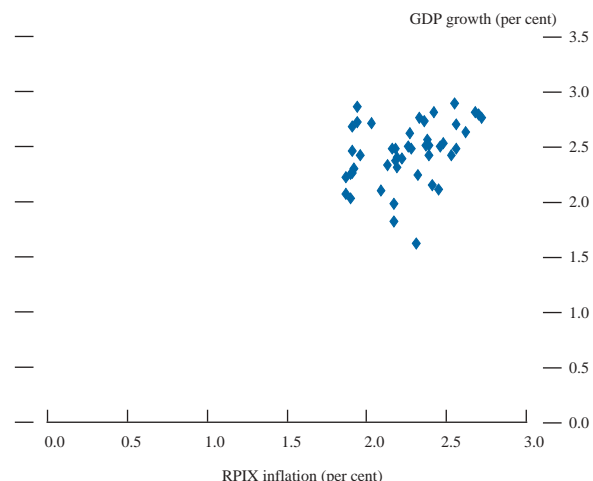**Figure 4**
MPC forecasts, August 1997-May 1998
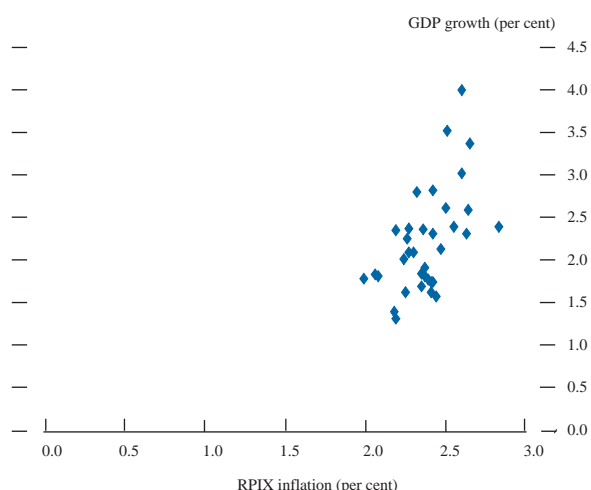
Figure 5
MPC forecasts, August 1998-May 1999
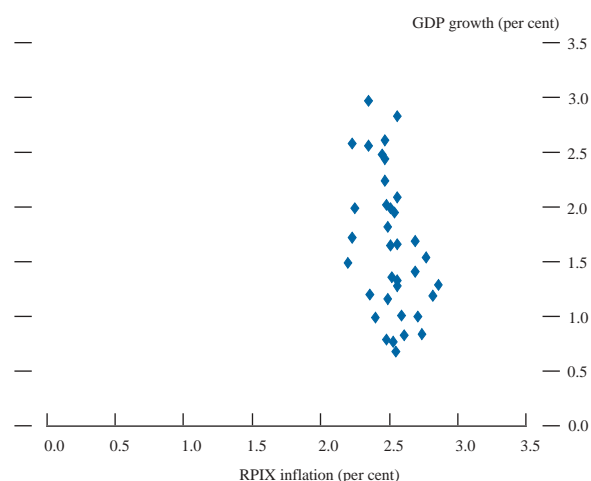
Figure 6
MPC forecasts, August 1999-May 2000

Figure 7
MPC forecasts, August 2000-May 2001

together rather than separately—the latter is what is provided by the fan charts. I would certainly recommend that more attention be paid to examining the joint outcomes when considering the forecasts being made at any point in time.

Communicating the models and projections

The Bank publishes a great deal of information on its projections, models and research. It is to be highly commended for this. Indeed, I think they are a model for other central banks. I certainly found that the material needed to write the report was largely available from published sources. Nevertheless, there are a few areas in which I think there can be some improvement.

The first item relates to the description of the model. As explained earlier, the type of model used at the Bank has a dual structure, involving an equilibrium position and a description of how the system responds to disequilibrium. It is logical then to present the equations of the model according to this principle. That was done for many of the equations in the MM description, but not for one of the most important, the earnings equation. It takes some effort to write it in the requisite form, so as to understand what the underlying structure of the relationship determining earnings is. I would recommend that, in order to consistently achieve clarity, all the equations of the model be written in EqCM form.

A second item relates to the presentation of the risks of the forecasts, ie the fan charts. There has been some criticism of these—see Wallis (2001)—one of which

involves the scaling factor used to determine the variability of the fan chart. In particular, it has been suggested that the value used is too high since it may have been constructed using data that are a mixture of different monetary policy regimes. The criticism seems a potentially correct one and this has been noted by the Bank in the August 2002 *Inflation Report*. Ultimately, this is an issue of whether the decline in the volatility of inflation is a temporary or permanent phenomenon. Around the world we have seen declines in the volatility of series such as GDP growth and inflation during the 1990s, but to date there has been no convincing explanation of these outcomes. Hence it remains unclear whether one should recalibrate the fan charts with a lower variability factor. Leaving this calibration issue aside, there is a good case for providing more information on the joint outcomes for inflation and growth. In the previous section I pointed out the benefits that can come from such a joint assessment. I am not sure that it is necessary to publish a bivariate fan chart to achieve this objective. It might be sufficient to provide the information needed to construct such an entity in the file that is now being published containing the quantitative parameters used in constructing the univariate fan charts.

Conclusion

When the MPC was formed in 1997 there were clearly going to be some stresses placed upon the existing modelling and forecasting systems. The novelty of having the monetary policy makers take responsibility for the forecast necessarily required some adjustments to previous operating procedures. Because it was a unique institutional arrangement, there was no real guidance to be had from other institutions over how to proceed. In the past few years a reasonably stable set of

activities connected with the monetary policy cycle seems to have emerged, and the system now seems to be working quite efficiently. There are clearly problems with the inputs into the decisions, as the core model has not performed in a satisfactory way, and that has required the MPC and Bank staff to make many adjustments to its forecasts. In this they have performed very creditably. As I have argued in the report, much of the criticism made of the actual forecasting record seems rather harsh and fails to take into account the nature of the series being forecast.

There is little doubt that the core model needs to be improved. It is possible that the new model that is being developed will be a more satisfactory vehicle for policy analysis and forecasting than the current one, but, until one sees its performance during a forecasting round, it is impossible to make a judgment about it. At this stage, all one can say is that it would appear to be 'best practice' and to correct many of the difficulties that have emerged when operating the current model. I also feel that greater attention needs to be paid to the suite of auxiliary models. In particular, the number used to make alternative forecasts could usefully be reduced and more attention paid to designing them as forecast vehicles, rather than just adapting models that were used for some other task.

Finally, the Bank has been quite sensitive to the need to perform ex-post forecast evaluation. Analysis that has been presented to the MPC has ranged from summarising the outcomes to attempting to ascertain the reasons for the errors, eg by decomposing the forecast errors for inflation in terms of the forecast errors for the influences on inflation of earnings, the exchange rate etc. I feel that the work in this area has been of high quality and certainly of adequate quantity.

Appendix

Let p_t be the quarterly variable to be forecast. A one quarter ahead projection involves forming the expected value of p_{t+1} given the information available at time t, $E_t(p_{t+1})$; an annual one year ahead forecast is $E_t(p_{t+1} + p_{t+2} + p_{t+3} + p_{t+4})$; and an annual inflation forecast two years ahead is $E_t(p_{t+5} + p_{t+6} + p_{t+7} + p_{t+8})$.

Now consider the case where p_t is a pure random walk, ie $p_t = p_{t-1} + e_t$, where e_t is an identically and independently distributed random variable with zero expectation and variance v. Then we would have as forecasts:

One quarter ahead
$$E_t(p_{t+1}) = E_t(p_t + e_{t+1}) = p_t$$

Annual inflation one year ahead
$$E_t(p_{t+1} + p_{t+2} + p_{t+3} + p_{t+4}) = E_t(p_t + e_{t+1} + p_t + e_{t+2} + e_{t+1} + p_t + e_{t+3} + e_{t+2} + e_{t+1} + p_t + e_{t+4} + e_{t+3} + e_{t+2} + e_{t+1}) = E_t(4p_t + 4e_{t+1} + 3e_{t+2} + 2e_{t+3} + e_{t+4}) = 4p_t$$

Annual inflation two years ahead
$$E_t(p_{t+5} + p_{t+6} + p_{t+7} + p_{t+8}) = E_t(4p_t + 4e_{t+1} + 4e_{t+2} + 4e_{t+3} + 4e_{t+4} + 4e_{t+5} + 3e_{t+6} + 2e_{t+7} + e_{t+8}) = 4p_t$$

Thus if the forecaster knew that the p_t followed a random walk the forecast errors would be:

One quarter ahead
$$f_t = e_{t+1}$$

Annual inflation one year ahead
$$f_t = 4e_{t+1} + 3e_{t+2} + 2e_{t+3} + e_{t+4}$$

Annual inflation two years ahead
$$f_t = 4e_{t+1} + 4e_{t+2} + 4e_{t+3} + 4e_{t+4} + 4e_{t+5} + 3e_{t+6} + 2e_{t+7} + e_{t+8}$$

The covariance between f_t and f_{t-1} will be:

One quarter ahead
Zero

Annual inflation one year ahead
$20v$

Annual inflation two years ahead
$84v$

while the variance of f_t will be:

One quarter ahead
v

Annual inflation one year ahead
$30v$

Annual inflation two years ahead

94v

giving autocorrelations of zero, 0.66 and 0.89.

If the process for p_t had just been $p_t = e_t$ then the expected value of p_t for all forecast horizons would be zero and the forecast errors would be:

One quarter ahead

e_{t+1}

Annual inflation one year ahead

$e_{t+1} + e_{t+2} + e_{t+3} + e_{t+4}$

Annual inflation two years ahead

$e_{t+4} + e_{t+5} + e_{t+6} + e_{t+7}$

from which the autocorrelations are zero, 0.75 and 0.75.

Finally suppose that the forecaster makes a mistake and thinks that the process for p_t has the form:

$p_t = b + p_{t-1} + e_t$

This implies a bias of b in the quarterly forecast as it would forecast b rather than zero. Following the same derivations as above, we see that the forecast made of the annual inflation one year out will be $4p + b + 2b + 3b + 4b$ which produces a bias of 10b. Continuing in the same way a bias of 26b is found for the annual inflation two years out. When the process is believed to be of the form $p_t = b + e_t$, whereas it is actually just e_t, the derivations above show that the bias is 4b for both of the annual forecasts.

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Bank's response to the Pagan Report

Introduction

The Bank of England's Monetary Policy Committee (MPC) was set up in May 1997. Its remit is to meet the Government's inflation target—currently set at $2^1/_2$% for RPIX. The Committee reviews its procedures regularly to ensure they constitute best practice and are appropriate for purpose. In addition, the non-executive Directors of the Court of the Bank have a statutory duty under the Bank of England Act 1998 for the oversight of the MPC's processes. Review by informed external experts represents one mechanism whereby the Committee refines its processes and procedures and simultaneously assists the non-executive Directors of the Court in the execution of their oversight duties.

In 2000, Court invited Don Kohn of the Federal Reserve Board in Washington to conduct an external review of the MPC's procedures. His Report, and the Bank's response, was published in the Bank's *Quarterly Bulletin*, Spring 2001. That Report focused on the procedures of the MPC itself and only tangentially touched on the technical analysis and forecast material provided to the Committee by the staff of the Bank's Monetary Analysis Division. In Autumn of 2001, and acting on a recommendation by the House of Lords Select Committee on Economic Affairs that the Bank conduct an audit of its forecasting methodology and assumptions, Court decided to commission a review of that technical work. The review was intended to complement that conducted earlier by Mr Kohn.

Court invited Professor Adrian Pagan of the Australian National University and Nuffield College, Oxford, and a former member of the Board of the Reserve Bank of Australia,[1] to conduct the review. The Bank is extremely grateful to Professor Pagan for agreeing to undertake it and the thoroughness with which he approached his task. To facilitate his work, Professor Pagan spent a total of about two months at the Bank during the first half of 2002 reviewing the Bank's technical and forecasting activities, interviewing the staff and current and former members of the MPC, and attending a number of key forecasting meetings. He returned in December 2002 to discuss his findings with both Court and the MPC, and with the staff of Monetary Analysis.

Professor Pagan's remit was to "...report on the statistical and economic modelling and forecasting work carried out by the staff of the Bank for the MPC and evaluate whether that work is 'state of the art'." In particular, he was asked to:

- focus on the technical aspects of the modelling and forecasting process, rather than the procedural and presentational issues addressed by the Kohn Report, and judged against the purposes set out for the monetary policy regime;

- cover the full range of modelling and forecasting approaches presently employed by the Bank and note where these methods lag behind best practice or are capable of improvement;

- identify any additional techniques or approaches that could usefully be employed; and

- evaluate the procedures for ex-post forecast evaluation.

The Bank welcomes Professor Pagan's perceptive and insightful Report. It believes that it contains important observations about economic modelling and forecasting in general, as well as a number of recommendations as to how the current process at the Bank of England might be improved. As with the Kohn Report, the Bank has decided to publish Professor Pagan's Report. Publication serves two purposes. First, it is in the tradition of making transparent the process by which monetary policy is formulated. It also reveals some of the information the non-executive Directors are able to draw on in their oversight of the MPC. Second, as already noted, the Report discusses a number of general modelling and forecasting issues. Consequently the contents of the Report should be of interest to those outside the Bank involved in preparing economic forecasts and commentating on them.

(1) The Australian equivalent of the MPC.

Court and the MPC have discussed the Report. The response below concentrates on the most significant issues that emerge from it. Corresponding to the remit, these are: whether the current modelling process is 'state of the art' and fit for purpose; how the models are developed and what additional techniques could be employed; and forecast performance and evaluation.

Is the modelling process 'state of the art'?

The Report notes that there is a spectrum of modelling approaches, ranging from tightly specified calibrated theoretical models (dynamic stochastic general equilibrium models) through to purely empirical models with little explicit theoretical content (vector autoregressions). Models are used to aid the MPC's thinking about the forces at work in the economy as well as to produce projections, and no single model is likely to be appropriate for all purposes. A model needs a clear theoretical structure that is consistent with the MPC's vision of how the economy functions if it is to help the Committee interpret the underlying economic forces moving the data. And a model ought to provide a satisfactory explanation of the historical experience if it is to be used with any confidence to make projections, although a good econometric fit does not in itself guarantee that a model will produce accurate forecasts. As all models represent gross simplifications of a complex reality, conflicts between the two objectives inevitably arise. The Report recognises this and consequently does not advocate the adoption of a single approach for all purposes. It is thus consistent with the Bank's 'suite of models' approach, which relies on a plurality of models to inform the Committee's judgments.

There is, however, a quarterly macroeconometric model (MM) that is the primary tool employed by the staff and the Committee in the construction of the projections contained in the quarterly *Inflation Report*. After considering how the MM relates to the current spectrum of modelling approaches, Professor Pagan concludes that greater theoretical coherence and consistency with the MPC's beliefs would be achievable without any sacrifice of empirical fit. Accordingly he believes that the MM does not represent the 'state of the art'. The Committee agrees with that assessment.

Prior to the commissioning of this review, the MPC had already recognised that the MM had a number of

deficiencies that limited its utility for analysis and forecasting. In particular the underlying analytical structure is not fully articulated and there are some obvious linkages that are absent which presently have to be catered for through ad hoc adjustments. The Bank has therefore directed some of its research effort in 2001–02 into the development of a new macroeconometric model (NMM) that has a more consistent and clearly articulated structure, and which better captures the MPC's vision of how the economy functions. The Bank welcomes Professor Pagan's conclusion that, at least in intent, the NMM appears to be 'best practice and to correct many of the difficulties of the current model'. However, as the NMM is still under development, Professor Pagan felt it was too early to judge how successful it would be in practice.[1] The Committee expects that the NMM will become functional during the course of 2003 and has invited Professor Pagan to produce a postscript to his Report covering the NMM in due course.

The Committee believes that it is worth stressing that the NMM does not represent a significant shift in its view of how the economy functions or the transmission mechanism of monetary policy. Rather it seeks to provide the Committee with a more useful and flexible tool to aid its deliberations. Its adoption should therefore not by itself lead to any significant change in the Committee's assessment of the prospects for inflation and growth.

Diversity of models and model development

The Report recognises that there is already a diverse range of models developed for policy analysis within the Bank. Most of them were developed to illuminate particular analytical issues, but a number are also now used to generate forecasts during *Inflation Report* rounds as a cross check on the Committee's projections. Professor Pagan's report suggests that for this latter purpose there would be value in focusing on those models that contain extra information relative to that contained in the MM. He also suggests that further experimentation with some specific alternative approaches (Bayesian vector autoregressions and models with evolving parameters) might be worthwhile. The Bank intends following up both these valuable suggestions.

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(1) Professor Pagan classifies the NMM as an 'incomplete dynamic stochastic general equilibrium' (IDSGE) model, perhaps with some 'Type II hybrid' features thrown in. His stylised Figure 1 may therefore seem to imply that the NMM can be expected to fit the data less well than the MM. While the Bank does not disagree with Professor Pagan's general characterisation of the NMM, the intention is to provide a more coherent and flexible analytical structure with at least as good an empirical fit as the MM, ie it involves a move up—or even up and to the right—in Figure 1.

All models are gross simplifications. It is therefore inevitable that any particular model may fail from time to time to explain some facets of the data. Constant model maintenance is therefore required to deal with new problems or puzzles. Professor Pagan provides an instructive commentary on a particular example of this—the equation for the GDP deflator in the MM—and concludes that sometimes too much effort is focused on 'tinkering' in order to improve the fit of an equation rather than the consideration of alternative paradigms that might provide a more fundamental solution. He also argues that such new thinking often originates outside the group of staff directly involved in production of the forecast. This criticism is well taken. The Bank will seek to make more room in the forecast process for exposure of alternative approaches. It is also seeking to facilitate experimentation by those outside the forecast group through the adoption of user-friendly modelling software and more streamlined data-management processes.

The Bank concurs with Professor Pagan's view that model development should be a continuous process. It will provide continuing resources for this type of work after the NMM is up and running.

The forecasting process and forecast performance

The models developed and used by the Bank staff are merely tools to help the Committee discuss issues in a structured and quantified way—there is no automatic link between either the MM, or any other model, and the MPC's projections for growth and inflation. Professor Pagan's Report recognises that economic forecasting is not a mechanical process and that judgments by the staff and the Committee have played a crucial role in generating sensible projections. Such judgments are required in respect of the interpretation of recent data, in the projection of exogenous variables and residual adjustments into the future, and from time to time in the explanation of why the relationship between certain variables may have shifted.

The Bank notes that Professor Pagan is broadly content with the way such adjustments have been developed and applied by the staff and the Committee. It also notes the Report's conclusion that the deficiencies of the MM have not in themselves detracted from the accuracy of the MPC's forecasts, although those deficiencies may have

reduced the usefulness of the MM and led to an enhanced need for supplementary models.

While forecasting is not a mechanical process, the analysis of past forecast errors may help to shed light on deficiencies in the models, as well as in the Committee's thinking. For this reason the Bank conducts regular analysis of its forecast errors. Professor Pagan concludes that the 'Bank has been quite sensitive to the need to perform ex-post forecast evaluation' and that 'the work in this area has been of high quality and certainly of adequate quantity'.

There has been a certain amount of public commentary on the tendency, documented in the August 2002 *Inflation Report*, for two-year ahead inflation outturns to run persistently somewhat below the corresponding projections since independence, resulting in an average overprediction of around 0.5 percentage points for projections made between February 1998 and May 2001. Professor Pagan provides a simple, but revealing, analysis of the persistence and bias in the MPC's successive inflation projections. He concludes that the high degree of persistence in the inflation process itself implies that runs of over or underprediction at the two-year horizon are to be expected and that recent experience is not particularly unusual in this respect. Moreover his analysis shows how that same persistence in the inflation process can turn a quantitatively extremely small overprediction in the one-quarter-ahead inflation rate into a much larger overprediction of the annual inflation rate two years out. The Bank welcomes his conclusion that '…the 'bias' is probably as small as one could reasonably expect' and that '…an observed bias in the forecast of the annual inflation rate two years out of just 0.5 percentage points is a tribute to the abilities of the Bank staff and the MPC.' Nevertheless the Bank is not complacent about its forecasting record and will continually seek to learn the lessons from past and future forecast errors.

Finally Professor Pagan recommends that more attention be paid by the Committee to the joint distribution of inflation and growth. The Committee intends giving further consideration as to how information on the joint outcomes for growth and inflation might be best presented and exploited in its procedures. It will also consider whether presenting such information could enhance its public communications.

The Bank's regional Agencies

By Phil Eckersley, the Bank's Agent for Northern Ireland and Pamela Webber, of the Bank's Inflation Report and Bulletin Division.

This article describes the work of the Bank's regional Agencies, updating that published in the November 1997 Quarterly Bulletin.[1] *It outlines, in particular, the contribution of the Agencies to the work of the Monetary Policy Committee.*

The Agencies' role

The Agencies' main function is to provide economic intelligence to the Monetary Policy Committee (MPC) every month ahead of its interest rate decision. Though regional representatives have been providing economic intelligence since 1930 (see the box on page 93), the Bank's independence since 1997 has increased the importance of that work in the monetary policy process. Between them the Bank's Agents and Deputy Agents hold 8,000 meetings with business contacts each year in order to take the temperature of the UK economy. In addition, the Agents facilitate regular visits by Committee members to the regions in order to hear first hand about business conditions.

These arrangements allow the MPC greater access to additional sources of information on a regional and sectoral basis. Moreover, they provide the MPC with access to more timely news than is available through the publication of official statistics, considerably aiding the MPC in analysing the latest economic developments.

Developments to the contact base

Over the past five years, the Agencies have improved the nature and quality of the information gathered for the MPC. They aim to maintain a contact base that broadly mirrors the sectoral breakdown of GDP in their regions. The sectoral breakdown of activity in the regions acts as a guide to the number of contacts rather than as a target.

Historically, the manufacturing sector has been over represented, although manufacturing contacts do provide indirect information on other sectors as well.

The Agencies have traditionally had relatively little contact with public services, such as public administration and health, because much of the information is available centrally from the government. For this reason, a lower proportion of contacts is in the public sector than would be implied by share of economic activity.

But outside the public sector, Agencies have attempted to improve sectoral coverage by adding contacts in sectors where a review of coverage had identified weakness. Chart 1 illustrates the progress on reducing the overdependence on manufacturing contacts, as well

Chart 1
The Agencies' contact base
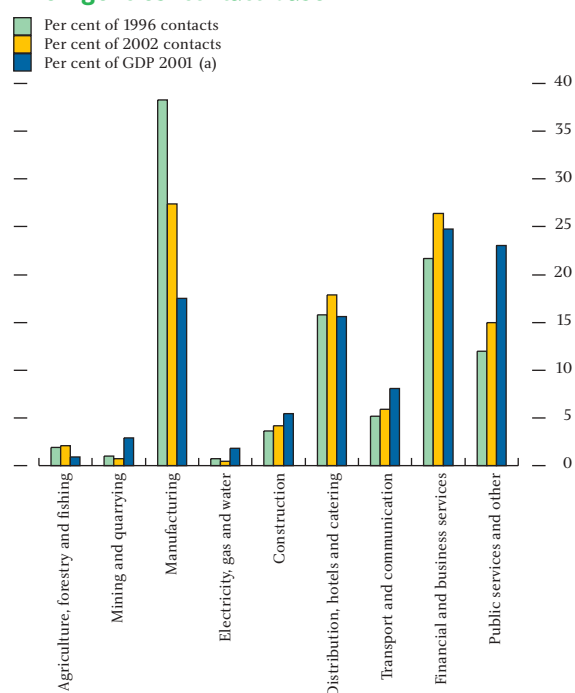
(a) Guide to contact mix in 2002 is based on 2001 GDP shares.

(1) Beverly, J (1997), 'The Bank's regional Agencies', *Bank of England Quarterly Bulletin*, November, pages 424–27.

An historical perspective

The Bank's regional representation, which has evolved into the current network of Agencies, began when the first Branches were established in 1826–28 to deal with problems caused by the failure of local banknote-issuing banks. The network of Branches grew and changed during the 19th century, but their basic responsibility was still to provide a banking and banknote distribution service in their areas. From 1930 onwards, the Branches were required to send confidential reports on economic and business conditions, drawn from local industrial and commercial contacts, to Head Office in London. In recent years these reports and the use to which they are put have developed considerably. The Bank was restructured in 1994 and industrial liaison work (including the work of the Agencies) was integrated within the Monetary Analysis area of the Bank. After a review of the Bank's regional coverage in 1995–96, it was decided to terminate banking in the Branches—Birmingham, Bristol, Leeds, Manchester and Newcastle—and concentrate banknote distribution from London (Head Office and Printing Works in Debden, Essex) and Leeds. The Birmingham, Bristol, Manchester and Newcastle Branches were each replaced by an Agency. Leeds is also the site of a new Agency, with banknote business run as a separate operation. Additional Agencies were opened in Greater London, Wales and the East Midlands.

The current network of twelve Agencies was completed in 2000, when the Agency for Northern Ireland was opened in Belfast. At the same time, the operations in Liverpool and Manchester were amalgamated to form the Agency for the North West with offices in both cities. And a separate office for the Agency covering the South East and East Anglia was opened in Cambridge to complement the London office. Another office for the

South West Agency is due to be established in Exeter in 2003. The staffing of the Agencies now typically comprises an Agent, a Deputy Agent and up to three additional support team members.

The geographical coverage of a number of Agencies is consistent with the official standard planning regions; others reflect economic and geographic considerations. Agency premises are located in the principal metropolitan and business centres, and spread across the country. The map shows the areas currently covered by each of the twelve Agencies, together with the proportion of UK output, based on 1998 weights, that they cover.
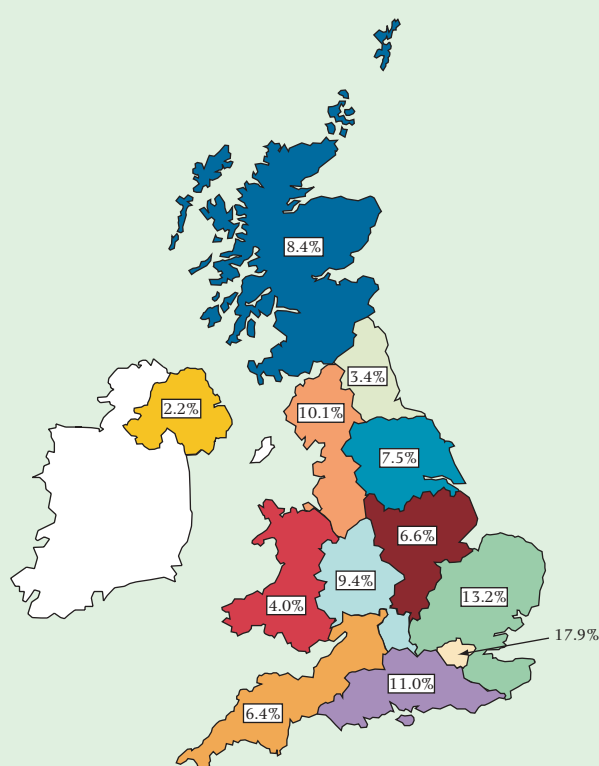
as achieving a better mix of other sectors covered. Additionally, since some service sector areas are dominated by small and medium-sized enterprises (SMEs), each Agency has established panels of small firms representatives which meet regularly to discuss developments in their business. This has also helped increase the coverage of the SME sector. Using regional GDP data broken down by county, individual agencies have been able to achieve good geographical coverage within their own regions.

The identification of potential new contacts is a continuous process at each Agency, as contacts are lost through business closure, take-over or as individual contacts move on. Agencies also review their contact list regularly to ensure that sectoral and geographical coverage is maintained.

Briefing the MPC

The Agencies provide information to the MPC through a number of channels.[1] Their most comprehensive

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(1) Bean, C and Jenkinson, N (2001), 'The formulation of monetary policy at the Bank of England', *Bank of England Quarterly Bulletin*, Winter, pages 434–41 provides a detailed description of all the briefing which the MPC receives on a monthly basis.

assessment of economic developments each month comes via their monthly report.

The monthly economic report

Each Agency produces a confidential monthly economic report (MER) based on discussions with a cross-section of companies, in terms of sector, location and size. The report covers demand, both domestic and export, costs and prices, labour market and pay developments. Agencies are asked particularly to identify any changes in trend. The information gathered through a programme of company visits is supplemented with evidence from business and public sector organisations—regional CBI Councils, Chambers of Commerce, universities and the press. The MERs are distilled into a monthly Agents' national summary. A quarterly Agents' summary of business conditions is also published in the *Inflation Report*.

Pre-MPC

Each month, typically on the Friday preceding the policy decision, the MPC is briefed fully on the current economic and market developments by senior Bank staff at the so-called pre-MPC meeting. Four Agents, one each from the North, Midlands and South of England and one from Scotland, Wales or Northern Ireland, plus three Deputy Agents attend the pre-MPC meetings. Two of the Agents deliver a presentation to the Committee each month, the first on a special topic chosen by the Committee and the second on key economic issues arising out of the visits undertaken during the latest month—the Agents' update.

The Agents' special topic

Each month, the Committee decides whether some targeted questioning by the Agencies could usefully supplement official data or seek to explain puzzling developments in the economy. When the required information is identified and specific questions are agreed, each Agency approaches a subset of its contacts to seek feedback. The Agents are asked to present the results of their investigations at the following pre-MPC meeting.

The Committee sometimes asks the Agencies to carry out a survey among their contact base in a form similar to that of a previous year, although more often it requires the Agencies to survey their contacts on a new area of interest that may have developed recently. An example of the latter is the special topic for

November 2001, which asked companies how their plans had changed following the events of 11 September 2001. More recently, the MPC was puzzled that the sharp decline in goods export volumes shown in official data for 2002 Q4 did not seem consistent with official data on production for export by manufacturers. Agencies were asked to find out whether their contacts had increased or reduced export sales in 2002 Q4 relative to Q3.

The questions may be asked as part of pre-planned meetings and are usually worded so that respondents have to choose from a number of alternative answers. Questionnaires may also be sent to contacts, or the topic may be discussed over the telephone. The number of responses varies between months from 150 to more than 300, according to the detail in the question being posed. Agencies rely on co-operation from contacts and are conscious of the need not to make excessive demands for information.

In presenting the results, responses are weighted according to turnover or employment of participating companies. In some cases a balance of responses, as used in Confederation of British Industry and British Chambers of Commerce surveys, is presented. Over the period August 1997 to March 2003 there have been 59 presentations covering 31 different topics, including 6 presentations each on investment and pay prospects and 5 on inventories.

The Agents' update

The Agents' update attempts to draw together the views of all the regions to present an overall UK picture. Though key regional differences are highlighted where appropriate. Unlike the more comprehensive MER, the presentation is focused on selected key issues; either covering areas in which the MPC has expressed particular interest, or reflecting significant developments identified by the Agents in the course of their contact visits. The Agents' update provides the MPC with a more timely assessment than is available through published official statistics

Other economic reporting

Prices and wages

The Agents also use contact visits to gather quite detailed information on price movements over and above that needed for the main body of their economic reporting. This information is helpful in the production

of the internal short-term inflation forecasts in Head Office, which are provided regularly to the MPC.

In a similar vein, Agencies collect information on pay settlements from their contacts. This forms part of the Bank's settlements database, which is used to provide an indication of labour market pressures and earnings growth within the economy. The data can be broken down by sector, thus providing an indication of differing developments, in manufacturing and services for example.

Structural issues

In addition to the conjunctural assessment that the Agents provide as part of the monthly MPC cycle, they are also able to provide information on longer-term trends or new structural developments. Briefing notes are produced jointly by the Agents and staff of the Structural Economic Analysis Division in Monetary Analysis. A recent example was a study of the extent and impact of e-commerce.

MPC and other regional visits

The Agencies facilitate meetings with their business contacts for the MPC. In 2002, 50 visits were organised by the Agencies for Committee members. A similar number is expected to take place in 2003.

The Agencies are also involved in the organisation of regional Court meetings. The Court is the governing body of the Bank. It consists of the Bank's Governor, two Deputy Governors, and 16 non-executive Directors. The Court determines the Bank's objectives and strategy, other than those relating to monetary policy. Additionally, it aims to ensure the effective discharge of the Bank's functions and the most efficient use of the Bank's resources. The first meeting of Court outside London organised by the Agencies took place in Birmingham in 1999. Since then, Court has met in Edinburgh (2000), Leeds (2001), Cardiff (2001) and Liverpool (2002). Members of the MPC also attend these meetings. Court will convene in Nottingham in 2003, and at other regional locations in the future. The formal meeting of Court is supplemented by sessions with local business and government contacts for a two-way exchange of views on recent economic developments.

Agencies also arrange visits for staff from Head Office. Agency offices plan programmes for the visitors, giving them the opportunity to meet contacts and to improve their appreciation of regional and sectoral economic conditions from a business perspective.

Representational developments

The Agencies continue to have a high profile externally and in the past five years they have been involved in an increasing amount of representational activity, including speaking engagements and presentations. A major part of Agencies' communications work involves explaining the Bank's monetary policy role. This includes elaborating on the reasons underpinning monetary policy decisions, and the judgments involved. All Agencies now present the details of the Bank's quarterly *Inflation Report* to business audiences in their regions.

These initiatives form part of the Bank's work on building a 'constituency for low inflation'—improving the understanding of how sustainable economic growth depends on maintaining price stability. As part of this initiative the Bank has produced a pamphlet for business people, which outlines the arguments in favour of low inflation. Another key component is a schools competition, Target 2 point 5, which is run jointly with *The Times* newspaper.

Target 2 point 5 schools competition

In the past three years the Agencies have been involved in judging the Bank's schools challenge, Target 2 point 5.

The Challenge attracts entries from over 250 schools from all over the United Kingdom. It requires students to take on the role of the MPC and give a view on the interest rate required to hit the inflation target. The first regional heats take place in November (there were 36 in November 2000 and 40 in 2001 and 2002). These regional heats are judged by the Agent and Deputy Agent from the region, plus a member of staff from the Monetary Analysis area. Following the regional heats, the winners go to the area finals in February, which produce six national finalists. The national final, held at the Bank of England in London, is hosted by Sir Edward George, Governor of the Bank and Chairman of the MPC.

Other representational activity

Agencies have acted as an important conduit for information about the practical implications of the euro for business. The Agencies also undertake work for the

Financial Stability wing of the Bank, for example on sources of funding for small firms and the financing of ethnic-minority-owned firms.

Foreign central banks' interest in Agency work

In recent years several foreign central banks have shown an interest in the work carried out by the Agencies. The Agents have discussed their work and liaised directly with counterparts in other parts of the world, ranging from Europe, North America, former Soviet republics to Australasia. Central banks in several countries have established, or are considering setting up, networks of regional units to gather economic information, quite similar to the Bank of England's Agencies.

A review of the work of the London Foreign Exchange Joint Standing Committee in 2002

This note reviews the work undertaken by the London Foreign Exchange Joint Standing Committee during 2002.

Introduction and overview

The Foreign Exchange Joint Standing Committee (FX JSC) was established in 1973, under the auspices of the Bank of England, as a forum for banks and brokers to discuss broad market issues. The membership of the Committee includes senior staff from many of the major banks operating in the foreign exchange market in London and representatives from brokers, corporate users of the foreign exchange market and the Financial Services Authority (FSA). A list of the members of the Committee, as at end-2002, may be found at the end of this review.

The FX JSC met six times during 2002. During the earlier part of the year, the main focus of the Committee's work was on the formation of an Operations subgroup and contingency planning, while in the latter months of the year it was on the issue of undisclosed principal trading.

Formation of an Operations subgroup

In the aftermath of the terrorist attacks in the United States on 11 September 2001, the FX JSC discussed the lessons to be learnt from the impact on the foreign exchange market of those events. The main conclusion drawn by the FX JSC was the key role played in New York by the Operations Managers Working Group (OMWG)[1] in facilitating the continued operation of the foreign exchange market there. The OMWG enabled effective communication and co-operation between market participants to ensure that payment and settlement problems were resolved quickly and efficiently.

The FX JSC noted at its January 2002 meeting that no similar group existed in the London market that could perform such a role, and furthermore that there was no existing group that met regularly to discuss operational issues in detail. The Committee therefore agreed that an Operations subgroup of the FX JSC should be created, and that it should also cover the international money market, given its synergies with the foreign exchange market.

The Operations subgroup first met on 18 April 2002 and met a further two times during 2002. The subgroup comprises individuals active in the operational areas of banks: its members, as at end-2002, are listed in the annex. As well as examining contingency planning[2] the subgroup can also act as a forum for the discussion of technical operational issues, raising with the FX JSC the potential or actual implications of developments in these operational issues for market practice and, where appropriate, suggest action to improve procedures. In 2002 it considered the following:

● Confirmation processing—contrary to guidance in the Non-Investment Products (NIPs) Code,[3] a number of companies were reported not to be confirming all foreign exchange trades. Banks were concerned that this could affect the promptness and accuracy of payment instructions and receipts, and contract enforceability. A particular processing issue was highlighted by losses sustained by Allfirst, a subsidiary of Allied Irish Bank, where it was reported that a contributory factor was a failure to confirm foreign exchange trades.[4] A working group has been formed to

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(1) This is a subgroup of the New York Foreign Exchange Committee. The latter has a similar role to the FX JSC in respect of the New York foreign exchange market.
(2) This issue is discussed in the next section of this review.
(3) This is a code of good market conduct for the sterling, foreign exchange and bullion wholesale deposit markets, and the spot and forward foreign exchange and bullion markets. It can be downloaded from: www.bankofengland.co.uk/markets/nipscode.pdf. The FX JSC has responsibility for its maintenance with respect to foreign exchange.
(4) See the 'Ludwig' Report to the Board of Allied Irish Banks Plc concerning currency losses, page 15 E.1. It can be downloaded from www.aibgroup.com ('Press Office' and search for 'Ludwig report').

produce a statement of good practice; it will liaise with other international foreign exchange centres where appropriate.

- Standard Settlement Instructions (SSIs)—there have been discussions about whether to review the current NIPs Code guidance, which is that all SSI changes should be authenticated. At present many firms do not adhere to this guidance, as they notify SSI changes by means of an unauthenticated SWIFT broadcast.

- Continuous Linked Settlement (CLS)[1]—the subgroup agreed to form a working group to look at technical issues relating to good market practice following the launch of Continuous Linked Settlement Bank (CLSB) in September 2002.

For 2003, a priority, in addition to the above, is to enhance liaison and communication with other similar groups. One member of the FX JSC Operations subgroup is also a member of the New York OMWG, while the Chairman of the subgroup is also a member of a similar group that meets under the auspices of the European Central Bank.

Contingency planning

During 2002 the FX JSC particularly focused on the issue of contingency planning. Presentations were made to the FX JSC and the Operations subgroup on the work of the resilience and continuity subgroup of the official sector's tripartite Standing Committee on financial stability[2] and on the Financial Sector Continuity web site.[3]

The Operations subgroup is primarily intended to act as a point of co-ordination in the foreign exchange market on operational matters during times of market distress, enabling speedy resolution of settlement problems and, by its actions, ensuring the market continues to operate as effectively as possible. It has therefore focused mainly on the development of a coherent and robust contingency plan for times of severe market distress. This plan covers two broad areas: first, the process and mechanics of invoking an emergency meeting of the group; and second, the output that would be required

once the group had been invoked. The process will involve the holding of regular conference calls, and the establishment of a contingency web site to facilitate information exchange. The Committee agreed to undertake such a test conference call during 2003. The output issue is being considered by a working group set up by the Operations subgroup, which plans to report later in 2003.

Undisclosed principal trading

Undisclosed (or unnamed) principal trading is when a fund manager acts as an agent for clients who do not want their identity disclosed to a third party (usually a bank) with whom the fund manager is trading on their behalf.

In late 2001 a number of banks became concerned about the extent of their exposure to unknown counterparties and so the credit officers from 14 UK banks formed a working group to investigate undisclosed principal trading and to see what action could be taken to end it. They saw it as inherently risky because the third party is unable to quantify accurately the counterparty credit, legal and operational risks in undertaking the trade. In addition, there is the possibility that money-laundering regulations could be contravened.

There are references to undisclosed principal trading in the NIPs Code (section 91), but it does not currently state that trading on this basis is inconsistent with good market practice. Therefore the banks' working group proposed a change to the NIPs Code that would discourage undisclosed principal trading. Under the proposed revised wording, the fund manager would notify the credit and compliance function of the bank counterparty as to the identity of the principal for which it was acting. The front office would be unaware of the principal's identity (a 'Chinese wall' would operate) and this would avoid any market-sensitive information being released.

At its September meeting the Committee concluded that it should undertake a wider consultation exercise with market participants (both banks and fund managers), the Investment Management Association (the fund managers' representative body), and those organisations

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(1) CLS is a payment-versus-payment settlement system for foreign exchange transactions. For more details see *Bank of England Quarterly Bulletin*, Autumn 2002, pages 257–58.
(2) The tripartite Standing Committee on financial stability was set up in 1997 in the Memorandum of Understanding drawn up between the Bank of England, HM Treasury and the FSA. For more details see *Bank of England Quarterly Bulletin*, Winter 2002, page 366 or www.bankofengland.co.uk/financialstability/mou.htm
(3) See www.financialsectorcontinuity.gov.uk

that endorse the NIPs Code[1] to ascertain their views on the proposal. Among the issues raised in the responses were:

- The impact of the proposed rewording on the wholesale deposit market. Such deposits are covered by the NIPs Code, but the risk issues are different: the counterparty credit risk applies only to the undisclosed depositor (rather than the bank accepting the deposit); and the fund manager is obliged, under anti-money laundering regulations, to have carried out the necessary 'know your customer' checks. Hence there was no desire on the part of banks to seek disclosure of the identity of the undisclosed depositor. Therefore the FX JSC felt that the proposed change to the NIPs Code, if approved, should exclude wholesale deposits.

- The interaction of the NIPs Code with FSA regulations. The FSA reported that, in its view, the current concerns regarding undisclosed principal trading in foreign exchange markets were not replicated in other markets. Therefore FSA-regulated investment products were distinct and separate from foreign exchange products and the NIPs Code was the correct vehicle to implement the proposed change. The NIPs Code links to FSA regulations through the Threshold Conditions for Authorisation, which state that non-compliance with a relevant code of practice may raise issues regarding a firm's integrity and/or competence.

There is an international dimension to the issue because undisclosed trading also occurs in the United States. The New York Foreign Exchange Committee (FXC) sent a letter, signed by all its members, to New York market participants, encouraging the ending of undisclosed trading in New York.[2] Undisclosed trading does not appear to occur in the rest of Europe (except Ireland), because the codified nature of these countries' legal systems effectively prevents the practice, since the fund manager would automatically become the principal in the deal.

The next stage will involve a round table meeting with interested parties to address the technical issues raised. Subject to this ongoing consultation process, it is hoped that the proposed change to the NIPs Code's wording could be implemented by the end of 2003.

E-commerce

During 2002 the Committee discussed developments in e-commerce and their potential impact on the foreign exchange market. The development of internet-based trading platforms had been identified as a driver of continued structural change in the foreign exchange industry. In 2001 the Committee set up a subgroup to undertake a detailed review of e-commerce developments and their effect, if any, on market practice. This group reported at the April 2002 meeting.

- There had been an increase in the number of customers transacting via the multi-bank portals. These are electronic trading platforms, which offer customers foreign currency trade execution with a number of banks providing liquidity, and in many cases straight-through processing of transactions. However, the average deal size remained smaller than in the voice market, reflecting customers' desire to have larger deals managed in a more hands-on fashion. The group noted that e-commerce systems are better positioned to handle smaller, operationally based foreign exchange transactions such as day-to-day cash management or flows relating to trade in goods or services.

- Banks have been able to increase the automation of their internal foreign exchange businesses (and generate operating cost savings) through their participation in multi-bank portals. Automated foreign exchange trading also offers benefits to banks' customers as the costs of trading support are lowered, audit trails improved and operational errors reduced.

- Pricing transparency was already very high in the foreign exchange market and on-line trading continued to improve this, again to the benefit of customers.

(1) The Money Market Liaison Group (MMLG) and the London Bullion Market Association (LBMA) co-ordinate the NIPs Code in their relevant markets, jointly with the FX JSC. The Association of Corporate Treasurers (ACT), the British Bankers' Association (BBA), the Building Societies Association (BSA), the Chartered Institute of Public Finance and Accountancy (CIPFA), the London Investment Banking Association (LIBA), and the Wholesale Markets Brokers' Association (WMBA) also endorse the code.
(2) This letter can be downloaded from: www.newyorkfed.org/fxc/2003/fxc030131.pdf

● Finally, larger banks were already offering white-labelled[1] e-trading packages to smaller banks, which is likely to concentrate further the majority of foreign exchange activity into the hands of a small number of global players.

The Committee found the report of interest in outlining a number of new developments, and it agreed that the subgroup would reconvene in 2003, to re-examine any new developments in the e-commerce field. It also agreed that this group would become a standing subgroup of the main Committee.

Continuous Linked Settlement (CLS)

The Continuous Linked Settlement Bank (CLSB) began live operations on 9 September, settling foreign exchange transactions in seven major currencies.[2] The intraday principal exposures entailed in foreign exchange settlement were first highlighted in 1974 by the failure of Bankhaus Herstatt. In a 1996 report prepared by the G10 Committee on Payment and Settlement Systems,[3] central banks set out a remedial strategy, a key component of which was that private-sector groups should provide risk-reducing multi-currency settlement services.

CLSB is the main industry response. It is designed to eliminate foreign exchange settlement risk by settling bought and sold currencies on a 'payment-versus-payment' basis. Settlement members, ie direct shareholders of CLSB, pay in, for each currency, the net amount they owe, according to a fixed timescale. CLSB then settles each foreign exchange transaction on a gross basis during a five-hour window, through accounts held with the respective central banks.

The Committee felt it was difficult at such an early stage to assess what impact CLSB will have on the broad structure of the foreign exchange market. Some members noted a reluctance among third parties[4] to access CLSB at the outset, although their participation was expected to increase. The Committee also felt that the main issues for the foreign exchange market associated with the introduction of CLSB were operational—such as changes to market practice related to making time-specific payments to CLSB—and these could possibly require changes to the NIPs Code. It therefore asked the Operations subgroup to consider these issues, leading the latter to form a working group to do so.

Other issues discussed in 2002

The Committee discussed a number of other issues during the year, including the Bank for International Settlements triennial survey of foreign exchange and over-the-counter derivatives market turnover, and presentations were made on a diverse range of topics, including the work of the Financial Markets Law Committee and 'volatility in the foreign exchange market'.[5]

Looking forward to 2003

Looking ahead to the Committee's work in 2003, most of the themes discussed during 2002 will continue to be active issues in the coming year, most notably the work on undisclosed principal trading and contingency planning. The Committee will aim to progress the development of the Operations, e-commerce and CLS groups and seek to improve liaison with foreign exchange market committees in other international centres.

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(1) White labelling is where a bank provides a trading platform to its client banks. These client banks then provide the platform, branded with their own company identity, to their customers. The customers trade on it, potentially unaware that the client bank is, in fact, channelling liquidity back to the trading-platform owner through a separate trade.
(2) See the *Bank of England Financial Stability Review*, December 2002, pages 82–86.
(3) See www.bis.org/publ/cpss17.htm
(4) These third parties are customers of CLSB settlement members. The third party submits its foreign exchange trades to the settlement member, who then settles these trades for it, all through CLSB.
(5) This was based on a box in the 'Markets and operations' article in the Summer 2002 *Bank of England Quarterly Bulletin*, pages 142–43.

Members of the London Foreign Exchange Joint Standing Committee as at December 2002

Name	Firm/Organisation
Mike Beales	Wholesale Markets Brokers' Association
Michael Brown	Tullett & Tokyo Liberty Plc
Jim Cameron	Banco Popolare di Lodi
Alan Collins	Bank of America
Darren Coote	UBS
Jeff Feig	Citibank
Brian Gracey	Chair, Operations subgroup
Geoff Grant	Goldman Sachs
David Hacon	Financial Services Authority
John Herbert	ICAP Plc
Simon Hills	British Bankers' Association
Jack Jeffery	EBS
Michael Kahn	State Street
Adam Kreysar	Merrill Lynch
Rob Loewy	HSBC Bank Plc
Peter Murray	Morgan Stanley
Peter Nielsen	Royal Bank of Scotland
Ivan Ritossa	Barclays
Jon Simmonds	Credit Agricole Indosuez
Matt Spicer	CSFB
Robert Standing	JPMorgan
Gordon Wallace	Deutsche Bank AG
Brian Welch	The Association of Corporate Treasurers
Paul Fisher (Chairman)*	Bank of England
Andrew Grice (Secretary)	Bank of England

*Clifford Smout was Chairman of the FX JSC until the April 2002 meeting.

Members of the FX JSC Operations subgroup as at December 2002

Name	Firm/Organisation
Paul Brock	Morgan Stanley
Andrew Brown	CSFB
Michael Douglas	Bank of America
John Godfrey	Goldman Sachs
Robert Hadley	ABN Amro
Barry Holland	Barclays
Elaine Kelly	Deutsche Bank AG
Brian Leddy	Mellon Bank
Chris Mann	Bank of England
Leigh Meyer	Citibank
Mike Neale	JPMorganChase
Colin Perry	ICAP Plc
Steve Portway	UBS
Stephen Smit	State Street
Richard White	Royal Bank of Scotland
Brian Gracey (Chairman)	HSBC Bank Plc
Simon Hills (Vice-chairman)	British Bankers' Association
Andrew Grice (Secretary)	Bank of England

Speech at the Chartered Institute of Bankers in Scotland Biennial Dinner[1]

*In this speech, at the Chartered Institute of Bankers in Scotland Dinner, the **Governor** gave a report on the current state of the UK economy. Despite the global economic slowdown, the UK economy had continued to enjoy positive quarter-on-quarter growth. Looking forward, the **Governor** discussed the risks that the global economy may not pick up gradually and the risk of a sudden sharp fall in the rate of growth of consumer spending. He said that such risks needed to be kept in proper perspective, and that these developments are not a necessary—or even the most likely—outcome. The **Governor** concluded that, although he didn't pretend it would be easy, he thought the UK economy could keep moving forward.*

May I begin, Mr President, by thanking you and the members of the Council for your great kindness in conferring the Honorary Fellowship of the Institute on me this evening. I very much appreciate the honour it represents—and it is indeed a great honour for a Sassenach.

But even more than that, for me it symbolises the broader—and very long-standing—fellowship between the Bank of England and the banking community here in Scotland—a fellowship, and indeed a friendship, which I myself have so much enjoyed ever since I first began my regular visits here over 25 years ago. As I move towards my retirement, this evening will serve as an enduring reminder of the warm personal and professional relationships with the bankers in Scotland—including many of you here this evening—that I have been privileged to develop over that time. And I will wear your—in fact I can now say our—splendid new tartan with both pleasure and pride.

This is the fifth occasion in just the past eight years on which I've had the pleasure of giving this biennial report on the state of the UK economy to our Scottish stakeholders. On each previous occasion I have been able to report to you relatively steady growth of overall output, a continuing fall in unemployment and stable low inflation. But I've then gone on to discuss the risks and uncertainties ahead and to worry out loud as to whether or not we could keep it up. On each occasion I have concluded—usually somewhat tentatively—that we could. And indeed we have in the United Kingdom as a

whole, though I have to admit it was a close-run thing last winter in the wake of the unexpectedly sharp economic slowdown that hit the whole of the industrial world from the beginning of 2001.

Despite that global economic shock—which produced near-simultaneous recession in the world's three largest economies, the United States, Japan and Germany—we in the United Kingdom—at the overall, aggregate, level—have now enjoyed continuous quarter-by-quarter growth at an annual average rate of $2^3/_4$% throughout the past ten years. That is far and away the longest period of consecutive quarterly growth since quarterly estimates began nearly 50 years ago—and the annual average growth rate has remained somewhat above most estimates—at least until recently—of the longer-term trend rate of some $2^1/_4$%–$2^1/_2$%. The number of people in employment has recently reached an all-time high in the United Kingdom as a whole; and it is very close to its all-time high also here in Scotland. And the number of people claiming unemployment benefit is at a 27-year low both in the United Kingdom as a whole and, again, up here north of the border. Meanwhile retail price inflation—on the Government's target measure—has averaged 2.5% over the past ten years. That is exactly in line with the present inflation target which recognises that consistently low inflation is a necessary—though not in itself a sufficient—condition for sustainable growth. And that of course is the universal central banker's mantra!

That's the good news. The bad news, of course, is that over the past two years the imbalance within our overall

economy which I referred to when I last spoke to you—between the internationally exposed sectors, including much of manufacturing industry, and more recently some parts of the financial services industry, which have been under intense pressure, and the more domestically oriented sectors, where I don't say things have been easy, but where the pressures have been less severe—has persisted, and indeed it has got worse. The grim fact is that there is nothing that we in the United Kingdom can do directly to address the global economic weakness which has been at the heart of our problem. In order to keep overall demand in the economy moving forward in the face of the slowdown overseas, which has depressed both financial sentiment and business investment in this country, as well as net external demand, we had no choice but to seek to buoy up the other elements of domestic demand. Without that, we too would have seen negative growth in this country.

In terms of monetary policy, that in effect meant cutting interest rates—to 4%, their lowest level for 40 years—in order to sustain the growth of consumer spending. And we were subsequently helped by the Chancellor's decision to increase public spending. That's something that, as a central banker, I'm supposed to frown upon—and it clearly is important for the stability and efficiency of the economy that public spending is kept within bounds over the medium and longer term in line with the Chancellor's Golden Rule. But I must confess to you that it is something that I positively welcomed in the immediate situation with which we were confronted. Without it we would have been even more dependent upon consumer demand than we have been.

In the event, domestic consumption growth has continued to hold up pretty well; but it has done so—inevitably—on the back of a rapid build-up in household indebtedness, including mortgage debt, which in turn was associated with a sharp acceleration in the rate of increase in house prices—to some 25% on average across the United Kingdom over the past year. And that is something that, as we've been pointing out for some time, clearly can't be sustained for ever.

So that's the background against which I turn once again to the question of whether we can continue to maintain reasonably steady growth of output, with high levels of employment and continuing low inflation over the next two years or so.

Now there is no denying that we are—as we always are—faced with significant uncertainties and potential risks in the period ahead, even without the possibility of imminent war with Iraq.

The global economy may not pick up gradually—as we certainly hope that it will—and some real gloomsters still talk of the possibility of a double dip back into recession. Domestically the gloomsters talk of the risk of a sudden sharp fall in the rate of growth in consumer spending—often related to a 'crash' in house prices generally. That's to say not just a sharp moderation in the rate of increase in house prices, but a fall in their actual level generally. And the real pessimists argue that the longer the fall is delayed the more dramatic it will be. Now it is certainly true that, if these risks were to materialise, then we would indeed be hard pressed to keep the economy moving forward.

But such risks need to be kept in proper perspective. The question is: are these possible developments a necessary—or even the most likely—outcome? I don't think that they are.

It's entirely understandable—in the light of the global industrial slowdown and generally weak export markets, and after a third year in a row of sharply falling equity prices, that business and financial market confidence should remain subdued. And people seem sometimes surprised to be told that, on the macroeconomic data, we passed the trough a year or more ago. The US economy, in particular, on which so much of the rest of the world depends, actually expanded by just over 3% in the year to the third quarter of last year—which is well above its long-term annual average rate until the surge in the later 1990s. The euro zone also grew—though only by around 1% over the same period, and there was even positive growth in Japan. Now that's not exactly a strong recovery after the slowdown, but it follows only a relatively mild recession.

More recent data certainly have been somewhat mixed—perhaps reflecting Alan Greenspan's predicted 'soft patch' through the winter; and we're in the shadow of uncertainty over Iraq. But, looking beyond that, the US economy is underpinned by its robust financial system, by continuing rapid underlying productivity growth, and by strongly supportive monetary and fiscal policies, so that most forecasters anticipate US growth of $2^1/_2$%–3% this year and somewhat more next. There's even been a better tone in equity and credit markets since mid-October, and some signs of a recovery in ICT investment.

On that basis—and notwithstanding the recent disappointing performance of the euro-zone (particularly the German) economy—that suggests a reasonable prospect of a continuing but relatively slow pick-up in the rate of growth in our major export markets. And we should also be helped by the recovery of the euro against both sterling and the dollar through the past year.

This moderately positive external environment should, looking forward, bring a gradual pick-up in external demand and help to stabilise, and subsequently improve, the prospects for business investment in the United Kingdom. So the key question on the domestic front remains what is likely to happen to consumer demand: will it fall away abruptly—as some people fear—or will it moderate more gradually as others expect? The truth is that no-one can know the answer with any great confidence—those who claim to know with certainty are always the ones to be wary of in the forecasting business.

Those who look for a sharp downward adjustment typically point to the ratio of household debt to income, and to the ratio of house prices to earnings. They discount the relatively low debt-service to income ratio on the grounds that it could rise sharply if interest rates went up, and ask what might happen if unemployment were to start to rise sharply.

To my mind those arguments have a degree of circularity. The possibility of a sharp rise in unemployment depends substantially on a sharp slowdown in consumer spending rather than the other way round. Similarly a sharp rise in interest rates is less likely if consumer spending is slowing down. So it is not all obvious to me at least that the household sector will suddenly run for cover in the current environment, where the labour market remains remarkably robust, and the prospect for inflation—and hence the prospect for interest rates—remains relatively benign, remaining somewhat above target in the near term but moving down gradually as we move into next year.

I don't say that things could not turn out rather worse than that—and there are other uncertainties, like development of the exchange rate, or the effect of the upcoming increase in National Insurance contributions, which I have not touched upon this evening. Uncertainty is a fact of economic life. But I do say that it would be unwise—as some have implied—to set monetary policy on the basis of the worst possible outcome, even if one knew what that would actually mean in policy terms.

At the time of our latest *Inflation Report* published in November the MPC's collective view of the most likely outcome for the United Kingdom, looking over the next two years, was for growth at around trend with inflation close to target. But we were—and we remain—acutely conscious of the uncertainties and risks around that prospect. And we review the position intensively both at our regular monthly policy meetings and in the context of our quarterly forecasting round. And in that context, I give you my assurance that, despite the fact that we have not changed interest rates now for over a year, we stand ready to do so at any time if and when we see the risks to our central expectation beginning to crystallise in either direction.

Mr President, let me conclude by suggesting once again this year that yes, we can keep the UK economy moving forward, but I don't pretend that it will be easy. Sadly I am attending this dinner for the last time as Governor this evening, so I will not be accountable to you for how we get on. But I leave the Bank of England in good hands.

Economists and the real world

In this speech[1] *to commemorate a century of economics teaching at the London School of Economics (LSE), Charles Bean, Chief Economist, looks at the contribution of economics to the wider world. He argues that economics provides deep insights that transcend those provided by 'common sense', by understanding how agents might change their behaviour in response to an alteration in their environment, and tracking how those changes feed through to the economy. Mr Bean also looks at the contribution of LSE economists to the making of economic policy, including the current inflation-targeting monetary regime. He briefly assesses the performance of the Monetary Policy Committee, noting that while there has been on average a small undershooting of the inflation target, the more interesting feature of the UK economy over this period has really been the unusual overall stability of inflation.*

Good evening. It is a great pleasure to be here to commemorate the 100th birthday of the BSc (Econ) at LSE. Those of you who know a little bit about the history of the LSE might, with reason, be a little puzzled by this as the School was actually founded in 1895 with lectures commencing on the 10th October of that year. In keeping with the Fabian founders' objective of facilitating the improvement of the lot of the working man through education and the pursuit of knowledge, those lectures were scheduled for the evening rather than the day. Fees were set at £3 per year—in relation to earnings, that would be equivalent to around £1,100 in today's money, a curiously familiar figure, as it is the current annual fee for undergraduate students!

The answer to the puzzle is that though the School from the outset offered a variety of courses within an ambitious three-year programme of study, they led to no qualification and there were no examinations—the latter is a feature I am sure would be of great attraction to today's students! Instead the lectures and classes were intended to be useful to candidates preparing for public professional examinations offered by other bodies, such as the Civil Service, the Council of Legal Education, the Institute of Bankers and the Institute of Actuaries.

But this arrangement did not last long. An 1898 Act of Parliament saw the creation of a federal University of London. In order to give credibility to the activities of the School, Sidney Webb and the first Director, William Hewins, made it their aim to persuade the University to add a Faculty of Economics and Political Science and make the LSE a college of the new University. That was achieved in the spring of 1900, paving the way for the creation of the BSc (Econ) and DSc (Econ) degrees. These were the first university degrees in the country devoted purely to the social sciences. But the need to develop curricula and examination schemes for the new degrees meant that students were not admitted to read for the BSc (Econ) until the 1902–03 Session. So that is why today is the Centenary, rather than 1995–96.

To obtain a degree, that first intake of BSc (Econ) students was expected first to pass an Intermediate Examination—which later metamorphosed into Part I— comprising four subjects: Economics, including economic principles and economic history; British constitution; Mathematics or statistics; and Geography (economic and political, rather than natural). Subsequently they would do courses in Economics; History; Public Administration and Finance; an Essay; and a number of papers specialising in one of: Analytical and descriptive economics; Economic history; Political thought; Public administration; Banking and currency; International trade; Transport; Insurance; Statistics and demography.

That is a surprisingly modern-sounding list, and one that is not a million miles away from the menu that confronts today's undergraduates—though the content

has certainly moved on a little since! And while subjects such as Sociology, Psychology, and International Relations have been added, that general structure of a broad introductory year across a range of disciplines, followed by progressively greater specialisation in one or two particular fields has remained. And though the BSc (Econ) was replaced in 1992 by new BSc degrees in Economics, Economic History, and the like, much of the essence of the old BSc (Econ) still lives on in the structure of the present degree schemes.

Even at the outset, the BSc (Econ) was never just an economics degree—indeed, economics was itself a broader, if less deep, discipline than today, embracing also politics and moral philosophy as indicated by its older name of Political Economy. And over time the BSc (Econ) embraced progressively more of the emerging fields of social science. But economics has always been very much at the centre of the degree, and it is on economics that I will focus in the remainder of this talk.

Economics and the real world

When Richard Jackman invited me to give this birthday address he suggested that, in addition to saying a few words about the history of the degree, I might also usefully reflect on the contribution of economics, and LSE economists, to the wider world—hardly the narrowest of remits! Now the subject matter of economics is probably of more immediate relevance to the man in the street than that of almost any other social science. Economists study which goods consumers choose to buy and how much labour they choose to supply. They study how much output businesses produce, by what means they produce it, and what price they charge for it. They study how those businesses interact in various market settings, and how they choose to organise themselves. They study how economies grow, what causes inflation and unemployment, and why there are periodic fluctuations in economic activity. And increasingly economists are applying the basic insights of the theory of choice under scarcity to all sorts of problems that one might not think of as being the natural domain of economics, such as marriage and even drug addiction.

I believe economics offers deep insights into these questions and, moreover, that those insights can usefully inform the design of policy and so improve the lot of mankind. But it has to be said that many non-economists, including many politicians, take a

somewhat jaundiced view of the potential contribution of economics. In part that is because the conclusions of economic reasoning often seem to offend common sense. And in part it reflects the supposed tendency of economists to disagree, neatly encapsulated in Winston Churchill's exasperated observation that 'If you put two economists in a room, you will get two different opinions; unless one of them is Lord Keynes, in which case you would invariably get three quite different opinions'.

But 'common sense' is frequently a poor guide to the right answer in economics. While sometimes sufficient for assessing the immediate effect of some change in the economic environment, 'common sense' is often not so helpful at tracing through all the consequential adjustments and interactions in a coherent fashion. As a consequence many 'common-sense' nostrums are often fallacious. Let me cite a few examples to illustrate the point.

Consider first the impact of more immigration. A common belief is that these additional workers will simply displace indigenous employees, raising unemployment. This may indeed be the short-run effect, though as often as not the migration will itself be a response to unfilled job vacancies. But in any case the reduction in labour market tightness will then tend to hold wages lower than they would otherwise have been. That in turn will boost the demand for labour and encourage extra investment. In the long run, output will be higher and, under constant returns to scale, by the same proportion as the increase in the labour force.

As a second, though related, example consider the case of some technological advance that allows a firm, or sector, to produce the same output with less labour. From Ned Ludd onwards, 'common sense' has had it that such technological progress destroys jobs. Now it may indeed lead to immediate job losses in the firm where the advance occurs. But then again it may not, as the lower cost of production also allows the firm to lower its prices and boost the demand for its product. Whether employment rises or falls will then depend on how much the demand for the product is affected by its price. And if overall employment does fall, then the processes described above in relation to immigration will kick in, ensuring that the extra labour is brought back into use.

These are both examples of the 'lump of labour' fallacy— that there is only so much work to go round. Economic

analysis is useful in exposing the forces that ensure this is not, in fact, the case. But they are theoretical arguments—do they hold up in reality? Chart 1 shows that the labour force has doubled since the middle of the nineteenth century, while productivity has risen seven-fold. But Chart 2 shows that these increases in the labour force and productivity have not been associated with any increase in the unemployment rate, which shows marked fluctuations and occasional step changes in level, but no discernible trend to match the ongoing increase in the labour force and productivity.

Chart 1
Labour force and productivity
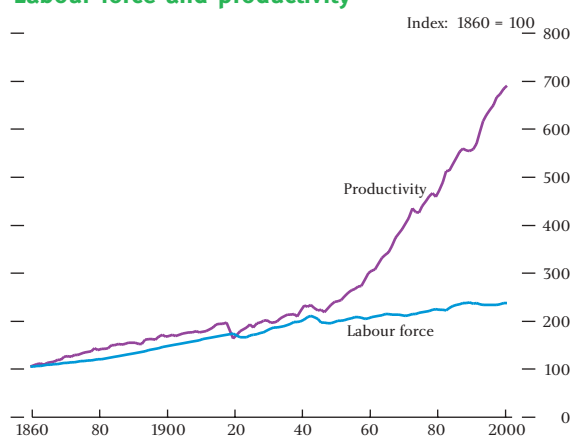
Sources: Mitchell, B R (1988), *British Historical Statistics*, Cambridge University Press and *Economic Trends Annual Supplement*, ONS.

Chart 2
Unemployment rate
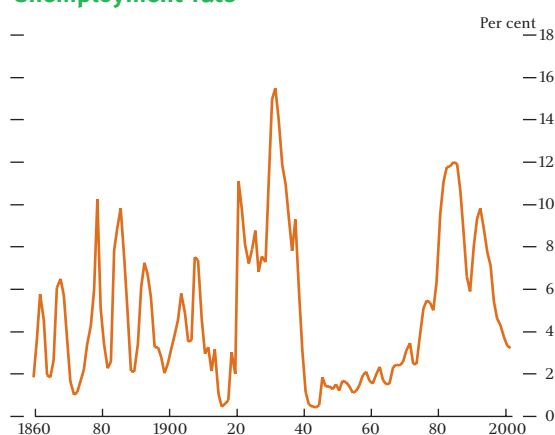
Sources: *The Economist* and ONS.

As another example where 'common sense' can mislead, take the issue of international trade, so much to the fore at present with the debate over globalisation. My colleagues on the MPC and I spend quite a bit of our time meeting with groups of local businessmen through the Bank's network of regional Agents, finding out about life at the sharp end. A common—if slightly caricatured—view we often hear is that international

trade is a zero-sum game and that Britain is losing out because of the shifting of production to China and other low-cost developing countries.

Now as with the earlier examples, there is a germ of truth in the businessman's conventional wisdom. At the level of the individual firm, trade is close to being a zero-sum game. If my foreign competitor wins the orders, then I certainly lose out. But what is true at the level of the individual firm is not true at the level of the economy as a whole. As a nation we gain by importing goods and services that are cheaper than we can make them at home, exporting in return goods and services that are cheaper for us to make. So both our trading partners and we benefit from the extra trading opportunities that international trade brings. At this point the non-economist will often argue that surely we cannot produce anything tradable more cheaply than the Chinese, given their very low labour costs? But in that case all production of tradable goods and services would move to China, precipitating counteracting movements in wages and prices both there and here. The great—and to a non-economist counterintuitive—insight of trade theory is that it is comparative, not absolute, advantage that ends up governing the international pattern of production and that trade is generally beneficial to both parties.

Viewed from this perspective, the displacement of low-cost production to China, Eastern Europe and other low-cost producers, together with the associated decline in the GDP share of manufacturing that is observed in all developed economies (see Chart 3), should be recognised as reflecting the working out of the principle of comparative advantage. Moreover, that is also part of the process whereby living standards in the developing

Chart 3
Manufacturing output share of GDP
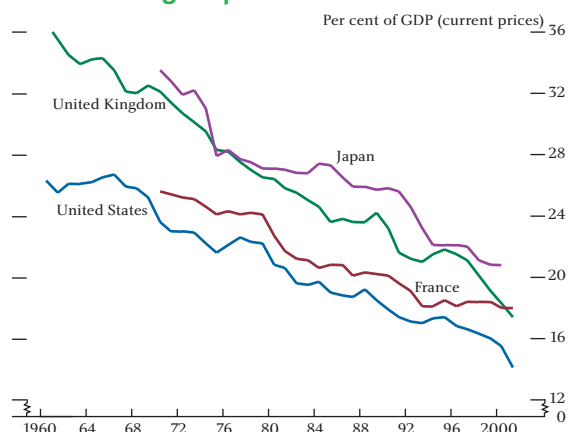
Sources: ONS, OECD, US Bureau of Economic Analysis, Japanese Cabinet Office and Bank of England.

countries rise—all the evidence suggests that international trade is good for growth in living standards, something that many of the critics of globalisation seem to be blithely unaware of.

To be sure, there are important distributional issues that are thrown up by these examples. If migration is concentrated amongst particular skill groups or if technical progress affects the demand for a particular type of labour, then the distribution of wages will be affected. And in the trade example, an economy will concentrate on the production of and trade in goods and services that use the relatively abundant production factor. The returns to those factors that are relatively scarce in a country will then tend to fall in relative terms—at the current juncture that means the wages of the relatively unskilled in the United Kingdom. Indeed, both skill-biased technical change and globalisation are possible explanations for the widening in the distribution of earnings in the United States and the United Kingdom over the past decade or so.

Exposing the fallacy, or at least incompleteness, in the 'common-sense' view of these problems does not involve any great technical firepower. Indeed I would expect anyone who had sat—and passed—a second-year Economic Principles course to be readily able to construct the arguments. And there are many other examples one could give where even quite basic economic analysis points to a different conclusion from that given by 'common sense'. Mostly that is because 'common sense' does not properly take account of the way economic agents adjust their behaviour and how that leads to associated changes in prices and quantities through the market mechanism. It is tracing through these adjustments and seeing how the whole story plays out that economists tend to be better at. And it is because there can be legitimate differences of view about the quantitative importance of the different effects and channels that two economists who share the same analytical apparatus may nevertheless end up disagreeing about the final result. But overall I believe economists have far more in common than Winston Churchill's caricature suggests.

It is this ability to understand how agents might change their behaviour in response to an alteration in their environment, and how those changes feed through the economy that is most valuable when the economist becomes a policy adviser. The first inclination of many policy-makers is often to attack the symptoms of a

problem rather than its underlying causes. The response is frequently to impose controls through legislation, which as often as not may turn out to be counterproductive or else end up having unintended consequences. By asking what the underlying cause is, where the market failure is, and tracing through the full consequences of a policy intervention, economists can guide decision-makers towards the implementation of policies that are both more effective at achieving their intended objective and avoid any associated unintended consequences.

LSE economists and the real world

The LSE has always set great store by the practical aspects of economics. The original 1895 prospectus stated that 'the special aim of the School will be, from the first, the study and investigation of the concrete facts of industrial life and the actual working of economic and political relations as they exist or have existed, in the United Kingdom and in foreign countries'. This emphasis on economics as a practical tool, both to understand and to improve the world, is exemplified by the many faculty members, not to mention alumni, who have played a role at some time in the formulation of public policy here or overseas.

For some it has been by moving out of academia into politics. William Hewins, the first Director and an economist with a bent towards history, became a Conservative MP engaging with the campaign for tariff reform. But perhaps the most notable faculty member who moved into politics was Hugh Dalton. A member of staff for nearly 20 years, he went on to achieve high office as Chancellor of the Exchequer in the post-war Labour government. Some have managed to combine a role in politics with continued activity in academia through their elevation to the House of Lords, including two current members of the department.

But more frequently LSE economists have impacted on policy through their advice. Perhaps the most notable of all was Lionel Robbins. Also a former student, Robbins joined the staff in 1925, rising meteorically to a Chair four years later. As well as being a key influence in the development of economics at LSE during the 1930s, his influence and involvement outside was substantial. In 1930 he was appointed to a Committee of the Economic Advisory Council, chaired by Keynes, whose task was to identify the causes and remedies for the developing slump. Robbins and Keynes had very different views—

Keynes was groping towards the ideas that would be elaborated at length six years later in the *General Theory*, while Robbins with his neo-Austrian approach was instinctively less interventionist. They disagreed in particular over the question of trade protection, leading Robbins to submit a minority Report creating a certain amount of ill feeling.

That disagreement with Keynes subsequently broadened out into a wider intellectual debate over the validity of the Keynesian vision and the relative merits of lower prices and demand management in fighting recessions. While relations with Keynes were frosty during this period, they were later to work together in perfect harmony, first when Robbins joined the Economic Section of the War Cabinet and subsequently when he accompanied Keynes to the Bretton Woods conference that drew up the blueprint for the post-war international financial order. Finally, mention should be made of Robbins's later contribution to education policy in his role as chair of the Committee on Higher Education that paved the way for the great expansion of higher education that took place in the late 60s.

Robbins is not the only policy giant of the 30s and 40s. One must also mention William Beveridge, Director of the School from 1919–37, whose wartime report under the unprepossessing title *Social Insurance and Allied Services* recommended the establishment of a national health service, national insurance and assistance, family allowances, and stressed the importance of full-employment in alleviating want. That report laid the foundations for the post-war welfare state.

As we move into the post-war period, so it has become more common for academic economists to cross the boundary into the provision of policy advice. In a short lecture I cannot hope to do justice to the many LSE faculty members who have contributed to the formulation of economic policy in some way or other. But even in my time at the LSE I can think of members of the department who have been actively involved in such matters as: the design of the tax and social security system; efficiency of delivery in public spending; the organisation and finance of higher education; urban and transport policy; the implementation of competition policy; policies to fight unemployment; reform of the international financial architecture; development policy, often through the auspices of the World Bank; and post-communist economic reform. The list is virtually endless.

Furthermore, the influence of LSE economists on public policy is by no means confined to those who have served as policy-makers or advisers to policy-makers. As Keynes once observed 'practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist'. Those toiling away developing the theoretical and analytical foundations often have a major impact through the way they influence the thinking of other, perhaps more practically oriented, people. Nine economists connected with the department have been awarded the Nobel Prize, and their contributions have profoundly affected the way others approach problems.

Given the range of policy questions to which LSE economists have contributed, rather than try to cover everything, I thought I would do better just to make a few brief remarks relating to some of the contributors in my own field of macroeconomics.

I have already mentioned the LSE versus Cambridge debate about the validity of the Keynesian vision—an exchange in which it has to be said the LSE was on the losing side. In the years after the Second World War the key objective for macroeconomics was the refining of the Keynesian vision. Much of this was conducted in the framework of Hicks's IS-LM apparatus, a distillation of the model of the *General Theory*—Hicks had of course previously also been a member of the LSE staff. But the IS-LM model was incomplete, as it said nothing about the determination of prices. It was that hole that a member of the department, Bill Phillips, plugged with his discovery of an apparent inverse relationship between wage inflation and the level of unemployment (see Chart 4). Though Phillips was not himself engaged in active policy advice to any great extent, his empirical relationship represented a seminal contribution to the conduct of macroeconomic policy. It has also represented the key battleground for controversies over macroeconomic policy since and provides a convenient backdrop against which to describe some of the other LSE contributions in this field.

Phillips's contribution appeared to imply that there was a trade-off between the level of activity and inflation—though it should be said that Phillips's own interpretation was more subtle. Governments could have higher output and lower unemployment if they were prepared to accept higher inflation. To many macroeconomists the broad structure of the macroeconomy had now been been settled and all that

Chart 4
Phillips curve

1880–1913
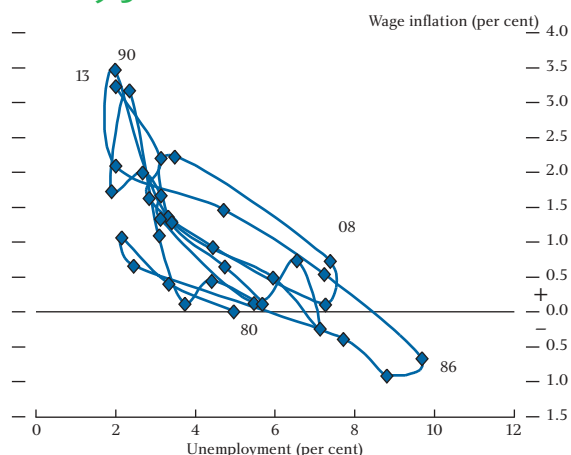
1950–1967

Sources: Crafts, N F R and Mills, T C (1994), 'Trends in real wages in Britain, 1750 to 1913', *Explorations in Economic History*, April, Vol. 31, Issue 2, pages 176–94; Feinstein, C H (1972), *National income, expenditure and output of the United Kingdom, 1855–1965*, Cambridge University Press and *Economic Trends Annual Supplement*, ONS.

was left was to fill in the details. The decade following the publication in 1958 of Phillips's article marked the high point—some would say nadir—of the application of Keynesian fine-tuning to steer the economy.

But a fundamental challenge to this view was brewing, in the person of Milton Friedman. Friedman's 1968 exploration of the analytical foundations of the Phillips relationship cast doubt on the existence of such a long-run trade-off between activity and inflation and indicated that output could rise above its natural rate only for as long as inflation was higher than agents expected. Attempts to exploit the apparent short-run trade-off to raise output above its natural rate would in due course merely lead to that trade-off shifting upwards as expectations adjusted. Moreover, the impact of macroeconomic policy on demand was uncertain in both magnitude and timing, making any attempt to eliminate fluctuations around the natural rate potentially counterproductive. According to his view of the world, the best policy-makers could do was to eschew the fine-tuning of activity and simply keep the money supply growing at a low and steady rate, thus guaranteeing low inflation over the medium term.

While the key players in this monetarist counterrevolution were based at Chicago, Harry Johnson and Alan Walters at LSE both played a significant role in espousing those ideas on this side of the Atlantic. The latter achieved a notable success by correctly predicting that the rapid monetary expansion of 1972–73 under the Barber boom would be associated with a subsequent acceleration in inflation rather than higher activity (see
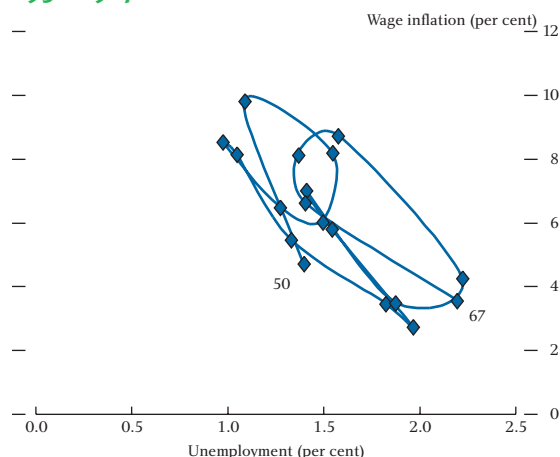
the blue segment in Chart 5). Increasingly, politicians retreated from the Keynesian approach and recognised the importance of monetary control; the adoption of monetary targets by Denis Healey in 1977 being a precursor to the wholesale embrace of monetarist thinking by the Thatcher government. Walters, of course, subsequently became Mrs Thatcher's personal economic guru, and in that role was highly influential, notably in arguing against sterling joining the European Exchange Rate Mechanism.

Chart 5
Phillips curve, 1967–2001
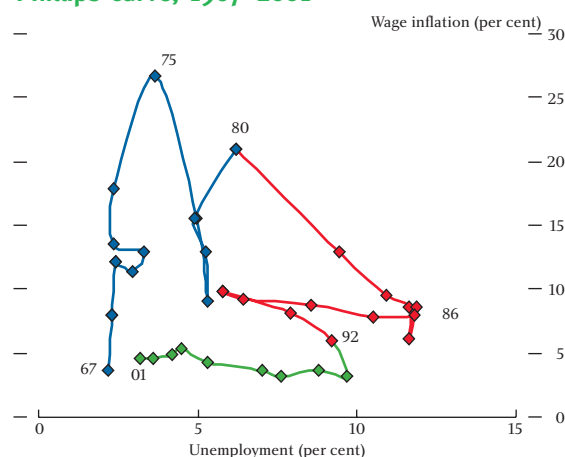
Sources: Crafts, N F R and Mills, T C (1994), 'Trends in real wages in Britain, 1750 to 1913', *Explorations in Economic History*, April, Vol. 31, Issue 2, pages 176–94; Feinstein, C H (1972), *National income, expenditure and output of the United Kingdom, 1855–1965*, Cambridge University Press and *Economic Trends Annual Supplement*, ONS.

The period thereafter was marked by continually rising unemployment in both the United Kingdom and many other European economies (the red segment in Chart 5). In part this was the result of the pursuit of counterinflationary macroeconomic policies, but the

persistence of high unemployment once inflation had stabilised was a puzzle that the monetarist model could not immediately explain. Not only did the short-run trade-off shift up and down as inflation expectations rose and fell, but it also appeared to shift in and out. Richard Layard, Steve Nickell and others at the LSE's Centre for Labour Economics were at the forefront of showing how this was related to the nature of labour market institutions and how temporary shocks could have persistent effects. That contribution has also proved influential in the debate over appropriate policies for the labour market and particularly in the design of Labour's New Deal.

My final episode in the life of the UK Phillips curve concerns the period since Britain's exit from the Exchange Rate Mechanism in 1992 and the subsequent adoption of inflation targeting (the green segment in Chart 5). Recently arrived from LSE, Mervyn King, then the Bank of England's Chief Economist, played a key role in persuading the Treasury of the virtues of an inflation target. And of course since the Bank was given operational responsibility for setting interest rates in 1997, LSE has been strongly represented on the Monetary Policy Committee: no less than six of the 18 people who have sat on the Committee have been members of the department at some time or another.

It is often said that central bank independence is desirable because it takes the politics out of monetary policy. But an equally important feature of the present UK arrangement is, I believe, the extent to which it has also put economics right at the centre of monetary policy. The MPC is a committee composed of economists and economically literate technocrats—to a degree that is probably unique—and I believe that greatly facilitates our deliberations.

When we meet each month to set the official interest rate, we are confronted with masses of economic and survey data, often giving conflicting signals, not to mention a mass of qualitative information from the business contacts of our Agents. The chart pack that we take into the Committee room contains more than a thousand individual data series and charts. Drawing together all this information so as to get a picture of where the economy is, let alone where it is headed, is by no means a straightforward task. Quantitative economic models can help, but need to be accompanied by a lot of independent critical analysis and a good dose of judgment.

There is certainly no guarantee that a committee of economically literate individuals will always get the policy judgment right, but in my view they have a better chance than one composed of individuals with little or no facility in economic analysis. That is particularly so at times of turbulence and great uncertainty like the present, when there is a real premium in being able to separate the substance from the froth.

Has the MPC delivered what it is supposed to? As Chart 6 shows, RPIX inflation has stayed quite close to, though mostly a little below, our mandated target of 2.5% in the period since independence. In the context of past UK inflation performance that is not at all bad, and moreover that has been associated with a growth performance that has for the most part been relatively good compared with the other G7 countries.

Chart 6
RPIX inflation

Source: ONS.

Now it would be unreasonable to expect inflation to be always exactly 2.5%, as there are bound to be unanticipated shocks that we will be unable to offset, or else may choose to accommodate in order to avoid undue volatility in output. But some observers have taken us to task for allowing inflation to persistently undershoot the target in the period since 1999. That undershoot—averaging around $1/2$ percentage point— has certainly not been by design. Each quarter we publish conditional projections for inflation and growth, as a probability distribution or 'fan chart', in our *Inflation Report*. Our mean projection for inflation two years ahead has always been very close to 2.5%, so that our average two-year ahead forecast error has also been about $1/2$ percentage point.

This small, though persistent, undershoot is less significant than it appears. Inflation is a persistent

process—indeed quite close to being a random walk on quarterly data—and it can take a year and a half or so for most of the effect of a change in interest rates to feed through to inflation. The consequence is that, even if our forecasts were optimal and the forecast errors for quarterly inflation random, the prediction errors for annual inflation two years ahead should be highly persistent, as would therefore also be true of the outturns of inflation compared with the target. A report on the Bank's modelling and forecasting activities by Professor Adrian Pagan of the Australian National University that will be published tomorrow includes a simple statistical analysis of our past forecast errors. His analysis suggests about a one in five chance of observing a run of eight consecutive quarters with forecast errors of the same sign even with an optimal forecast. The analysis also implies that just a small bias of 0.02 percentage points in our projection of the quarterly inflation rate would be enough to generate an average undershoot of the magnitude observed.

Of course, that is not to say that we should not try to learn from even relatively small errors. The forecasting error can be traced to the unexpected strength of sterling in the first part of the period and a better-than-expected supply performance thereafter, and the Committee has over time absorbed this into its analysis.

But a more interesting feature, in my view, than the undershoot is the overall stability of inflation over this period, reflected in the apparently very flat Phillips curve over the past decade, and the fact that since independence the Governor has not had to write an Open Letter to the Chancellor, as would have been the case had inflation strayed more than one percentage point from target. An unresolved question is whether this stability, which has coincided with remarkably stable growth, is mainly down to: the change in monetary regime and the associated anchoring of inflationary expectations; structural changes to the economy, including a better functioning labour market, the effects of ICT and enhanced international competition; or just a fortuitous sequence of shocks. That bears on the question of whether we can expect such relative stability to continue in the future or not.

The present environment is a challenging one for the MPC. Against the background of a sharp global downturn, the UK economy has managed to keep growing at only a little below its trend rate. But that has been achieved only through boosting domestic demand—and especially consumer spending—to offset the external weakness. Consequently, beneath the surface, there have been significant and growing divergences between the performance of the tradable and non-tradable sectors of the economy. So long as the global recovery remains patchy it is important that domestic spending remains strong, but eventually spending will need to slow and the associated imbalances unwind. Achieving such a rebalancing smoothly would be quite an achievement, especially against the particular uncertainties posed by the current threat of war in Iraq and the fragility in financial markets.

Beyond these immediate concerns, we and other central banks are grappling with a range of issues concerning the appropriate conduct of monetary policy in a world of low inflation, such as: What role should asset prices and financial imbalances play in the conduct of monetary policy? Is deflation a potential problem and what can policy do about it? And how will the return to a low-inflation environment affect the behaviour of economic agents?

Mervyn King, now the Bank's Governor-designate, once said in a speech from this very spot that his objective was to make monetary policy boring. I do not know whether we have succeeded in that yet, but one thing I can assure you of is that the *making* of monetary policy is certainly not boring. If there is one thing I am sure about, it is that LSE economists will continue to contribute to the making of better monetary policies as much in the next century as they have in the past one. And I am sure that will be equally true of the many other areas of policy-making where economics has so much to offer.

Adjusting to low inflation—issues for policy-makers

In this speech,[1] *Kate Barker*[2] *of the Monetary Policy Committee considers some of the implications for the United Kingdom of the transition to a low-inflation regime. She argues that, in some areas, considerable adjustment has already occurred (financial markets' expectations, firms' target rates of return for investment and the expectations of wage bargainers.) The greater stability of the new regime also implies a permanently higher household debt/income ratio. Even so, for households it is less clear that the implications for prospective pension returns, or for debt repayment in real terms, have been fully assimilated. This implies some risk of a future change in household behaviour as the transition is completed. Of course, these added risks to economic stability will be offset by other changes, such as inflation expectations of companies and of wage bargainers remaining close to the inflation target, and from lower rates of exchange rate pass-through.*

One of the significant factors in economic debate over the past few years is the way in which the United Kingdom's economic history from the early 1970s to the early 1990s is now being put firmly into a broader context. During that period, high (and volatile) inflation was seen in many quarters as the main problem that stood in the way of the United Kingdom achieving greater economic success and in particular achieving lasting reduction in the rate of unemployment. The following quotes capture the flavour:

The Conservative pamphlet 'The Right Approach', from 1977, stated that: 'our prime and overriding objective is to unwind the inflationary coils which have gripped our economy and threaten to throttle the free enterprise system'.

Referring to the end of the 1980s, John Major's views on inflation were just as apocalyptic: 'the principal objective was the destruction of inflation, an insidious demon, always waiting in the wings, that I had every reason to loathe. Inflation is disastrous and morally corrosive, and it destroys lives.' (Major (1999)).

In 2003, the flavour of the debate has changed significantly. This does not refer to the odd (odd in both senses) comment suggesting that perhaps a little

more inflation would actually be welcome. Rather to comments to the effect that low inflation is not by itself a sufficient, or perhaps even adequate, achievement for policy-makers. Something of this sort presumably underlay the recent Treasury Select Committee recommendation that: 'The Treasury and the Bank of England should undertake a joint review of the UK experience of inflation targeting to date…examining its impact on both aggregate and sectoral inflation and growth.' (Treasury Select Committee (2003)).

The results of low inflation?

Overall, it is very clear that there are many benefits from the successful achievement of low and stable inflation, especially in terms of greater macroeconomic stability and improved efficiency. Firms and households are able to plan with greater confidence, and there are efficiency gains from the greater transparency of relative prices. In the Treasury's own description of the new policy framework (see Balls and O'Donnell (2002)), stress is laid not only on these more usually cited benefits, but also on distributional issues: 'the costs to the poor (of high inflation) come from policy fluctuations arising from intermittent and inconsistent attempts to fight inflation, and the fact that inflation is often a reflection of distributional struggles within the economy'.

But any major policy change yields a variety of consequences. The trend of lower and more stable inflation has been established here since the early 1990s, and confidence in the sustainability of this trend has been enhanced by the granting of operational independence to the Monetary Policy Committee in 1997. The chart of the estimated inflation premium in UK long-term interest rates indicates that further improvement to credibility of the commitment to low inflation was recognised quickly by financial markets in 1997 (see Chart 1). However, in the wider economy it is reasonable to suppose that a full appreciation of the implications of this change in policy structure would take rather longer to emerge and therefore the United Kingdom could be regarded as being towards the end of a period of transition to a low-inflation economy. The two main issues raised by this are:

● The process of transition itself leads to a number of questions for policy-makers. There are difficult judgments to be made, about where the new equilibrium levels are for a range of economic indicators and about how quickly this new equilibrium will be reached. In addition, in some cases there may be misperceptions about the implications of the changes in the inflation process, with potentially disruptive adjustments. Inevitably, reaching judgments about what is going on is complicated by other simultaneous changes, now most obviously globalisation pressures and a faster pace of technological development.

● To the extent that high and volatile inflation creates an arbitrary situation of winners and losers, the move away from this regime will mean that those

who were 'winners' will feel their situation to have worsened. It is therefore not surprising, since losers generally tend to be more prominent in debate, that some comments are made which appear to question the benefits of low inflation.

Over the past few years, a range of concerns about the UK economy have been expressed, where at least one of the questions raised above has some relevance. Among them are:

● The risk of a general deflation

● The impact on manufacturing of prolonged deflation in that sector

● A restricted ability of relative wages to adjust, to the extent that zero represents a lower bound on pay settlements

● Lower profitability, as lower inflation improves price transparency and increases competitive pressures

● The decline in annuity rates and in investment returns putting downward pressure on pensions

● A lower household saving rate, as low nominal interest rates are seen as unattractive

● Willingness to take on higher levels of household debt, fostering, *inter alia*, sharp rises in house prices.

Real interest rates and inflation

Whether or not some of the potential changes listed above are actually results of the low-inflation regime turns to some extent on whether or not low inflation also means lower real interest rates. The household saving ratio, for example, might be affected by this. The view that 'it is not worth saving today' would only be true if the return on saving was now lower after adjustment for inflation had been made, rather than just the nominal rate being lower. The Fisher effect suggests that changes in inflation, in the long run, should not have any effect on real interest rates—ie nominal interest rates should adjust to offset any change in inflation. However, the real world may not quite accord with this theory.

Real interest rates, particularly long-term real interest rates, play an important role in the economy. But they are very hard to draw firm conclusions about, as they are imperfectly observable. Even in the United Kingdom,

Chart 1
Total inflation premium expected in ten years' time, United Kingdom 1997

Source: Bank of England.

where the return on indexed bonds can be used as a guide, this is not a perfect measure of real rates due to distortions arising from the tax system and from other factors, such as the impact of the Minimum Funding Requirement on pension funds' bond holdings.

Several of the factors that determine real rates are also hard to fix with much precision. A simple description might be as follows: real rates are driven by the interaction between the supply of funds (savings) and the demand for funds (investment). In turn, saving at any given real interest rate is determined by consumers' rate of time preference (if future income is not valued very highly, then a high interest rate is required to induce savings) and expectations about future labour income. Investment at any given real interest rate is determined by the marginal rate of return on capital projects. So analysis of what drives real rates is inevitably difficult.

In the developed world, with few capital controls, real interest rates are also likely to be determined to some extent by global, rather than purely domestic, factors. In turn, at the global level, there is some evidence for OECD countries that the level of government debt affects real interest rates (for example, Ford and Laxton (1999)), although, unsurprisingly in view of the many uncertainties around this whole topic, this is somewhat controversial. There is, more clearly, evidence that while there may be some global convergence, domestic factors still play a significant role in determining real interest rates (Breedon *et al* (1999)).

In the short term, monetary policy clearly affects real interest rates at least at the short end of the yield curve by moving nominal short rates around the (unobservable and imprecise) natural real rate. However, there is a more structural question about the relationship between the real interest rate and the credibility and success of the monetary policy framework. In looking at the question of how real rates might be affected by monetary regime changes, the focus is on long-term rates (having in mind around a ten-year rate), in order to abstract from the fluctuations of the short rate. Of course these fluctuations will affect long rates also, but to a lesser extent.

Has the low-inflation regime changed UK real interest rates?

While both savings and investment behaviour mainly reflect what might be relatively slow-changing structural features of the economy (the rate of time preference for savings, and capital productivity for investment), the behaviour of both consumers and firms will also be affected by perceptions of risk over rather shorter time horizons. And, as indicated above, UK real interest rates will be affected to some (uncertain) extent by convergence of real interest rates at the global level.

The change to a low-inflation regime might be expected to have the following results which might affect real interest rates:

- For consumers—greater confidence about their future labour income due to the greater stability of the macroeconomy would tend to raise the real rate, as less is saved at any given real rate due to a reduced precautionary demand for saving. On the other hand, consumers are more confident of the real return received from long-term savings, reducing the risk premium on long-term interest rates and lowering the real rate.

- It is equally difficult to be sure about the implications from changes to firms' behaviour. The reduction in volatility of inflation and of output growth should reduce the riskiness of investment, and therefore increase the demand for funds at any given real rate, pushing the real rate up. However, there is a probable countervailing effect from the loss of pricing power as low inflation increases price transparency, reducing the return to capital and lowering the demand for investment funds.

- Some small positive effect on the real interest rate might also be expected from the increased growth rate of the economy resulting from improved allocation of real resources due to the better functioning of the relative price mechanism.

The relative size of all these effects is highly uncertain, and it is therefore unclear in which direction the long-term real interest rate in the United Kingdom might be expected to shift. Interpreting the movements in interest rates over the recent past is unlikely to yield a clear guide, due to two main factors:

- Not all of the adjustments suggested above will occur immediately. The evidence in the response of the long-term bond yield to the announcement of operational independence for the Bank of England (see Chart 1) is that the financial markets'

adjustment was under way very quickly. However, the expectations of consumers and of firms may adjust more slowly (evidence with regard to both of these is discussed below).

● Factors other than the monetary policy regime will also be affecting real rates. These include, most importantly, the path of real global interest rates and the inherent riskiness of investment projects from a microeconomic standpoint. On the latter point, increased intensity of competition and shortening product cycles might lead firms to raise the 'hurdle' rates used in investment appraisal.

Two studies which have looked at the relationship between inflation and interest rates empirically have both concluded that lower inflation is linked to higher real interest rates. One of these reviewed evidence for the United States over the past 100 years (Ahmed and Rogers (2000)). The other looked at structural breaks in real interest rates and mean inflation rates across a range of industrialised countries since 1960 (Rapach and Wohar (2002)). However, given the points about the problems of observation already made (and reinforced below) these cannot be regarded as conclusive.

Recent history of real rates

The recent history of real interest rates might provide some pointers in terms of trying to understand how the transition to a low-inflation environment is affecting behaviour now in the UK economy, and what further changes might be expected. Chart 2 shows real long-term (ten-year) rates since 1960 in the United Kingdom, the United States and Germany. The difficulty

Chart 2
Real long-term interest rates
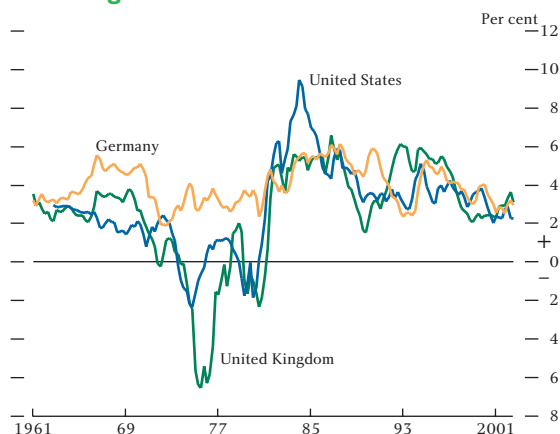
Sources: Federal Reserve, IMF, OECD, ONS and Statistisches Bundesamt.

that real rates depend critically on unobservable inflation expectations has been ameliorated in part by the introduction of index-linked bonds in the United Kingdom in 1981, and in the United States in 1987. This enables better (but not perfect, as discussed above) estimates to be arrived at for the recent past. However, for this longer period the real rates below are derived simply using a nine-quarter moving average of actual inflation rates (centered except for the past few observations).

The picture for the United Kingdom and the United States is broadly similar. During the 1960s, rates were around 2%–4% and showed no clear trend. In the 1970s, real rates, at least measured in this way, became much more volatile, with the periods of unanticipated inflation around the two oil shocks resulting in negative real interest rates (it is possible that, had index-linked bonds existed at that time, these very pronounced negative rates would be seen to reflect mismeasurement to some extent). In the early 1980s, real rates rose sharply in both countries, though more markedly in the United States, taking the level above that generally prevailing in the 1960s. More recently, in both countries there has been some downward drift in the real rate since the mid-1990s.

In Germany the past 40 years have seen less volatility of real rates, with a much less marked fall in rates in the 1970s. Real rates were generally much higher than in the United States and the United Kingdom in the 1960s and 1970s, but in the past two decades the three rates have moved closer together, and the UK and German long rates in particular have begun to move in a more similar fashion. Taking a big picture viewpoint, the pattern of apparently very low real rates in the 1970s being followed by a pick-up and then a tailing off in the 1990s was also seen in other major industrialised countries.

So while it might be concluded that the improved credibility in the United Kingdom may have reduced real long-term rates modestly, some of the recent fall probably reflects broader factors, possibly including the reduction in net government debt across the OECD in the late 1990s. It is likely that some of the fall in real rates will prove to be permanent, rather than cyclical, and even a small change could be expected to have sizable effects on long-term financial contracts. The remainder of this paper looks at what kind of changes, in terms of the issues mentioned at the start of the paper,

could be expected from the shift to lower inflation and, to the extent this proves durable, lower real interest rates.

The risk of deflation

Concern about deflation has risen up the list of economic worries over the past year or so, sparked both by the continuation of very weak economic outturns in Japan and by the fear that the present world slowdown will prove very prolonged due to structural weaknesses. A generalised deflation that resulted from a loss of confidence would of course be undesirable and, if sustained for any period, would damage growth and confidence over several years. In my view, this sort of deflation is unlikely to appear in the near term either in any other major developed economy, or as a more general developed country deflation. Equally, neither risk can be dismissed entirely.

For most countries, it is fairly easy to produce plausible reasons why an outturn similar to the Japanese situation is very unlikely. The institutional factors, and the probable policy reaction functions elsewhere are more robust and flexible, making it more likely that deflation could be avoided and less likely that it would prove prolonged if it were to arise as a result of a major unexpected adverse shock. In the United Kingdom in particular, as has been frequently pointed out, the present high level of employment and service price inflation running at 4.8% suggest that an economy-wide deflation is ruled out in the foreseeable future.

However, the situation in Germany is somewhat different. There, unemployment is presently 8.4% (on the Eurostat definition), inflation is 1.1%, consumer spending was weak through 2002 and consumer confidence is well below the long-term average. Diagnosis of the persistent weakness of domestic demand is not straightforward, but a plausible explanation is that the German economy, still wrestling with the aftermath of reunification, is not competitive within the euro area at the fixed euro parity. With no possibility to adjust the exchange rate or to set an interest rate directly suited to the weak economy, Germany would, on this basis, face a period of painful real wage adjustment. One reason for considering that this process should be undertaken gradually, rather than forced quickly via a tighter fiscal policy, is that in the latter circumstances deflation could become a possibility.

Deflation in manufactured goods

The other source of deflation that has been discussed in the current environment is the present excess of supply over demand, on a worldwide basis, of some major manufactured goods. This has arisen as new supply capacity has been brought on stream at a time of prolonged slow global growth. The consequence, reinforced by technological change, which is also supporting more intense global competition, has been deflation in parts of the manufacturing sector.

With the present inflation target, higher productivity growth in manufacturing than in services is likely to lead to very low inflation in the sector as a whole on a permanent basis, and in some sectors very probably to periods of falling prices. Where this is productivity driven, there is no particular reason for concern. However, for sectors where it is competitive pressure that is driving prices down in the United Kingdom, this creates pressure for nominal cuts in wages (whether this raises a significant problem is discussed further below).

But this sectoral issue certainly does not raise any problems from the macroeconomic standpoint, where the real worry would be about a generalised deflation, most probably resulting from a shortfall in domestic demand. In the United Kingdom, a key reassurance against the dangers of deflation is the symmetric inflation target. This means that the MPC is committed to working to keep inflation at a target high enough to mean that the risk of encountering an economic shock large enough to result in a deflationary spiral is very small. Indeed, a recent ECB working paper on this topic concludes that not only the United Kingdom, but also other regimes with inflation targets are already in a situation where the risk of deflation is given sufficient (or even too much) weight relative to the costs of inflation (Yates (2002)).

Can relative wages adjust sufficiently?

Even if there is little risk to the overall economy from a deflationary spiral, there could be some cost from having a low inflation target if nominal wages are sticky at zero because it is difficult to get workers to accept pay cuts in cash terms. This might lead to real wages overall proving difficult to adjust downward. Also, the labour market would work less well, as there would be a compression of relative wages, compared with the distribution prevailing at higher inflation rates. This would reduce the efficiency of relative wages as a

mechanism for adjusting the labour supply, both overall and between sectors.

However, a recent paper (Nickell and Quintini (2002)) finds, in line with other studies, that in the United Kingdom a considerable proportion of wage-earners does receive annual pay cuts (this proportion ranges up to 20% when inflation is low). Further, the paper concludes that, while there is clear evidence of some bunching of nominal pay changes at zero, this is not sufficiently important to make much difference to the overall functioning of the economy. This suggests that this is not likely to be a particular concern for policy-makers, and implies that the issue of competitive pressure forcing down prices in parts of the manufacturing sector similarly should not raise any issues from the macroeconomic perspective.

Profits and firm behaviour

Over the ten-year period since the United Kingdom adopted inflation targeting, and more noticeably since the shift to the present regime, it is clear that any lingering sense in the business community that higher inflation might not be such a bad thing has been largely dispelled. However, it is easy to understand why it used to exist, which is that, while greater price transparency improves economic efficiency, it also reduces the opportunity for earning excess profits from misperceptions about pricing. But this latter factor is not likely to affect the average profit situation in terms of the average return to capital across the economy, determined much more by capital productivity in the long run and the balance of power in wage-bargaining over the cycle.

In the United Kingdom, the long-run story with regard to profitability is shown in Chart 3. For the manufacturing sector, profitability in the mid-1990s was unusually strong, and the subsequent decline was to a level still above the very low levels of the 1970s. Service sector profitability, for which such a long run of data is not available, shows a broadly similar pattern over recent years but rates of return are consistently higher. As far as manufacturing is concerned, the trend in profits seems related to the swings in the exchange rate, although this is unlikely to have been the only factor. Increased global competition has been a further pressure recently, with global growth below its long-term trend in three of the past five years. It is unfortunately not possible to disentangle the data for profits for the service sector to determine how far the recent

deterioration in services profits is due to tradable services.
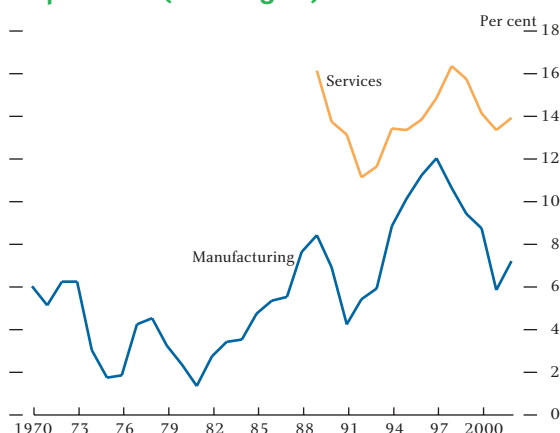
Note: The figure for 2002 is the average of 2002 Q1, Q2 and Q3.

Sources: ONS and Bank of England.

The transitional issue which does arise from the move to a low-inflation/low nominal interest rate environment is that firms may be slow to adjust their required rates of return on projects (hurdle rates), and therefore could underinvest in the early years of a changed regime. But in the United Kingdom at least, the evidence suggests that this has not been a significant factor. The CBI ran two surveys of manufacturing companies' hurdle rates, one in 1994 and one in 2001 (Godden (2001)). Despite a general health warning that these data should not be taken too literally, as in practice firms can deviate from their declared hurdle rates, they provide useful evidence on what adjustment has taken place. In the later survey, nominal hurdle rates had been reduced by over 5 percentage points, compared with a reduction in real hurdle rates of just over 3 percentage points. And a greater proportion of firms using hurdle rates assessed them in real terms, stripping out the impact of economy-wide inflation. For the (generally smaller) firms using the simpler payback criterion, the average had shifted from 2.7 years to 3.6 years. There was some evidence, however, that the adjustment was not complete, as, while 70% of firms had reduced their expected inflation rate, the average expected rate had declined from 4.9% to 3.6%, still above the 2.5% inflation target.

As well as lowering target rates due to lower expected inflation, firms might have been expected to reduce the risk premium on investment projects due to the greater expected stability of the economy. Indeed, the fact that

real hurdle rates have fallen, and that nominal hurdle rates declined by more than inflation expectations tentatively suggests that this has occurred to some extent. However, it is important to note that other factors (such as globalisation and shorter product cycles) would tend to discourage any such reduction in risk premia. To the extent that any reaction has occurred, one consequence is that firms might be expected to show a greater willingness to take on debt.

It is difficult to determine directly from the investment data (see Chart 4) whether business investment in the United Kingdom has been unusually weak in a way that might be related to a tardy adjustment of firms' target returns. First, since the move to low inflation the UK economy has not yet experienced a full economic cycle. Second, business investment itself has been affected by a number of other special factors: in particular a speeding-up in the relative decline of investment goods prices, and a surge of ICT investment in the late 1990s (related to the simultaneous arrival of the widespread business usage of the internet, and the concerns over the millennium bug). Business investment has been weak since 2000, falling relative to GDP in both current and constant-price terms. But it seems unlikely, given the evidence cited above, that this has been due to a misperception, or slow adjustment of inflation prospects.

Chart 4
Business investment ratios
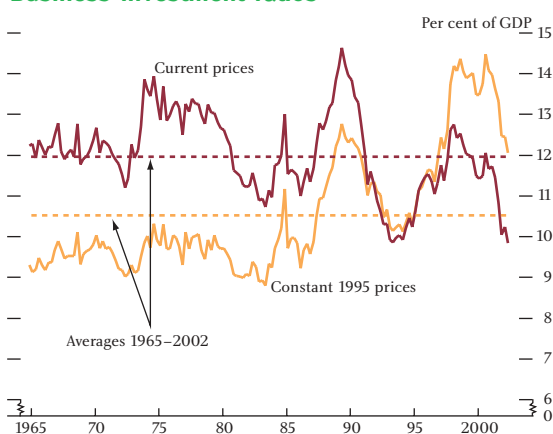
Sources: ONS and Bank of England.

Changes in company behaviour in response to low inflation are also apparent in pricing. Taylor (2000) suggests a decline in the extent to which changes in exchange rates are reflected in consumer prices, which he interprets as a decline in the pricing power of firms. Campa and Goldberg (2002) find that in some countries low inflation has been associated with a fall in the extent

to which changes in exchange rates are reflected in import prices, though this is due in part to changes in the type of good being imported, rather than to low inflation.

So far the possible consequences of a move to low inflation that have been discussed relate mainly to changed behaviour or pressures on firms. It suggests that from a policy perspective none of the potential difficulties—sectoral deflation, real wage adjustment and slow adjustment of investment hurdle rates—have in practice led to any adverse effects in the United Kingdom. More tentatively, it indicates that firms have on the whole adjusted to the changed environment. In addition, some of the changes, for example to the extent that there is less pass-through from exchange rate volatility, may make the task of the policy-maker a little easier.

Impact of low inflation on the personal sector

However, it is households where the concern about a failure to adjust is considered a major issue.

The argument here is that households, while in the short term realising the consequences of low inflation in terms of wage claims, nominal interest rates, etc, have nevertheless failed to understand the longer-term implications of low inflation. In particular, it is argued that prospective real pension payments will be lower than the aspirations of the present working population, while on the other hand household debt will be eroded more slowly than presently expected in real terms. The implication of these misperceptions, if they exist, would be that the household savings ratio is below its equilibrium level, and that households will wish to adjust both this ratio and the debt/income ratio at some future date. Both of these would result in a period of below trend personal spending, and in the case of the debt/income ratio in particular there is a fear of an abrupt adjustment if there were an adverse shock to the household sector, such as a rapid rise in unemployment.

What is the evidence that households are in fact making either of these mistakes?

Is pension saving inadequate?

Chart 5 shows that household savings are indeed lower, relative to income, than the long-term average, although the ratio has been fairly stable over the past couple of

years. However, in inflation-adjusted terms, taking account of the fact that less saving is needed to maintain the real value of financial assets, the ratio is not particularly low (though it is difficult to take full account of the divergent changes in equity prices and house prices in this assessment).

Chart 5
Household saving ratios
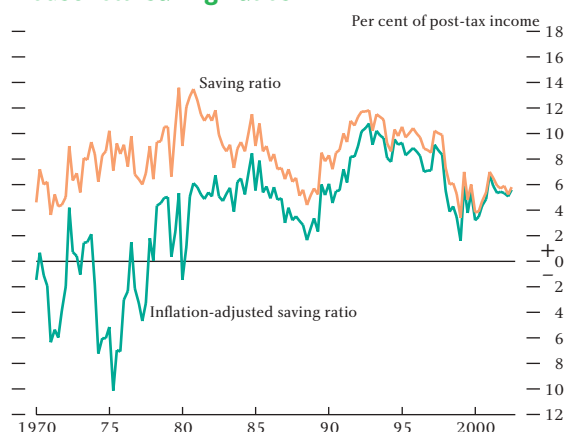
Sources: ONS and Bank of England.

A number of factors suggest that the savings ratio ought to have risen in recent years, if individuals are to attain the same replacement ratio of income in retirement as that enjoyed by the most recent cohort of retirees. The most obvious of these is lower mortality rates, but any fall in real long-term bond rates would also add to pressure for higher saving.

However, in practice the situation is more complicated than that:

- First, for some households towards the bottom of the income distribution the Minimum Income Guarantee, which effectively sets a floor to income in retirement, may actually have made savings less worthwhile.

- Second, a large number of households have been benefiting from the big rise in house prices, and the impact of this on household balance sheets has only recently been offset by the falls in equity values. Many may be intending to downsize their house on retirement, and would therefore regard themselves as having an offset to the lower expected income from pension savings through real asset acquisition. However, this is not going to apply to the less well-off, and there is a significant proportion of households who will not benefit from this effect.

- Third, households may never have counted on being able to enjoy the very high returns on pension savings that those retiring over the past decade or so have experienced. Perceptions of what might be expected from pension savings are generally obscured for individuals by the wide range of experiences among retirees, depending on number of jobs held, type of scheme, and other factors.

- Fourth, to the extent that there is realisation of disappointment relative to previous expectations, individuals may now implicitly be thinking of retiring a little later, rather than reducing consumption today.

So, while it is very likely that there are many individuals who do have an unrealistic view of their pension prospects, it is not obvious that this has become more widespread. Studies of the so-called savings shortfall have been based on specific views of desired income in retirement which may or may not be correct. We will have to await the outcome of the enquiry into this topic by the newly appointed independent pensions commission to get a better understanding of just how significant this problem really is.

A further source of perceived concern is over annuity rates. Here the big picture is of course that annuity rates have declined over the past ten years, primarily reflecting lower long-term interest rates. A recent study (Cannon and Tonks (2002)) concluded first that annuity rates, while below the unusual peaks of the early 1990s, were still good value in terms of the net present value of the annuity, relative to the average of the past 30 years. The early 1990s, being followed by an unexpected and persistent fall in inflation, offered purchasers of level annuities unusually good value. However, the study's second conclusion, that low annuity rates did not matter due to the steep rise in the value of pension funds, looks less convincing following the recent further declines in equity markets.

So as far as pensions are concerned, the move to low inflation may, via any reduction in long rates, prove to be a further factor making the acquisition of pension rights more costly. By itself, however, it has not made annuities poor value, but the comparison with the unexpectedly good value of annuities over the previous few years has given rise to this perception. Nevertheless, there would be distributional consequences from any sustained trend to lower investment returns.

Is the consumer overborrowed?

It is certainly the case that the debt/income ratio (see Chart 6) has been rising rapidly for UK consumers in recent years, and is now over 120%. Capital gearing has now reached around 19% (see Chart 7). The debt/income ratio is now relatively high in the United Kingdom by international standards, although a similar rise in the ratio has also been seen in the United States. But this fact cannot be used to assert that the ratio in the United Kingdom must have gone too far—it is notable that in the Netherlands the debt/income ratio is now around 190%.

Chart 6
UK household sector debt as a percentage of post-tax income(a)
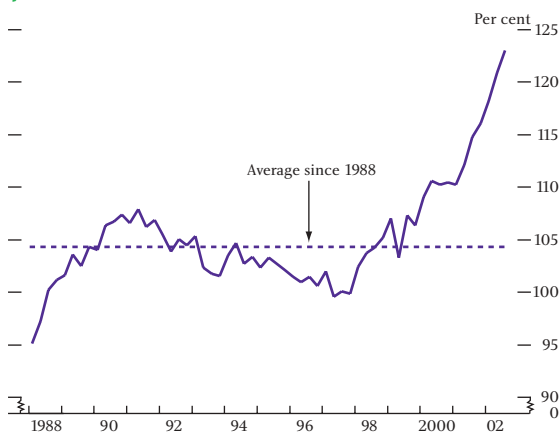
Sources: ONS and Bank of England.

(a) Debt is total liabilities.

Chart 7
Household sector gearing
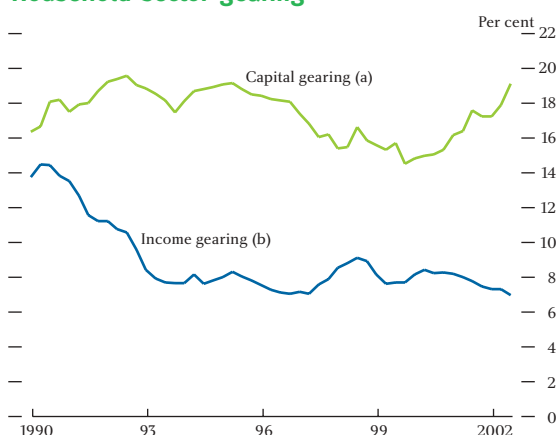
Sources: ONS and Bank of England.

(a) Capital gearing is the ratio of household debt to net total wealth.
(b) Income gearing is the ratio of household interest payments to post-tax income.

A shift towards a higher level of consumer debt would be expected in the changed economic circumstances, due in part to less front-loading of the mortgage debt burden, which has reduced credit constraints for

borrowers. (Less 'front-loading' refers to the fact that lower interest rates mean that payments on a loan are initially less burdensome, relative to income, although as the real burden of debt is eroded less quickly, payments later on will be higher than under high inflation.) In addition, it is likely that changes in the perceived risk of unemployment will have encouraged a higher level of debt. Flows into unemployment have been gradually declining since 1993, and in addition there may be a perception that it is easier to find another job (although the effect of the New Deal makes it difficult to substantiate this from looking at data on unemployment duration).

However, while this should improve confidence in the ability of a household to maintain income, it is unclear whether the greater chance of re-entering employment also implies that income is easily restored to the previous level. A study in the late 1990s (Gregg, Knight and Wadsworth (1999)) indicated that in the mid-1990s the cost of job loss was highest for older workers and for those with low educational qualifications, and that on average displaced workers re-entered the labour market into jobs paying 10% less than their previous employment. While this suggests that there is a cost to being made unemployed, the low level of interest payments, relative to income, at present implies that this decline in wages would not necessarily lead to default as interest payments are less likely to become an intolerable burden.

The present combination of a firm commitment to low inflation and a sustained improvement in the labour market is unprecedented over the past 30 years of the United Kingdom's economic history—a period in which the financial markets have changed very greatly. In these circumstances it is difficult to judge what level of the household debt/income ratio will prove to be sustainable.

In assessing whether it is likely that households have an appreciation of the fact that debt will erode more slowly in real terms, one question is whether individuals' inflation expectations have declined. There are a number of UK surveys on this, of which the Barclays Basix survey (available only up to early 2001) asks about inflation expectations over the next 12, and the next 24 months. The results of this survey (at least with regard to the general public, other groups in the survey produce more reassuring answers from the viewpoint of an MPC member) are perhaps a little surprising (see

Chart 8). There is only a modest downward trend in inflation expectations since 1997, and expectations at the two-year horizon are persistently higher (though the gap has narrowed slightly). In particular, one year ahead inflation expectations in early 2001 remained above 3.5%.

Chart 8
General public inflation expectations

Source: Barclays Bank Basix.

While this suggests there is some way yet to go in embedding the 2.5% target in the public consciousness, equally it does not indicate that there is any expectation of seeing inflation back at the very high levels frequently experienced prior to 1992. And it seems unlikely that inflation expectations will have changed so much over the past year that the inflation outturns we are forecasting for 2003–04, generally a little above the 2.5% target, are so out of line that this would be much of a shock to households. (The Bank of England's survey (conducted by NOP) indicates rather lower inflation expectations than the Barclays Basix survey, although the question asked is not identical. It has however only been conducted since 1999 and does not suggest a very clear trend in inflation expectations.)

Of course, the debt figures for the whole of the household sector conceal a variety of different situations, and some particular groups of households are in situations which look to be a great deal more fragile. But more work needs to be undertaken to uncover exactly what has given rise to the change in debt ratios over recent years (for example, how far student debt has changed the picture) before concluding that, even at a lower level of aggregation, there are problems with debt which would lead to a need for retrenchment with significant macroeconomic consequences.

What are the problems from the recent rise in debt? There seem to be four issues to consider:

- The debt/income ratio cannot rise indefinitely, unless assets also rise relative to income. Over the next two years, slower house price increases may well subdue asset growth, and a reduction in the pace of consumer spending growth is therefore expected to bring it into line with the growth of income. Indeed, the forecast published in the February 2003 *Inflation Report* foresees just such a slowdown.

- Part of the recent growth in debt may prove to have been an overshooting of the desired long-term level of debt, as short-term interest rates have probably now for some time been unusually low, as the MPC has sought to offset the weakness of foreign demand. But it is very difficult at present to distinguish this from simply the upward adjustment of debt in response to the improved medium-term economic environment.

- The acquisition of a higher level of debt by the private sector has been linked with a higher current account deficit. However, although the trade deficit has increased sharply, the rise in the current account deficit has been less severe, and the deficit may decline over the next couple of years as the pace of household expenditure growth fades. But there is some risk of a less easy correction of the deficit, driven by a big fall in the sterling exchange rate.

- The higher debt levels induced by the greater stability of the new regime increase the dangers if, due to a policy error or an external event that is too significant to be offset successfully, there were to be a period in which either unemployment rose rapidly, or interest rates needed to be raised significantly. In either of these situations, households might cut back their expenditure sharply in order to strengthen their balance sheets.

This last point does give rise to some unease for policy-makers in that these bigger risks may exist, and in particular that the cost of a policy error might be greater (despite the evidence that many sectors of the economy may now be well adjusted to the new regime). However, the alternative of not permitting the upward trend in the debt/income ratio (if it is accepted that the bulk of the rise is not due to the present, probably

unusually low rate of interest) would imply restraining growth in the economy (the MPC's subsidiary objective), reducing welfare as well as missing the inflation target. That would have prevented the United Kingdom from reaping one of the very benefits the new regime was intended to bring.

Conclusions

There is, rightly, no serious questioning of low inflation as a goal, and indeed many of its benefits are readily apparent to businesses as they construct their plans. But some of the consequences of the low-inflation regime are starting to become more apparent and have given rise to the expression of a fresh set of concerns. Some of these, however, seem to be overstated, certainly in a UK context where there is at present little risk of a generalised deflation.

Other comments about the impact of low inflation turn on perceptions about what may have happened to real interest rates (for example, concerns about low annuity rates). There is little guide from theory or past experience to whether or not a change to low inflation should be expected to affect real rates. Though the expectation that low inflation may improve growth would suggest a possible rise in real rates, the inflation risk premium, certainly on bonds, is likely to have fallen, and the latter may prove more significant.

Firms and wage bargainers seem, on the available evidence, to have adjusted to the new regime, though surveys of inflation expectations suggest that households may not have completed their adjustment. The key problem for policy-makers is how far households have appreciated the longer-term implications of the new regime, and to what extent they may have adjusted their debt/income ratio up too far because these implications have not been fully grasped.

But a somewhat higher debt/income ratio is to be expected in these changed circumstances, and to resist this adjustment would run the risk of holding down growth unnecessarily. This higher ratio may have increased the risks from policy error, or from an adverse shock to the household sector. But if this adds to the difficulties of policy-makers, it should be remembered, as a counterbalance, that other adjustments to the new low-inflation regime (firmly based inflation expectations by firms and wage bargainers, lower rates of exchange rate pass-through) are important factors adding to the stability of the economy.

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Six months on the MPC: a reflection on monetary policy

In this speech,[1] Marian Bell[2] of the Monetary Policy Committee discusses three current issues in the context of the role and limitations of monetary policy: house prices, discretion and deflation. She suggests that areas such as house prices are not suited to monetary policy control and argues that the degree of discretion offered by the letter-writing process is limited. Deflation, on the other hand, is an area where monetary policy can have an influence. As deflation is a monetary phenomenon, the monetary policy authorities' job is to prevent a pernicious deflation occurring. She notes that with the exception of Japan, broad money growth in the major economies is strong and the risk of deflation is not high currently, but if it should threaten, it is something that policy-makers would respond to.

Thank you for inviting me to speak to you here today. Last week I voted on the appropriate level of UK interest rates for the sixth time since my term on the Monetary Policy Committee began in June. Today I thought I might take the opportunity to reflect on my first six months.

In many ways it is a very technical and narrow job. The monetary policy arena in which policy-makers can have influence, by alterations in interest rates and the quantity of money, is the general price level and its rate of change, ie the rate of inflation. In some respects, the central bank's monetary policy role is even narrower in the United Kingdom than in some other countries because the rate of inflation that the Monetary Policy Committee targets is set, quite properly, by the democratically elected government and not by the Committee itself. The Committee has no discretion over the choice of target. And to avoid any confusion, the government also defines the measure of inflation that is to be targeted. Although the target is confirmed each year by the Chancellor, since its inception in 1997 the Committee has been charged with keeping the inflation rate of the retail price index excluding mortgage interest payments (RPIX) at $2^{1}/_{2}$%: no more, no less. The low and symmetric target indicates that deflation, or falling prices, is as undesirable as significant inflation.

There are lots of things over which monetary policy has no influence. Many that might be judged to come within the economic sphere are outside the realm of monetary policy. To attempt to do more than affect the overall price level would jeopardise the substantial achievements of the inflation-targeting regime which were eloquently set out by Deputy Governor Mervyn King in his recent speech. Monetary policy can do nothing about relative prices. And nor should it. Not only are the limited instruments at the disposal of the authorities unsuited to the task of controlling individual prices, but the central bank should not interfere in market functioning that leads to an efficient allocation of resources. The MPC is not running a command economy. If there are issues of market failure, when the market price is not economically efficient because it does not fully reflect the costs and benefits to society, they can be addressed by the appropriate fiscal, regulatory or other authority, not the monetary authority. The MPC should be only interested in individual prices in the economy to the extent that they affect the overall level of demand and supply, and hence inflation. Where the overall price level is increasing only modestly it is likely that the movements in relative prices one would expect in a dynamic economy will lead to some prices falling.

Monetary policy works via its influence on aggregate demand and, in the long run, it determines only the nominal value of goods and services, that is, the general price level. When inflation expectations are in line with

the target, the role of the MPC is to ensure that monetary policy is set so that demand in the economy is running in line with supply capacity. This will keep inflation constant and avoid unexpected inflation or deflation.

For much of the past two years monetary policy has supported domestic demand to offset weak global economic conditions and keep overall demand growing at a rate consistent with hitting the inflation target. Externally exposed sectors of the economy have done relatively less well and those serving the domestic economy, in particular the UK consumer, have performed rather better. While we recognise that this has been difficult for some sectors, the MPC cannot address sectoral, regional or industrial difficulties without putting achievement of the inflation target in jeopardy.

By the time my appointment to the Committee was announced in April, it appeared likely that this policy of supporting domestic demand would soon have run its course. I expected that, as demand from the external and public sectors picked up, interest rates would have had to be raised to slow consumer spending and keep overall demand growing in line with supply. That did not happen as financial markets and the prospects for the major economies took a turn for the worse in mid to late summer.

Now things look somewhat brighter, leading to a degree of cautious optimism about the future. Financial markets have steadied over the autumn, prospects for world growth have recovered, and the UK economy, having stagnated around the turn of last year, is now growing back at around trend. Excluding the volatile agriculture, mining and utilities sectors, the economy grew by 1.0% in the third quarter of this year, up from 0.3% in the second quarter, and zero in the first. Recent data are likely to have been influenced by the timing of Easter and the two Jubilee Bank Holidays this year, but such an acceleration in growth appears consistent with an improvement in underlying activity.

On the expenditure side, consumers' expenditure has been robust, up 0.8% in the third quarter, in line with high levels of optimism and boosted by strong borrowing. Consumers' confidence in their own financial position is close to record levels while the balance of those considering it a good time to make major purchases has been on a rising trend and in

November was at its highest level since July 1988. Together with rapid growth in borrowing this suggests that the outlook is for spending to remain strong in the near term. Government spending has also been growing strongly, up by 3.2% in the year to the third quarter. Public sector and consumer demand have been more than sufficient to offset the negative impact of falling business investment and net trade, which has made a negative contribution to growth in each of the past six years.

The central projection of the Committee's November *Inflation Report* was for robust consumer demand to push annual GDP growth up to a little above trend in early 2003. Growth then settles back, as a deceleration of household spending offsets a recovery in external demand, higher public expenditure and a modest pick-up in business investment. In the central projection, inflation rises above the 2.5% target by the end of 2002, reflecting the impact of higher oil prices than a year earlier and an unusually high contribution from housing depreciation. It remains at that higher level for most of 2003, and then drops a little below target as those influences unwind, subsequently edging back up to target as the two-year horizon approaches.

Although the central projection of output at trend and inflation close to target is a monetary policy-maker's dream, the reality feels far less comfortable, with significant risks in either direction. In what follows I offer reflections on some current issues that are relevant to the risks in the context of the role and limits of monetary policy.

On deflation

The risk of 'deflation' emerging in several major economies is being widely discussed. With inflation and interest rates low in many economies, we cannot afford to be complacent but must be alive to the downside risks. Indeed in the context of the November *Inflation Report* forecasting round the Committee explored various scenarios that might result in weaker growth and inflation in both the United States and Germany and assessed the likely impact of these scenarios on the United Kingdom over the forecasting horizon. These were described in the risks to the central projection in the November *Inflation Report*.

However, although the Committee will continue to monitor the evolution of the risks going forward, there are several reasons for thinking that some of the worst

case deflation scenarios that some external commentators have painted are not a real prospect, at least not on the basis of currently available information. My colleague on the MPC, Charlie Bean, outlined some in his recent speech to the Emmanuel Society. I would like to add another. First, we should remember that falling prices are not always a bad thing. Sometimes they are the fruit of supply and productivity improvements and lead to an improvement in welfare as real purchasing power is increased. 'Deflation', the possibility of which alarms many commentators, is a more insidious beast where purchases are postponed in anticipation of lower prices; nominal interest rates fall to zero but cannot be reduced below, leaving real rates too high to stimulate demand; and the real value of debt rises, redistributing wealth from debtor to creditor. During such a pernicious deflation nominal demand falls.

Among the major economies, the main historic episodes of pernicious deflation have been the depression of the 1930s and Japan over the past five years, although the former episode was far more pronounced than the latter. In both episodes falling nominal demand was accompanied by and preceded by very weak monetary growth. During the 1920s, from the cyclical economic trough in July 1921 to the peak in August 1929, growth of the US money stock had averaged 4.6% per annum. Policy was tightened in early 1928 in an attempt to curb the strong stock market[1] and from April 1928 the money stock declined. In the five years to April 1933 the stock of both the M1 and M2 monetary aggregates fell by around 30%. In Japan, there was a sharp slowdown in the annual growth rate of broad money (M2 plus CDs) from double-digit rates of growth in 1990 to around zero in 1992, since which time broad money has grown only sluggishly, averaging under 3% per annum.

By contrast, broad money growth in the major economies is currently strong, with the exception of Japan. Indeed, it has risen. Annual IMF data for the advanced economies show broad money growth picking up from 5.1% in 2000 to 8.7% in 2001. US broad money growth slowed significantly in the early Summer of 2002, but is now growing at a three-month annualised rate of around 9%. UK M4 growth has been growing at a three-month annualised rate of around 7% since mid-summer. In the euro zone, the annual growth rate of broad money (M3) has been in excess of 7% in

2002, having picked up substantially in the previous year. It is unlikely that growth rates of this magnitude would be consistent with declining activity in nominal terms unless there was a sharp and very unusual fall in the velocity of circulation of money. Of course that does not rule out falling prices, but these would have to be accompanied by strong real economic growth rates for nominal growth to be positive: a benign rather than malign deflation.

Both in the 1930s' depression[2] and in Japan more recently, weak money growth has been accompanied by a weak banking system and a failure of financial intermediation. During the stock market declines of the summer I was concerned that a similar pattern might emerge elsewhere. I am pleased to say it has not, and there is little sign that it will. There has been no major bank failure and little evidence of constraints on credit growth. UK M4 lending was up nearly 10% in the year to October. Within the total, both the household and corporate components have been accelerating. US credit growth, which had been weak earlier in the year, is now running at a 6% annual rate. Moreover, companies' access to capital markets does not seem to have been impaired by recent developments. Capital issuance by UK companies has been robust. In the third quarter total external finance raised by private non-financial companies was the highest for over a year and monthly data showed a further pick-up in October. To the extent that credit growth has been slow (for instance for US corporate and industrial loans), this appears to reflect weak demand for credit to a greater extent than any supply limitations.

The situation with regard to Germany is a little different, since the German economy constitutes a region of the euro currency area and does not have its own currency. There are several reasons to expect that German inflation will continue to run below that of the euro area as a whole. First, it is possible that Germany entered monetary union with an overvalued real exchange rate *vis-à-vis* its partners and now needs to regain competitiveness. Within the single currency that can only be achieved by lower relative inflation. Second, productivity catch-up will lead to higher inflation in many of the other countries. Since the European Central Bank (ECB) seeks to keep inflation for the euro area as a whole at 2% or lower, in accordance with its definition of price stability, it is therefore possible that

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(1) See Friedman and Schwartz (1963) and Cecchetti (1997).
(2) See Bernanke (1983).

Germany will at times experience periods of very low inflation or even falling prices. However, prices in Germany are unlikely to fall very far without provoking a policy response from the ECB as that would most likely be accompanied by overall euro-area inflation falling well below 2%. Germany has a weight of around 30% within the overall harmonised index of consumer prices (HICP) for the euro zone. For example, if German prices were to fall by 2% a year, the remainder of the euro area would need to be experiencing an average inflation rate of close to 4% in order for overall inflation to register 2%. That would imply an inflation differential between the highest and lowest inflating countries in excess of 6 percentage points. However, research by Canzoneri *et al* cited in Charlie Bean's recent speech, suggests that productivity differences mean that inflation rates for individual countries within the euro area are unlikely to diverge by more than about 2–2.5 percentage points over the medium term. This suggests that a policy response from the ECB should prevent a deflationary spiral developing in Germany.

On house prices

UK house prices have been rising at an extraordinarily rapid rate of late, in the region of 25% to 30% over the past year. The buoyant housing market has had a direct impact on consumer demand and on inflation. Not only has the rising value of housing equity made households feel wealthier and provided an offset to falling share prices, but households' ability to borrow against housing equity more cheaply than via other forms of consumer borrowing has boosted household debt and supported consumption. In the second quarter mortgage equity withdrawal supplemented personal disposable income by around 6%. The annual growth of lending secured on residential property was 12.8% in October, the highest rate since 1990 Q4.

The housing market has been an integral part of the mechanism by which easier monetary policy has boosted consumer demand in the United Kingdom and offset weak growth overseas. It has thus necessarily had an impact on the Committee's decision-making. Developments in the housing market may well continue to be an important factor for some time. The recent rate of increase in house prices is not sustainable and, as house price inflation slows, so too will the boost to consumption from that source, though perhaps with a lag. The Committee's central projection is for house price inflation to slow soon, with prices becoming broadly stable after two years, but there are significant risks. The longer the recent exceptional rate of house price inflation continues, the more abrupt the ultimate slowdown of house prices and consumption might be. But to say that the Committee pays attention to the relationship between the housing market, consumption, borrowing and inflation in reaching its decisions certainly does not mean that it seeks to manage the housing market directly.

I have said that monetary policy has no role with regard to relative price movements, except in so far as they affect overall demand, supply and inflation. But should monetary policy take an interest in house prices that goes beyond this? There are two major problems with seeking to interfere directly in the housing market. The first is that it requires a view on the 'correct' level of house prices and, associated with this, the appropriate level of household debt.

The supply of houses in the United Kingdom has long been constrained by land shortages and planning restrictions, but has recently been growing very slowly, even by UK standards. The number of new homes built in Great Britain in 2001 at 162,000 was at its lowest for 54 years. Excluding the war years and immediate aftermath (1940–47), fewer new homes were built than at any time since 1924. Any increase in demand for housing services will thus push up prices. Demand for housing services is likely to be a positive function of household formation and of income (though whether it moves more or less than proportionately with income is unclear) and a negative function of the cost of housing (affordability). To the extent that it is possible for house owners to extract equity, the demand for housing will also be a positive function of expected future house prices.[1] All of these factors have been supportive of demand. The number of households has increased by 170,000 a year on average over the past ten years. Real after-tax labour incomes have been rising strongly and unemployment has fallen. And it is likely that expected house prices have risen along with actual prices, but, to the extent that houses have been bought on the expectation of future capital gains, prices could be vulnerable to a change in expectations.

Moreover, lower nominal interest rates have reduced the cost of housing services by reducing mortgage

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(1) This could either be because they are owner-occupiers who are trading down or withdrawing equity through borrowing, or are investors able to realise a capital gain.

interest payments. Households' interest payments are currently just over 7% of personal disposable income, less than half that of 1990. To the extent that this reflects lower inflation rather than lower real interest rates, lower real payments now will be followed by higher real payments in the future as the value of future payments is eroded less rapidly by inflation. Chart 1 shows how the real value of payments falls under different inflation rates with a constant real interest rate.

Chart 1
Effect of inflation on real mortgage repayment schedule
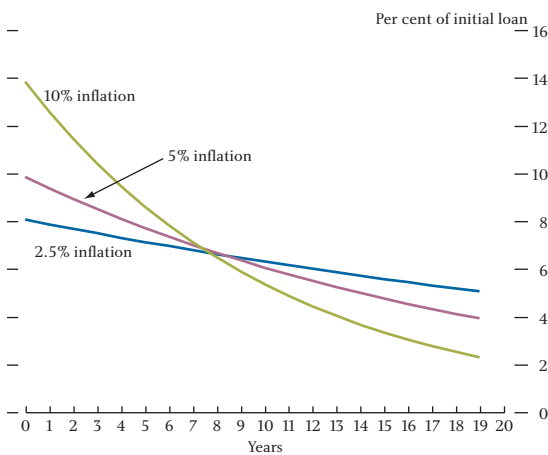
Under which state of the world the consumer will be better off will depend on the rate at which he values current consumption over future consumption, in other words on his own internal rate of discount or time preference. If his real rate of time preference is the same as the real rate of interest on the loan, then he will be indifferent between the different states, as the net present value of his repayment stream will be the same in each case. But if the real rate of time preference is higher than the real rate of interest on the loan, the consumer will be better off with low inflation as the lower early real repayments are more important to him than the higher real repayments later on. In that situation, if the mortgage is flexible, the household may choose to alter its repayments to replicate the repayment schedule of the high-inflation case. However, it may also be rational to take on a larger mortgage until the net present value of interest payments is the same as in the high-inflation case.

Thus, while there are several reasons for thinking that the equilibrium house price might have risen, this is an

area in which there is considerable uncertainty which makes forecasting difficult.

The second problem with seeking to manage house prices is that, even if one had a clear view on the appropriate level of house prices, the MPC only has one instrument (the short-run interest rate). It would be unlikely that the interest rate required to hit the inflation target would be equal to that required to control the housing market. As Cecchetti (1997) said in relation to the focus of US monetary policy on equity prices in 1928–29:

'…if central bankers allow the fluctuations in asset markets to affect their decisions it may distract them from concentrating on some combination of output growth and inflation.'

On discretion

I have commented on the limits of monetary policy. However, there is one area in which the MPC has some degree of discretion. It is the time frame over which the inflation target is to be met. The MPC's remit is to meet the inflation target at all times, but the monetary policy framework enables the MPC to allow inflation to diverge from target in the short term if bringing it back quickly would lead to undesirable volatility in output and inflation. If inflation diverges from target by more than 1 percentage point either way the Governor is required to write a public letter to the Chancellor explaining the reasons for the deviation, what policy action the Committee is taking to deal with it, the period within which inflation is expected to return to target, and how this meets the Bank's remit. The Chancellor's response to the Governor's letter would depend on the merits of the case at the time and on the prevailing economic circumstances.[1]

It has always been envisaged that it would be in the event of a shock to the economy, more usually a supply shock but also possibly a short-lived demand shock, that the policy discretion offered by the letter-writing procedures would come into play. Indeed, it is difficult to envisage circumstances other than a supply shock or a short-lived demand shock in which it might be appropriate for the Committee to accept a significant temporary short-term deviation of inflation from the target of the magnitude that would

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(1) *The inflation target and remit for the Monetary Policy Committee*, HM Treasury, 13 June 1997, available at
www.hm-treasury.gov.uk/documents/uk_economy/monetary_policy/ukecon_mon_remit.cfm

invoke the letter-writing procedure. In particular, to severely undershoot the target could take chances with deflation.

Conclusion

I have described the job of the MPC as a narrow and technical one limited to controlling changes in the overall price level. In particular I have spoken about areas that are not suited to monetary policy control, such as house prices, and I have argued that the degree of discretion offered by the letter-writing process is constrained. I have also discussed deflation. Here my conclusion is rather different. Deflation is a monetary phenomenon and it is quite clearly the job of the monetary policy authorities to prevent a pernicious deflation occurring, for, to use a well-known phrase, 'prevention is better than cure'. I have given reasons for believing the risk of such deflation is not high currently. But rest assured that, should it threaten, deflation is something that the MPC should, can and, I am sure, will do something about.

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House prices, household debt and monetary policy

In this speech,[1] *Stephen Nickell, a member of the Bank's Monetary Policy Committee, addresses the question: should we keep interest rates higher than would be required to hit the inflation target during 2004 in order not to encourage further debt accumulation and increases in house prices? He argues that the right answer to the question is no.*

A key issue in the present conduct of UK monetary policy is the high and unsustainable rate of house price inflation and the build-up of household debt. To quote the October MPC Minutes, the first reason for leaving interest rates unchanged was 'domestic demand was still quite resilient and the economy was growing close to potential. An interest rate reduction seemed likely at present predominantly to affect house prices, household borrowing and consumption, which were already increasing strongly. A further reduction in the repo rate risked creating an unsustainable increase in debt which might subsequently unwind sharply. This would increase the risk of undershooting the inflation target in the medium term'. This argument continues to apply. For example, a typical newspaper comment sets out a somewhat cruder version prior to the December meeting of the MPC: 'The Monetary Policy Committee is expected to decide that the unsustainable house price boom prevents it from cutting rates to help the ailing corporate sector' (*The Independent,* 2 December 2002).

This is an important issue for discussion because the corporate sector is indeed ailing, with business investment having fallen for seven consecutive quarters. More important for an inflation-targeting committee, the latest MPC inflation projection, which, in my view, is based on a slightly optimistic view of the world economy and domestic investment growth, has the most likely path of RPIX inflation slightly below target throughout 2004. The year 2004 is important because interest rate decisions taken now will not affect inflation much until 2004. Given this, if interest rates were cut a little now, the most likely path of RPIX inflation would move up to the target in 2004. In the light of this, it is worth considering in more detail the particular reason quoted above for not cutting rates. First, we look at the summary interpretation implicit in *The Independent* quote. Then, we analyse the more subtle argument contained in the quote from the October Minutes.

Interest rates and the house price boom

House prices in Britain are currently rising extremely rapidly. This house price boom has had, and is having, an impact on monetary policy and interest rates because house prices directly affect consumption and aggregate demand, and hence future inflation prospects. Future inflation prospects have a direct impact on the setting of interest rates. However, the argument implicit in *The Independent* quote goes further than this. The idea is that house price booms are, of themselves, dangerous for macroeconomic stability because the bigger the boom, the bigger the subsequent slump. If policy instruments were available to restrain the boom at an early stage, they should be used in order to encourage future macroeconomic stability. This suggests, for example, that policies to raise the current (historically very low) rate of new house building might be considered. But in the absence of any such policies which will have an impact in the short run, the argument goes that interest rates should be used directly to restrain house price increases on top of their role in hitting the inflation target. This suggests that interest rates during a housing boom should be set at a higher level than is required to hit the inflation target. Indeed, probably considerably higher, if they are to have a significant impact on house price increases.

The general view is that this is not a good idea. The proposition expounded by Bernanke and Gertler

summarises the current consensus, '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' (Bernanke and Gertler (1999, page 115)). The analysis underlying this proposition is clearly set out in any of Bernanke and Gertler (1999), Vickers (1999), Allsopp (2002), King (2002). The basic argument is straightforward. Raising interest rates simply to restrain asset price booms may reduce one of the shocks hitting the economy. But this will be at the probable expense of systematically moving inflation further from target which will add extra instability of its own. Allsopp summarises the situation as follows: 'It is hard enough to establish a credible (monetary policy) reaction function based on clear objectives with the interest rate being used to meet the inflation target … If the interest rate has another role as well, being used to moderate the shock structure (eg by heading off bubbles from time to time), the reaction function is far less rule-like and predictable, and the system is likely to be less transparent and accountable' (Allsopp (2002, page 494)). Furthermore, as King (2002) notes, in practice the response of asset prices to changes in monetary policy is so unpredictable—think of the exchange rate—that targeting asset prices is virtually impossible.

In the current context, keeping interest rates higher than is required to hit the inflation target simply to attempt to restrain the housing boom is not consistent with the consensus view described above. Since I am completely in accord with this view (see Nickell (2002)), it is time to look at the more subtle arguments sketched in the initial quote from the October Minutes.

Sustainability and the growth of domestic demand

Since 1997, UK consumption and domestic demand have been growing faster than output. Basically, this means that we have been increasing our spending on consumption and investment at a more rapid rate than the growth rate of what we produce. So the rest of the world has been supplying us with more than we are supplying them with. The extent of this imbalance since 1999 is illustrated in the table. We can see that on average in the period 1999–2001, consumption grew exactly twice as fast as GDP. The gap between domestic demand growth and GDP growth was a more modest 0.2 percentage points per quarter. In 2002, these gaps have narrowed somewhat.

Average quarterly real growth rates

Per cent

	Consumption	Domestic demand	GDP (market prices)
1999–2001	1.16	0.78	0.58
2002 (first three quarters)	0.87	0.48	0.52

Note: Quarterly growth rates refer to a quarter on the previous quarter.

The first question to ask is whether this is sustainable? If domestic demand grows more rapidly than GDP, there must be a trade deficit. In principle, this can be funded indefinitely if UK citizens have lots of overseas assets generating high levels of interest and dividends, and these substantially exceed the interest and dividends paid out to foreign holders of UK assets. So, to consider sustainability we must add in these income and transfer flows to the trade deficit, the result being the current account deficit. On average, in 1999–2001, this stood at just under 2% of GDP. More recently, in 2002, it stands at around 1.6% of GDP. Is this sustainable?

First, it is worth noting that in the period before domestic demand started growing faster than GDP, we regularly had a current account deficit. In the 25 years from 1970 to 1994, it averaged around 1% of GDP. Second, measures of the current account deficit omit capital gains and losses on asset holdings. According to the current account statistics, the UK external net asset position should have deteriorated in recent years because of the current account deficit. Yet under some measures, there has been no deterioration in the UK external net asset position since 1996 (see Senior and Westwood (2001, page 390)). Since arguably it is this net asset position which ultimately determines sustainability, the current situation in this regard is by no means clear cut.

The upshot of this discussion is that measured current account deficits at the existing level can be sustained for considerable periods without significant adjustments being required. However, a noticeable feature of the numbers presented in the table is the fact that household consumption growth is substantially higher than domestic demand growth, reflecting a 'domestic' imbalance which may, itself, carry some dangers for the future.

Consumption growth, debt and the house price boom

Household consumption was growing at an average rate greater than 4% per annum from 1997 to 2001, far in

excess of GDP growth. While there has been a slight slowdown in 2002, it is still growing at an annualised rate of around 3^1/$_2$%. By contrast, since 1999 the growth of business investment has declined sharply and has been negative since the first quarter of 2001. To understand what is happening, we first take one step back and look at the house price boom.

House prices

House prices are currently rising at an annual rate somewhere between 20% and 30%, depending on which index is used. And they are reaching a level, relative to earnings, which is close to an all-time high. Basically, this is a simple consequence of high demand (low mortgage rates, high rates of population growth, the attractions of buy-to-let relative to equity investments) meeting low supply (the lowest rate of new house building since the Second World War). Particular features of the boom at the moment are the slowdown in house price inflation in London and the South East and the weakening of the London rental market, contrasting with very high rates of house price inflation in northern Britain. Given that London and the South East led the housing market into the boom, they now appear to be leading it out again. However, there is probably some way to go, although in 2003 we expect to see a fairly rapid slowdown in house price inflation across the board. This boom has been, and remains, a significant part of the consumption story as we shall see.

Consumption growth and debt

Why did consumption growth take off in the second half of the 1990s? There appear to be two main reasons. First, over this period there was strong growth in household real disposable income, driven by falling unemployment and substantial improvements in the terms of trade (associated with higher levels of the sterling exchange rate). Insofar as these shifts are gradually taken to be permanent, we should expect to see higher consumption growth over some period, accompanied by a build-up of debt. Furthermore, we would expect this high level of consumption growth to fall back at some point in the future. Of course, if the terms of trade improvements are subsequently reversed

as the sterling exchange rate comes down, we may then see a more rapid slowdown in consumption growth. However, there can be no argument for any pre-emptive moves in monetary policy to deal with the consequence of possible future moves in the exchange rate.

Until 2000, these moves in household consumption growth were supported by the buoyant equity market but, more recently, this has gone into reverse. The second main factor underlying rapid household consumption growth arises from the housing market. The key role that housing plays arises from the use of housing equity as collateral for debt. Suppose you have just bought a house on a 100% mortgage, you have a secure, well-paid, job with rising real earnings. Despite your mortgage, you would like to take on some more debt to purchase durables. Your options are a personal loan at around 10.5% (real rate, 8%) or borrowing on a credit card at around 15.5% (real rate, 13%). These numbers are the current average rates in these categories. Now suppose your property appreciates in value by 50%. You can now take out a loan secured on your property at around 5.5% (real rate, 3%). This enables you to behave as a consumer facing a real borrowing rate of 3% as opposed to a consumer facing a real borrowing rate of 8%. This makes an enormous difference to your behaviour.[1] It will be optimal to consume significantly more and to take on substantially more debt. In fact, this huge difference between the real interest rate payable on secured debt as opposed to unsecured debt will enable house prices to have a substantial impact on consumption, irrespective of the underlying level of interest rates within, say, a 2% band.[2] Of course, lower interest rates help to generate house price increases in the first place. But once new housing equity becomes available, we can expect this to have a significant impact on consumption independently of modest changes in the underlying interest rate.

So what has actually happened in the past few years? First, gross housing wealth has risen substantially relative to household disposable income (around 80 percentage points since 1999). Second, net housing equity (ie, gross housing wealth less secured lending) has risen significantly as a proportion of gross housing

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(1) Consider a consumer who lives for 40 years, with initial real earnings *y* and real earnings growth of 2% per annum. Her preferences are such as to generate a flat consumption profile. If she faces a real interest rate of 8%, she will consume 1.26 *y* in every period and will have accumulated around 1.65 *y* in debt after 10 years. However, if she faces a real interest rate of 3%, she will consume 1.42 *y* in every period and will have accumulated around 3.25 *y* in debt after 10 years.

(2) In footnote 1 we saw that an individual facing a 3% real interest rate compared with one facing an 8% real interest rate will consume around 12.7% more in each period and will have accumulated 1.6 *y* more debt after 10 years, where *y* is the initial income. Now suppose interest rates rise by 2 percentage points. The equivalent numbers for an individual facing a 5% real interest rate compared with one facing a 10% real interest rate are that the former consumes 10.7% more per period and accumulates 1.3 *y* more debt than the latter. So the gap between the two is modified only slightly.

wealth, so it is now nearly 75%. What this means is that there are more households with significant net housing equity and those who initially had net housing equity now have significantly more of it. So many more households now face much lower real borrowing rates, as we noted above. This is on top of the recent cuts in interest rates resulting from monetary policy decisions. The consequence of all this is obviously a significant increase in consumption and household debt as these households avail themselves of their new opportunities. To summarise, therefore, household consumption and debt have risen, first, because of the rise in disposable incomes driven by falling unemployment and a significant improvement in the terms of trade and, second, because the rise in house prices has driven up net housing equity enabling more secured borrowing at real interest rates that are hugely advantageous relative to those available on unsecured loans. Having understood what has been happening, we can now address the dangers inherent in this situation.

The dangers of record levels of household debt

As we have noted in the previous section, in the face of a sharp rise in both household disposable income and net housing equity, there are powerful reasons why rational and sensible households will raise their consumption growth rate and build up debt for a limited period. Further out, of course, they will ease back on consumption growth. What are the dangers for monetary policy makers inherent in this process?

Currently, the situation appears benign. Household income gearing is at a low level and interest rates would have to rise to around 10% if the measure of household income gearing which includes regular repayments is to reach its average value in the early 1990s. Furthermore, mortgage arrears are well below their early 1990s' high and the debt build-up is concentrated in low-risk groups. Those with the highest debt levels have the highest levels of net wealth. But the job of the MPC is to look to the future.

There are two distinct arguments here. The first is based on the possibility that households have overegged the pudding either by underestimating the true real interest rates which they face or by overestimating future nominal income growth. There are two points. In the era of high inflation that ended in 1993, debts were

rapidly eroded. This no longer happens. But the young, who tend to have the highest levels of indebtedness relative to both assets and income, were not financially aware during the high-inflation era. Furthermore, this same group tends to have the fastest rate of real earnings growth.[1] The second point is that the rise in real disposable income growth in the late 1990s, generated by the improvement in the terms of trade, may have been extrapolated into the future, producing overoptimistic forecasts of future real income growth. However, since the terms of trade have improved at a trend rate of only $^1/_2$% per year since 1999 compared with a trend rate of over 2% per year in the three years prior to 1999, it seems unlikely that households will still be projecting the rapid growth rates of the late 1990s. Nevertheless, the risk remains that some borrowers and indeed lenders, are behaving imprudently, and this risk must be thrown into the balance.

The second argument concerns the behaviour of the economy in response to shocks if households have high, as opposed to low, levels of debt. Suppose there is a future adverse shock to the UK economy—for example, the major European economies do not recover? This will lead to a rise in UK unemployment and a fall in consumption whatever the debt levels. The argument here is that higher debt levels will make things substantially worse. This is because more people will be in a position where they are unable to extend their borrowings. If they become unemployed, or are threatened with unemployment, they will significantly reduce consumption because they will be, or will have the prospect of being, unable to service their debts.

The first question is, will higher debt levels put substantially more people in this position? In aggregate, there appears to be 'plenty of room'. Even now, secured debt is only around one quarter of gross housing wealth, a substantially lower level than throughout the 1990s. But the aggregate hides a wide variation across the population and the numbers on the margin are the ones that count. Comfort may perhaps be taken from the fact that data from the Survey of Mortgage Lenders indicate that loan to value ratios among first-time buyers are modest by historical standards. Similarly, the proportion of first-time buyers with loan to value ratios in excess of 95% is also at a relatively low level. Furthermore, there has been a significant demographic shift towards

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(1) Male earnings functions estimated on Labour Force Survey data indicate that, abstracting from the trend growth of real earnings (around 2%), average real earnings growth for those aged between 20 and 30 tends to be around 3% and for those aged between 30 and 40 it is just below 2%.

two-earner households over the past two decades and these households have a greater cushion against unemployment.

Another point worth noting is that because one of the key issues in this argument is the cost of debt service, this will be moderated by the easing of monetary policy following the adverse shock. However, the excessive debt may still induce greater precautionary saving and a larger drop in consumption. Overall, it is hard to quantify whether higher debt levels will generate a significant additional cut-back in consumption that cannot be modified by easier monetary policy.

The final question

The final question is, should we keep interest rates higher than would be required to hit the inflation target during 2004 in order not to encourage further debt accumulation and increases in house prices, because these will add to the risk of sharper falls in consumption, leading to even bigger undershooting of the inflation target further out?

In the October and November MPC meetings, I felt that because of the relatively minor impact on debt and house prices of a small cut in rates and the very uncertain nature of the dangers described above, a judgment based simply on the likely outcomes in the nearer term was the correct one. Since the most likely outcome was for inflation to undershoot the target throughout 2004, albeit by a small margin, I judged that it was better to institute a small cut in rates rather than hold off for fear of exacerbating problems of uncertain magnitude yet further into the future.

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Bank of England speeches

Speeches made by Bank personnel since publication of the previous *Bulletin* are listed below.

Basel II and systemic stability.
Speech by Sir Andrew Large, Deputy Governor, at the British Bankers' Association—Basel II/CAD 3 Conference in London on 13 March 2003. www.bankofengland.co.uk/speeches/speech191.htm

Adjusting to low inflation—issues for policy-makers.
Speech by Kate Barker, member of the Monetary Policy Committee, delivered at the Manchester Statistical Society Meeting in Manchester on 18 February 2003. www.bankofengland.co.uk/speeches/speech190.pdf Reproduced on pages 113–24 of this *Bulletin*.

Economists and the real world.
Speech by Charles Bean, Chief Economist, at a lecture to mark the centenary of the BSc (Econ) at the London School of Economics in London on 29 January 2003. www.bankofengland.co.uk/speeches/speech189.pdf Reproduced on pages 105–12 of this *Bulletin*.

Speech at the Chartered Institute of Bankers in Scotland Biennial Dinner.
Speech by The Rt Hon Sir Edward George, Governor, in Glasgow on 20 January 2003.
www.bankofengland.co.uk/speeches/speech188.htm Reproduced on pages 102–04 of this *Bulletin*.

House prices, household debt and monetary policy.
Speech by Stephen Nickell, member of the Monetary Policy Committee, at a private dinner for Glasgow Agency contacts in Glasgow on Wednesday 11 December 2002.
www.bankofengland.co.uk/speeches/speech187.pdf Reproduced on pages 131–36 of this *Bulletin*.

Six months on the MPC: a reflection on monetary policy.
Speech by Marian Bell, member of the Monetary Policy Committee, to the CBI South East in Crawley, Sussex on Monday 9 December 2002. www.bankofengland.co.uk/speeches/speech186.pdf Reproduced on pages 125–30 of this *Bulletin*.

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138	PPP and the real exchange rate–real interest rate differential puzzle revisited: evidence from non-stationary panel data *(June 2001)*	Georgios E Chortareas Rebecca L Driver
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External MPC Unit discussion papers

The MPC Unit discussion paper series reports on research carried out by, or under supervision of, the external members of the Monetary Policy Committee. Papers are available from the Bank's web site at www.bankofengland.co.uk/mpc/extmpcpaper0000n.pdf (where n refers to the paper number). The following papers have been published recently.

No.	Title	Author
7	The future of macroeconomic policy in the European Union *(February 2002)*	Christopher Allsopp
8	Too much too soon: instability and indeterminacy with forward-looking rules *(March 2002)*	Nicoletta Batini Joseph Pearlman
9	The pricing behaviour of UK firms *(April 2002)*	Nicoletta Batini Brian Jackson Stephen Nickell
10	Macroeconomic policy rules in theory and in practice *(October 2002)*	Christopher Allsopp
11	The exchange rate and inflation in the UK *(October 2002)*	Amit Kara Edward Nelson

Monetary and Financial Statistics

Monetary and Financial Statistics (Bankstats) contains detailed information on money and lending, monetary and financial institutions' balance sheets, analyses of bank deposits and lending, international business of banks, public sector debt, money markets, issues of securities and short-term paper, interest and exchange rates, explanatory notes to tables, and occasional related articles. Bankstats is published quarterly in paper form, priced at £60 per annum in the United Kingdom (four issues). It is also available monthly free of charge from the Bank's web site at: www.bankofengland.co.uk/mfsd/latest.htm

Further details are available from: Daxa Khilosia, Monetary and Financial Statistics Division, Bank of England: telephone 020 7601 5353; fax 020 7601 3208; e-mail daxa.khilosia@bankofengland.co.uk

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
Property prices, measurement and impact: a report on a meeting of the Financial Statistics Users' Group	Andrew Moorhouse Robert Golcher	January 2003	1–3
Compilation methods of the components of broad money and its balance sheet counterparts	Karen Westley Stefan Brunken	October 2002	6–16
Assessing the reliability of monetary statistics	Chris Wright	October 2002	1–5

Financial Stability Review

The *Financial Stability Review* is published twice a year, in June and December. Its purpose is to encourage informed debate on financial stability; survey potential risks to financial stability; and analyse ways to promote and maintain a stable financial system. The Bank of England intends this publication to be read by those who are responsible for, or have interest in, maintaining and promoting financial stability at a national or international level. It is of especial interest to policy-makers in the United Kingdom and abroad; international financial institutions; academics; journalists; market infrastructure providers; and financial market participants. It is available from Financial Stability Review, Bank of England HO-3, Threadneedle Street, London, EC2R 8AH.

Practical issues arising from the euro

This is a series of booklets providing a London perspective on the development of euro-denominated financial markets and the supporting financial infrastructure, and describing the planning and preparation for possible future UK entry. Recent editions have focused on the completion of the transition from the former national currencies to the euro in early 2002, and the lessons that may be drawn from it. Copies are available from Public Enquiries Group, Bank of England, Threadneedle Street, London, EC2R 8AH.

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. An update was published in September 2000 and is available free of charge.

Quarterly Bulletin

The *Quarterly Bulletin* provides regular commentary on market developments and UK monetary policy operations. It also contains research and analysis and reports on a wide range of topical economic and financial issues, both domestic and international.

Back issues of the *Quarterly Bulletin* from 1981 are available for sale. Summary pages of the *Bulletin* from February 1994, giving a brief description of each of the articles, are available on the Bank's web site at www.bankofengland.co.uk/bulletin/index.html

The *Bulletin* is also available from ProQuest Information and Learning: enquiries from customers in Japan and North and South America should be addressed to ProQuest Information and Learning, 300 North Zeeb Road, Ann Arbor, Michigan 48106, United States of America; customers from all other countries should apply to The Quorum, Barnwell Road, Cambridge, CB5 8SW, telephone 01223 215512.

An index of the *Quarterly Bulletin* is also available to customers free of charge. It is produced annually, and lists alphabetically terms used in the *Bulletin* and articles written by named authors.

Bound volumes of the *Quarterly Bulletin* for the period 1960–85 (in reprint form for the period 1960–85) can be obtained from Schmidt Periodicals GmbH, Ortsteil Dettendorf, D-83075 Bad Feilnbach, Germany, at a price of €105 per volume or €2,510 per set.

Inflation Report

The Bank's quarterly *Inflation Report* sets out the detailed economic analysis and inflation projections on which the Bank's Monetary Policy Committee bases its interest rate decisions, and presents an assessment of the prospects for UK inflation over the following two years.

The *Report* starts with an overview of economic developments; this is followed by six sections:

- analysis of money and asset prices;
- analysis of demand;
- analysis of output and supply;
- analysis of costs and prices;
- summary of monetary policy during the quarter; and
- assessment of the medium-term inflation prospects and risks.

The minutes of the meetings of the Bank's Monetary Policy Committee (previously published as part of the *Inflation Report*) now appear as a separate publication on the same day as the *Report*.

Publication dates

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Quarterly Bulletin		*Inflation Report*	
Spring	21 March	February	12 February
Summer	20 June	May	15 May
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