Quarterly Bulletin

Spring 2006

Bank of England

Volume 46 Number 1

Foreword

Every three months, the Bank of England publishes economic research and market reports in its *Quarterly Bulletin*. This quarter, one article reports the key findings from a Bank-commissioned survey on the state of household finances. The *Bulletin* also considers the information on inflation expectations and real interest rates that can now be derived following developments in index-linked financial markets, and reviews the latest movements in sterling and global financial markets.

The household financial position is an important influence on consumer spending. Recently, the Bank commissioned a survey asking households a range of questions about their assets, debts and income — the third on this issue in recent years. The key findings are reported in the article entitled *The distribution of assets, income and liabilities across UK households: results from the 2005 NMG Research survey*, by Richard Barwell, Orla May and Silvia Pezzini.

The survey reveals that a small fraction of households accounted for a large proportion of the total assets owned, debts owed and income earned. The majority of households surveyed reported being comfortable with their financial position. But there were a small proportion of households in the survey who appeared to be in financial distress. These results are similar to those contained in the previous year's survey.

For some time, the Bank has used index-linked financial instruments to derive market-based measures of inflation expectations and real interest rates. But trading in inflation swaps and index-linked bonds has increased rapidly in recent years. As discussed in the article entitled *New information from inflation swaps and index-linked bonds*, by Matthew Hurd and Jon Relleen, there now exists an increasingly liquid global market for such instruments. This facilitates analysis of inflation expectations and real interest rates across countries. In the United Kingdom, the United States and the euro area, index-linked instruments currently appear broadly consistent with each central bank's inflation objective of broad price stability. A downward drift in international long-term real rates has also been apparent over recent years.

The regular *Markets and operations* article describes financial market developments since the previous *Bulletin*. It notes how asset prices across many financial markets have continued to rise during the past three months, with the price of risk remaining unusually low. There was a further decline in long-term government bond yields, driven by declines in global real interest rates. In sterling markets, real rates fell particularly sharply at very long horizons, possibly linked to heightened demand from UK pension funds.

Charles Bean
Chief Economist and Executive Director for Monetary Policy, Bank of England.

This edition of the *Quarterly Bulletin* also includes:

- *Understanding the term structure of swap spreads* (by Fabio Cortes). Market expectations of the future path of interest rates can be derived from both government bond and swap yield curves. But, at times, these can provide different signals about market views. This article investigates the factors that contribute to the gap between government bond rates and swap rates at different maturities;

- *The information content of aggregate data on financial futures positions* (by Caroline Mogford and Darren Pain). This article examines the empirical link between speculative financial futures positions and movements in asset prices; and

- *The forward market for oil* (by Patrick Campbell, Bjorn-Erik Orskaug and Richard Williams). This article explores the working of the forward market for oil and considers why producers have not been hedging more of their future oil production.

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.

Bank of England Quarterly Bulletin

Spring 2006

Recent economic and financial developments

Research and analysis

MPC speeches

The contents page, with links to the articles in PDF, is available at www.bankofengland.co.uk/publications/quarterlybulletin/index.htm.
Authors of articles can be contacted at forename.surname@bankofengland.co.uk.
The speeches contained in the *Bulletin* can be found at www.bankofengland.co.uk/publications/speeches/index.htm.
Except where otherwise stated, the source of the data used in charts and tables is the Bank of England or the Office for National Statistics (ONS) and all data, apart from financial markets data, are seasonally adjusted.

Volume 46 Number 1

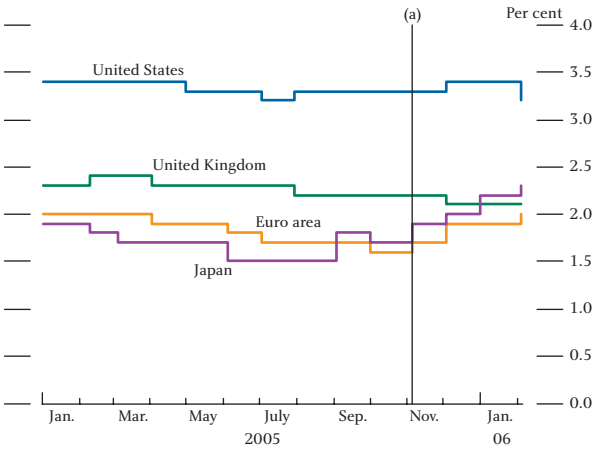
Markets and operations

This article reviews developments since the Winter Quarterly Bulletin *in sterling and global financial markets, in market structure and in the Bank's balance sheet.*(1)

- *Short-term sterling market interest rates fell, while short-term US dollar and yen market rates increased, as market participants revised upwards their expectations for official rates in these currencies.*
- *At longer horizons, real forward interest rates declined across the major currencies. At very long maturities, sterling real forward rates fell by more than rates in other currencies, possibly reflecting heightened demand by UK pension funds to match their expected liabilities with long-dated fixed income assets.*
- *Global equity prices rose and credit spreads narrowed, suggesting that investors' appetite to take risk remained strong.*
- *In January, as a further step towards the planned introduction of reforms to the Bank's operations in the sterling money markets, the Bank began lending using longer-term repos at market-determined interest rates.*

The global economy continued to grow robustly, with upward revisions to forecasters' views on future GDP growth in the euro area and Japan (Chart 1). Against this backdrop, global financial asset prices generally rose (Table A). Credit spreads narrowed, equity indices increased and volatility in many markets remained low.

Chart 1
Expected real GDP growth for 2006



Source: Consensus Economics.

(a) Observations on and to the left of the line were available at the time of previous *Bulletin*.

There was also evidence of market participants looking to invest in a wider range of assets. In particular, there were sizable inflows into commodities and emerging market assets.

Loan markets remained buoyant with companies able to borrow on more favourable terms. Perhaps reflecting this, leveraged buyout activity remained high.

There were some differences in behaviour across investor types over the period. In particular, trustees and corporate sponsors of defined benefit pension funds in the United Kingdom, and to a lesser extent elsewhere, have been looking to match better the characteristics of their assets with their expected liabilities. As a result, these investors may have become more averse to holding risky assets with high and visible short-term price volatility. At the same time, they may have become more willing to accept lower returns on long-dated government bonds, the cash flows on which better match those on their expected liabilities. In turn, this may have contributed to further falls in long-term risk-free interest rates.

(1) The period under review is 18 November 2005 (the data cut-off for the previous *Quarterly Bulletin*) to 17 February 2006.

Table A
Summary of changes in market prices

	18 Nov.	17 Feb.	*Change*
Dec. 2006 three-month interbank interest rates (per cent)			
United Kingdom	4.65	4.47	*-18 bp*
Euro area	3.08	3.06	*-2 bp*
United States	4.81	5.05	*24 bp*
Ten-year nominal forward rates (per cent)(a)			
United Kingdom	4.17	3.94	*-23 bp*
Euro area	4.11	3.91	*-20 bp*
United States	5.03	4.71	*-33 bp*
Equity indices			
FTSE All-Share	2765	2980	*7.8%*
DJ Euro Stoxx	315	351	*11.5%*
S&P 500	1248	1287	*3.1%*
MSCI Emerging Markets (US dollar)	658	779	*18.4%*
Exchange rates			
Sterling effective exchange rate	98.8	98.8	*0.0%*
Euro effective exchange rate	90.5	91.1	*0.7%*
US dollar effective exchange rate	98.7	96.9	*-1.8%*
Yen effective exchange rate	125.2	125.1	*-0.1%*
Global corporate credit spreads (basis points)			
Investment grade	71	67	*-4 bp*
High yield	367	331	*-36 bp*
Emerging market	262	196	*-66 bp*
Commodity prices (US dollars)			
Brent crude oil	53.1	58.2	*9.5%*
Gold (London PM fixing)	486	552	*13.6%*

Columns may not correspond exactly due to rounding.

Sources: Bank of England, Bloomberg and Merrill Lynch.

(a) Three-month forward rates, derived from the Bank's government liability curves. Estimates of the UK curve are published daily on the Bank of England's website at www.bankofengland.co.uk/statistics/yieldcurve/index.htm.

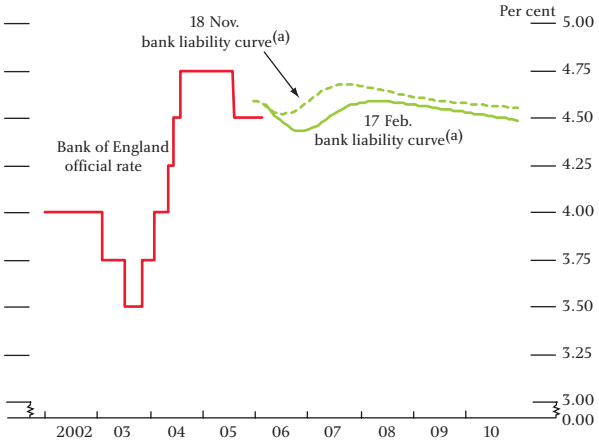
Overall, asset market developments suggested that investors' appetite to take risk had not diminished and that the 'search for yield' remained largely intact.(1) It is possible that, at least in part, the associated falls in term and risk premia on financial assets reflect structural changes, perhaps linked to greater macroeconomic stability. But such developments might also reflect a mispricing of risk. If this is the case, financial markets could remain vulnerable to a correction in asset prices.

Short-term interest rates

As had been widely anticipated, the FOMC increased official US dollar interest rates by 50 basis points, in two 25 basis point moves, continuing the gradual withdrawal of monetary accommodation that began in mid-2004. The ECB also raised its key policy rate by 25 basis points on 1 December, whereas sterling official interest rates remained at 4.5%.

Short-term sterling market interest rates fell over the review period. On 17 February, forward rates implied by market prices were consistent with market participants attaching some probability to a reduction in official rates during 2006 (Chart 2). And according to the Reuters survey of market economists' views (carried out in early February), the majority of economists expected the next move in sterling rates to be down.

Chart 2
Sterling official and forward market interest rates

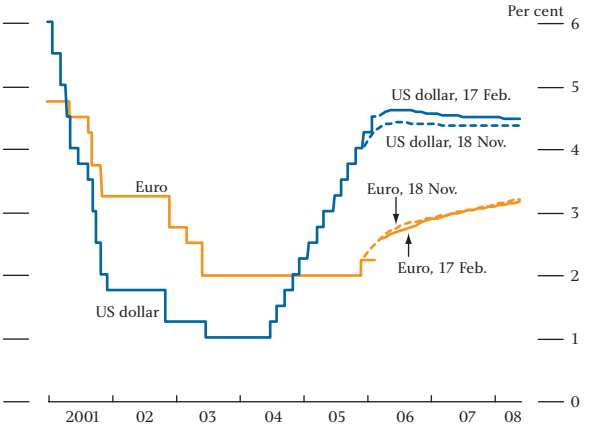


Sources: Bank of England and Bloomberg.

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

Despite a slight slowdown in economic activity in some euro-area countries at the end of last year, euro short-term market interest rates suggested that the ECB was still expected to raise official rates over the next year or so (Chart 3).

Chart 3
Short-term official interest rates and nominal forward rates(a)



Sources: Bank of England and Bloomberg.

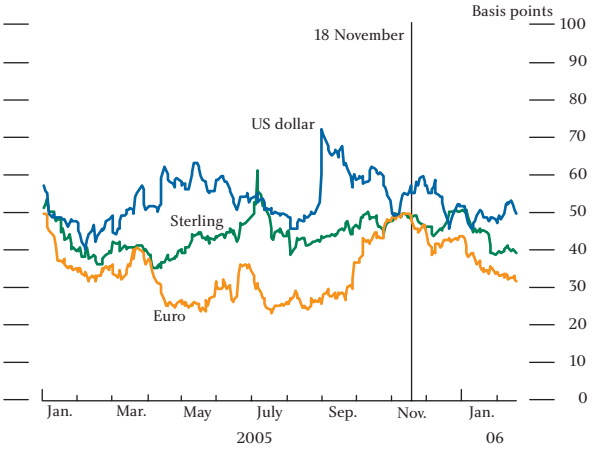
(a) One-day nominal forward rates implied by repo rates and government securities.

US dollar short-term market interest rates increased over the period, as market participants appeared to revise upwards their expectations for near-term policy rates. Most of the revision occurred towards the end of the review period, following slightly stronger-than-expected US economic data.

(1) For further discussion of the 'search for yield' see, for example, the Bank of England's *Financial Stability Review*, December 2005.

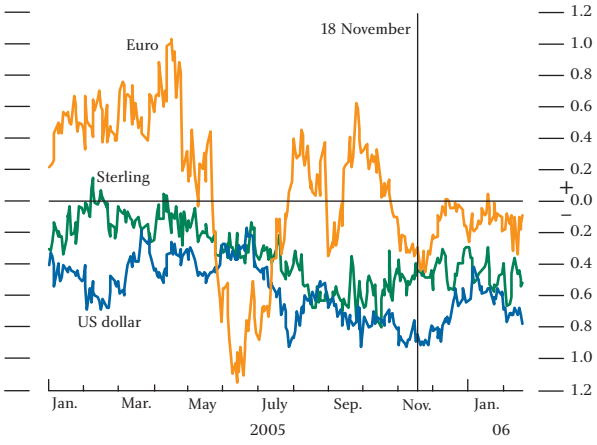
Uncertainty surrounding market participants' expectations for sterling, euro and dollar short-term rates, as measured by implied volatilities on interest rate options, fell slightly over the review period (Chart 4). The implied skew of the distribution of possible interest rate outcomes for near-term sterling, euro and dollar rates remained negative (Chart 5). This suggested that market participants continued to attach a greater probability to a sharp downward move in short-term interest rates than a comparable upward move.

Chart 4
Six-month implied volatility from interest rate options



Sources: Bank of England, Chicago Mercantile Exchange (CME) and Euronext.liffe.

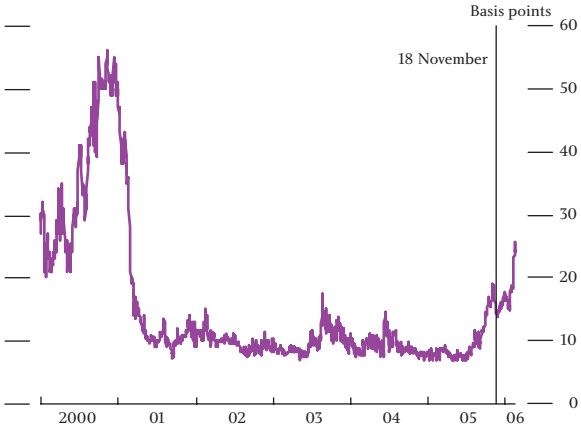
Chart 5
Six-month implied skew from interest rate options



Sources: Bank of England, CME and Euronext.liffe.

Japanese monetary policy did not change over the period. But market speculation grew stronger that the Bank of Japan might be close to ending its 'quantitative easing' policy, which was introduced in March 2001. With signs that the economic recovery in Japan may have become more firmly established and broadly based — real GDP rose in 2005 Q4 for the fourth successive quarter — market expectations of future yen interest rates have increased (Chart 6).

Chart 6
One-year yen swap rate

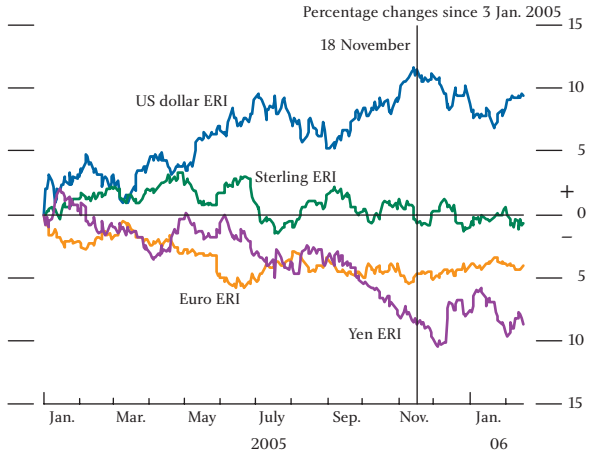


Source: Bloomberg.

Foreign exchange markets

Given these developments in short-term interest rates, changes in the major exchange rate indices were relatively small. The sterling exchange rate index (ERI) was broadly stable over the review period and remained in the relatively narrow range observed throughout 2005 (Chart 7).

Chart 7
Cumulative changes in effective exchange rate indices



The value of the US dollar fell against both sterling and the euro. As a result, over the period as a whole, the dollar ERI fell by around 2%, although it remained around 10% higher than at the start of 2005.

Some of the strength of the US dollar during 2005 may have reflected increases in short-term dollar interest rates relative to interest rates on other currencies.(1) In

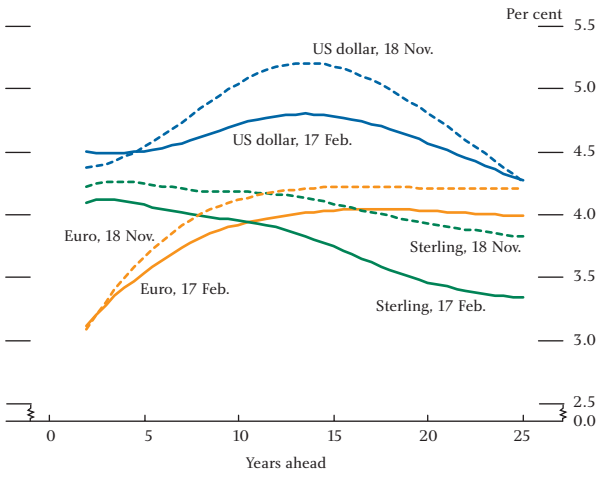
(1) In theory, the uncovered interest parity condition suggests that only *unexpected* movements in dollar interest rates relative to those in other currencies should have influenced the value of the dollar. But, in practice, the rise in short-term US dollar interest rates may have discouraged so-called 'carry trades' funded out of US dollars.

addition, market contacts have suggested that repatriation of funds related to the United States' Homeland Investment Act (HIA) were a factor. But with the deadline for the repatriation of funds under the HIA having drawn closer,(1) and with market participants seemingly perceiving that US dollar official rates may be close to their local peak, some commentators have suggested that these factors may provide less support for the dollar in the future.

Long-term interest rates

At longer horizons, international nominal forward rates fell, particularly in sterling (Chart 8). The sterling nominal forward curve became more inverted over the period and the US dollar and euro forward curves flattened.

Chart 8
International nominal forward rates(a)

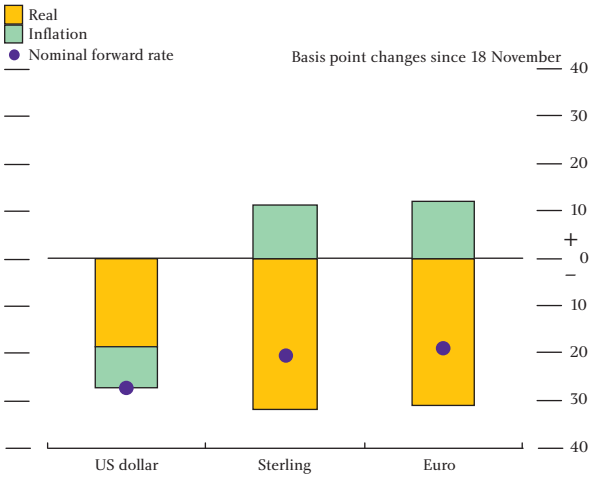


(a) Instantaneous forward rates derived from the Bank's government liability curves.

The falls in nominal forward rates largely reflected declines in real rates (Chart 9), continuing the drift down in global real forward rates that began at the end of 2003 (Chart 10).

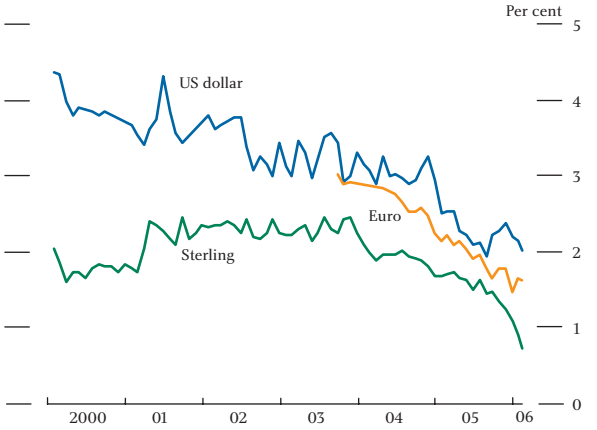
As mentioned in previous *Bulletins*, possible explanations for the decline in global long-term real interest rates include: a glut of global savings and/or a dearth of global investment opportunities;(2) a build-up in global money balances;(3) and lower-term premia.(4)

Chart 9
Changes in nine-year forward rates(a)



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

Chart 10
International nine-year real forward rates(a)



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

Another factor, frequently cited by market contacts, is that increased demand from defined benefit pension funds may have pushed up prices of long-dated government bonds, thereby reducing their yields.(5) Rising pension deficits across countries may have prompted funds to increase their holdings of long-dated government debt and accept lower expected returns in order to match more closely the characteristics of their assets and liabilities. The box on pages 8–9 outlines in more detail the factors affecting defined benefit pension fund asset allocation decisions.

(1) Under the HIA, firms could repatriate funds and benefit from tax relief during their first taxable year beginning on or after 22 October 2004, or in the last taxable year that began before that date.
(2) The low level of long-term global interest rates was discussed in a recent speech by the Governor reprinted on pages 80–82 in this *Bulletin*. It has also been discussed in the boxes 'The fall in global long-term real interest rates' in the Spring 2005 *Quarterly Bulletin* and 'The economics of low long-term bond yields' in the May 2005 *Inflation Report*.
(3) See the box entitled 'Excess global liquidity, asset prices and inflation' in the February 2006 *Inflation Report*.
(4) See the box entitled 'Real interest rates and macroeconomic volatility' in the Autumn 2005 *Quarterly Bulletin*.
(5) See 'Markets and operations' (2005), *Bank of England Quarterly Bulletin*, Winter, pages 412–13.

Increased holdings of long-dated government bonds would tend, on average, to reduce a pension fund's expected asset returns. At the same time, pension funds may have become less willing to hold higher-yielding assets (such as equities) with relatively high and easily observed price volatility. In an attempt to maintain returns, these investors are reported to have increasingly looked to so-called 'alpha' generating investment strategies, which aim to provide predictable returns without relying on exposure to the market portfolio, and may involve investing in 'alternative' assets such as hedge funds and private equity.(1)

Some market contacts have suggested that regulatory developments in 2005 may also have influenced UK pension fund behaviour and, in turn, contributed to the recent falls in long-dated UK government bond yields. The box on page 10 outlines recent developments in UK pension fund regulation.

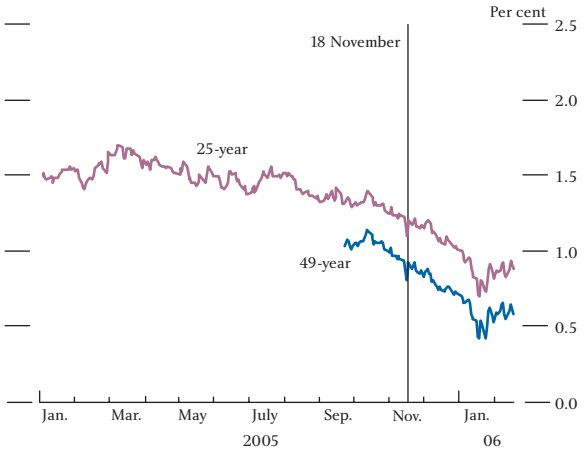
Despite these developments, contacts differ in their opinion about the actual scale of pension-related sterling bond purchases and swap transactions during the current review period. However, given a limited supply of long-dated gilts, large flows may not be required to generate significant movement in yields.

An example of large moves in long-dated index-linked gilt yields being amplified by liquidity and/or supply constraints occurred in mid-January. A fall in long yields, perhaps initially triggered by pension fund activity, was rumoured to have prompted other investors to cover short positions (ie buy long-dated government bonds), increasing downward pressure on yields. As a consequence, the implied 49-year sterling real spot rate fell to around 0.4%,(2) and a few market contacts reported mildly disorderly market conditions. This episode was short-lived, however, and long rates subsequently rose (Chart 11).

To the extent that yields on government bonds influence the discount rates that pension funds use to assess their future liabilities, the recent falls in real interest rates could have further widened deficits between the value of their assets and liabilities. In turn, this may have reinforced the demand for long-dated assets.

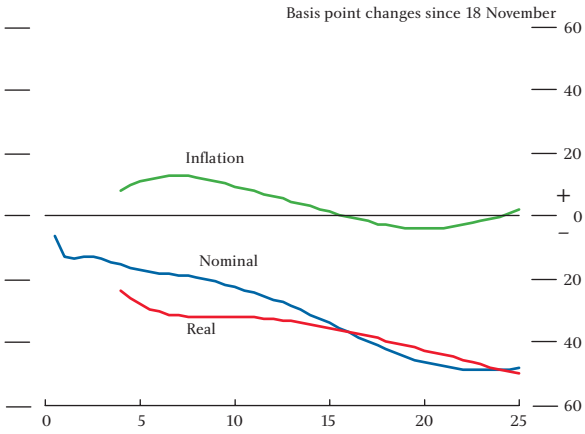
At long horizons, both real and nominal sterling forward rates fell over the review period such that the impact on implied inflation was fairly small (Chart 12). This suggests inflation expectations remained stable. It may also be consistent with pension funds being primarily concerned with matching the duration of their assets and liabilities, rather than hedging their inflation exposure, or with dealers and other market participants being prepared to take on the long-dated inflation risk.

Chart 11
Sterling real spot rates(a)



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

Chart 12
Changes in sterling forward rates(a)



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

Equity markets

Consistent with the fall in long-term real interest rates, which, other things equal, would tend to lead to higher asset prices via lower discount rates, equity prices increased over the review period (Chart 13).

(1) For more details on 'alpha', see the box entitled 'Search for alpha' on pages 272–73 of the Autumn 2004 *Quarterly Bulletin*.
(2) Note that index-linked gilts are indexed to the retail prices index. Alternative measures of inflation would lead to different levels for the implied real interest rate.

Pension fund valuation and liability driven investment strategies

This box outlines the factors affecting the valuation of defined-benefit (DB) pension fund assets and liabilities and the investment strategies that may be used to hedge some of the risks faced by schemes.

Pension fund asset and liability valuation

The assets of a DB pension fund depend on the contribution rate of the sponsoring company and the expected rate of return on the invested assets. The surplus/deficit on any fund is the difference between the present value of a fund's assets and the present value of its liabilities.(1)

An important risk faced by a DB pension fund (and therefore the sponsoring company) is that its assets will be insufficient to meet its liabilities. This *shortfall risk* depends on the uncertainty surrounding the future value of the fund's assets, and also changes in the factors used to value its liabilities. On the liability side, a fund faces the following risks:

- *Interest rate risk*. The present value of a pension fund's future liabilities depends on the discount rate used: the lower the discount rate, the higher the liabilities. Because pension fund liabilities last many years into the future, they have a long duration, and so liability valuations can be highly sensitive to changes in the interest rate used for discounting.

- *Longevity risk*. A rise in the life expectancy of the members of a scheme will increase the amount a fund will expect to pay out in pensions. In turn, this raises the value of the scheme's liabilities.

- *Inflation risk*. In the United Kingdom, on retirement a member's pension is typically linked to a measure of retail price inflation.(2) A rise in the expected rate of inflation increases the liabilities of the fund.

- *Wage risk*. As a DB pension is typically a function of the member's final salary, higher assumed wage inflation is associated with higher liabilities. To some extent wage growth is correlated with the inflation rate, although average earnings should normally grow a little faster, broadly linked to growth in labour productivity.

In deciding its asset portfolio, a pension fund faces a trade-off. By investing in assets that offer, on average, high expected returns, a pension fund may reduce the expected contribution rate of the sponsoring company. However, assets that offer high expected returns are typically riskier, ie the returns are more uncertain. This greater uncertainty increases the probability that losses on the assets could lead to a deficit on the pension fund, which would ultimately require higher contributions to make up the shortfall. In contrast, investing in assets that match the characteristics of the liabilities will reduce the shortfall risk, but the expected contribution rate of the sponsoring company is likely to be higher.

Recently, increasing numbers of pension fund managers have been given mandates to, at least partially, match expected liabilities and consequently reduce the shortfall risk of the fund. These have been termed 'liability driven investment' (LDI) strategies.

LDI strategies

In its purest form, an LDI strategy would seek to invest in assets that exactly match the characteristics of the pension fund's liabilities. Currently, however, no financial market instrument linked directly to wage inflation exists, and the market for longevity bonds is relatively limited.(3) Pension funds can, however, invest in assets that reduce their exposure to interest rate and consumer price inflation risk.

Full matching of interest rate and inflation risk would leave the value of the fund neutral to changes in discount rates or inflation. However, as many funds currently have deficits, full matching would be costly as it would 'lock in' the need for higher contributions. Instead, many schemes seem to have sought to hedge part of their interest rate and inflation risk, while

(1) In contrast, a defined-contribution (DC) pension fund makes no commitment to the size of the individual's pension on retirement. This is determined by the return generated by the pension fund over the pensioner's working life. The liabilities of such a fund are therefore equal to the assets of the fund.
(2) This is typically based on Limited Price Indexation which involves using an RPI-based index but with an upper bound on inflation.
(3) See the Governor's speech, 'What fates impose: facing up to uncertainty', the Eighth British Academy Annual Lecture, 2004.

leaving part of their portfolio in riskier assets with higher expected long-term returns.

Reducing interest rate risk

Interest rate risk can be reduced by investing in assets with a market value that moves closely with the interest rates used to discount the pension fund's liabilities. Long-maturity government and corporate bonds have a high duration and therefore provide a relatively good match to the duration of a pension fund's liabilities. Many funds have reportedly been increasing their bond allocation in recent years.

However, bonds are not the only instruments that schemes can use to manage interest rate risk. Contacts have also reported increasing use of long-maturity interest rate swaps. These offer pension funds a number of advantages over investment in bonds. First, being derivative instruments, they enable cash flows to be tailored more closely to liabilities than allowed by bonds. Second, as there is no exchange of principal, using swaps means that more of the fund can be invested in risky assets to earn higher returns. However, not all pension funds have mandates or the capability to invest in derivative products.

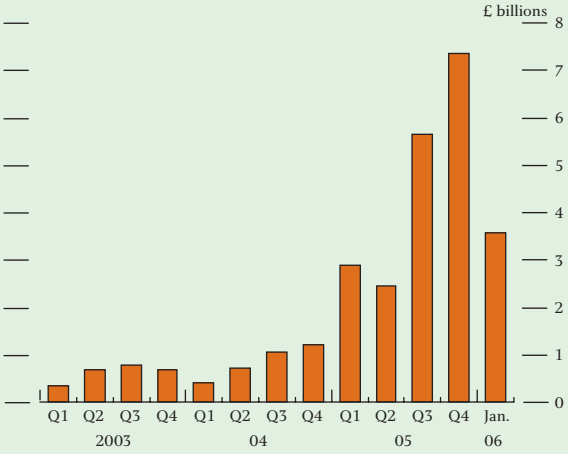
Reducing inflation risk

Part of an LDI strategy often involves some investment in index-linked products to reduce inflation risk, although the reduction of interest rate risk has reportedly been of greater concern to some pension funds.

For a fund that wishes to reduce inflation risk, there are a number of investment options available. First, the pension fund can shift part of its portfolio directly into inflation-linked gilts. This provides RPI-linked cash flows that are free from default risk.

Institutions can also use the inflation derivative market, including inflation swaps, to hedge inflation risk. Turnover in sterling inflation swaps increased considerably towards the end of 2005 and remained high in January (Chart A). Inflation swaps offer a fund increased flexibility to tailor inflation-linked cash flows as required, although as with interest rate swaps, some funds will face constraints on their ability to use the inflation swaps market.

Chart A
Notional value of UK RPI inflation swaps traded



Source: ICAP estimates.

At longer horizons, however, there are only a limited number of 'natural' payers of inflation. In the sterling market, a relative demand/supply imbalance is reflected in implied breakeven inflation forward rates derived from inflation swaps being currently higher than breakeven inflation rates implied by government bonds (Chart B). This makes hedging inflation exposure using the inflation swap market more expensive than investing directly in index-linked government bonds.

Chart B
UK RPI inflation forward curves on 17 February

Sources: Bank of England and Bloomberg.

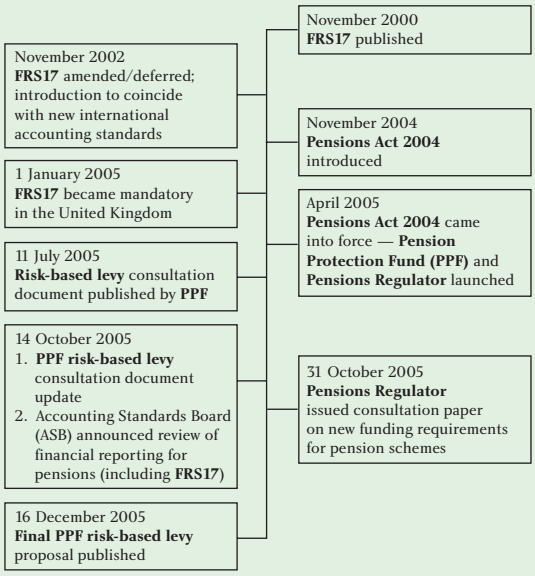
Hedge funds and dealers are said to be involved in trades designed to exploit the difference between the two inflation curves.(4)

(4) See Hurd, M and Relleen, J (2006), 'New information from inflation swaps and index-linked bonds' on pages 24–34 of this *Bulletin*.

Recent developments in UK pension fund regulation

Market contacts have suggested that regulatory changes may have increasingly influenced UK pension funds' asset allocation decisions over the past year or so. Diagram 1 highlights some of the recent developments in UK pension fund regulation.

Diagram 1
Timeline of recent key regulatory and accounting developments affecting UK pension funds



The FRS17 'Retirement benefits' standard was first issued in November 2000 by the UK Accounting Standards Board (ASB). The key components were: the measuring of pension scheme assets at market value; the discounting of liabilities using the rate of return on a high quality corporate bond of equivalent term; and the full recognition of pension scheme surpluses/deficits on the balance sheet and acknowledgement of movements in this surplus/deficit in other financial statements. This standard was effective from the start of 2005.

The Pensions Act 2004 came into effect in April 2005. As part of the Act, new funding regulations[1] came into force from the end of December 2005, and pension fund trustees were given up to 18 months to complete their valuation of funds on this new basis. Other key components of the Act were the introduction of a new Pensions Regulator and the Pension Protection Fund (PPF). The new Pensions Regulator requires fund trustees and company sponsors to address issues of underfunding — the Regulator has indicated that most schemes should aim to eliminate deficits within ten years. In addition, the regulator has powers to make the reduction of a pension deficit a condition of any takeover or leveraged buyout. This may provide an incentive for firms involved in such deals to take steps to address deficits. Market contacts have cited this as a significant factor behind some recent pension fund investment flows.

The PPF is a statutory fund set up to protect members of defined-benefit pension schemes by paying compensation if their employer becomes insolvent and the pension scheme is underfunded. To assess the level of funding for a pension scheme, the discount rates used by the PPF to value a scheme's liabilities are linked to yields on FTSE Actuaries gilt indices. For many schemes these are rates derived from long-maturity index-linked gilts.

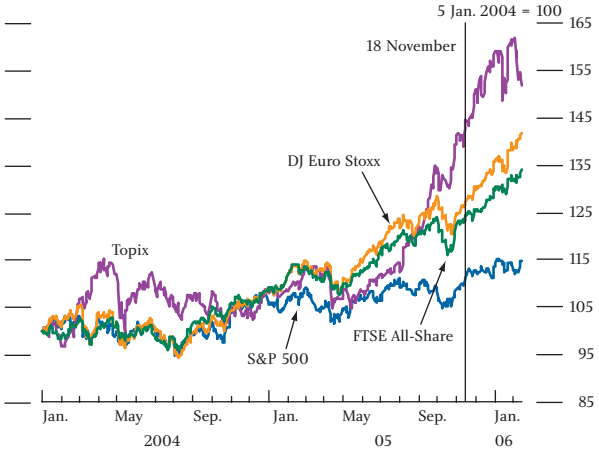
The PPF will be financed by charging compulsory levies on the pension schemes, with 80% of a fund's levy to be related to the risk of it not being able to meet its liabilities. As a result, firms with low funding levels will be required to make larger contributions to the PPF than those with smaller deficits, providing a financial incentive for firms to address shortfalls. However, market participants have suggested that, so far, this has had a relatively limited impact on pension funds' investment decisions.

The combined effect of these regulations has been:

- The introduction of more market-based (rather than actuarial-based) valuation methods for assessing pension funds' liabilities.
- The recognition of pension fund valuations explicitly on the balance sheet and other accounting statements of the sponsoring company.
- The introduction of regulatory valuation methods for assessing pension scheme funding levels that go beyond those specified for accounting purposes.

(1) These replaced previous funding requirements under the Minimum Funding Requirement (MFR).

Chart 13
International equity indices, domestic currency

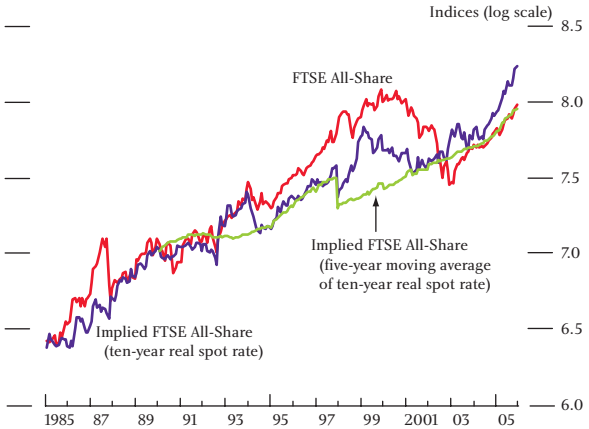


Sources: Bloomberg, Thomson Financial Datastream and Bank calculations.

In principle, the potential impact of the recent falls in long-term risk-free interest rates on equity prices can be gauged using a simple dividend discount model (DDM). Assuming real dividends grow at a fixed rate from their current levels and a constant equity risk premium, implied equity prices can be calculated by discounting the future dividend payments using long-term real interest rates from index-linked government bonds.

Chart 14 shows the observed level of the FTSE All-Share and its level implied by a simple DDM.(1) It suggests that the rise in the FTSE All-Share over recent months could be accounted for by changes in dividends and real sterling interest rates. Indeed, over the past year or so, the model would have predicted a more pronounced rise in UK equity prices. This might suggest that there have been changes in investors' expectations for dividend growth and/or required risk premia. Alternatively, it may be that equity investors assume a higher risk-free discount rate than that currently implied by the yields on index-linked UK government bonds. As an illustration, if a five-year moving average of the long-term real interest rate is used as the discount factor in the model, the implied and observed rises in UK equity prices have tracked each other more closely over the past year or so.

Chart 14
FTSE All-Share index and level implied by simple dividend discount model(a)



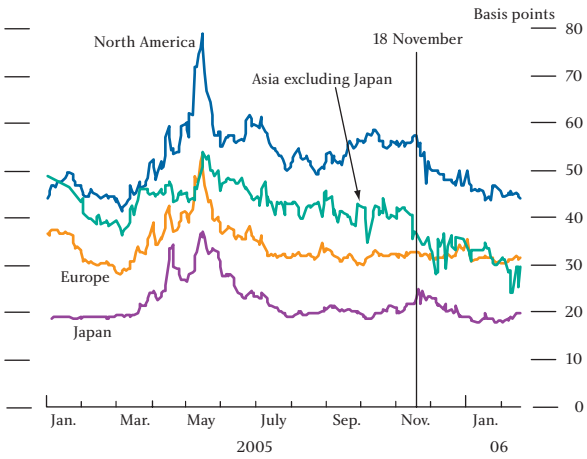
Sources: Bloomberg and Bank calculations.

(a) The implied levels are calculated using a Gordon growth model, assuming constant and arbitrary values for the equity risk premium and real dividend growth rate. The jump down in implied levels in January 1998 reflects a break in the dividend series to incorporate changes to advance corporation tax.

Corporate credit markets

Some contacts have suggested that equity prices have been boosted by firms taking advantage of low interest rates and issuing debt in order to finance acquisitions and to return cash to shareholders, either through share repurchases or higher dividends. To the extent that this has increased leverage, such activity might have been expected to widen credit spreads. But over the review period, spreads on credit default swap (CDS) indices have narrowed slightly (Chart 15) and corporate bond spreads generally remained narrow by historical standards.

Chart 15
International credit default swap index spreads



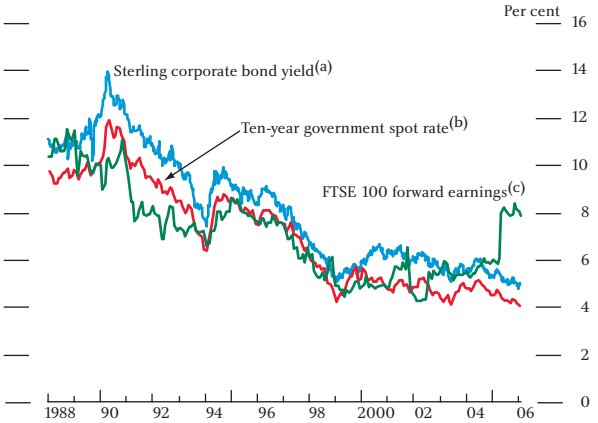
Source: Bloomberg.

Some crude measures suggest the cost of debt finance has been fairly low relative to the cost of equity finance. For example, over the past year or so, expected earnings relative to equity prices (the so-called 'forward earnings

(1) This analysis uses a simple 'Gordon growth model' (see Gordon (1962), *The investment, financing and valuation of the corporation*) assuming an (arbitrary) equity risk premium of 4% and a long-term real dividend growth rate of 3%. For more details on dividend discount models, see Vila Wetherilt, A and Weeken, O (2002), 'Equity valuation measures: what can they tell us?', *Bank of England Quarterly Bulletin*, Winter, pages 391–403.

yield')[1] for the FTSE 100 has risen sharply and has been high relative to yields on sterling-denominated corporate debt (Chart 16). This could help to explain the recent high level of private equity and leveraged buyout (LBO) activity.

Chart 16
FTSE 100 forward earnings yield and sterling bond yields

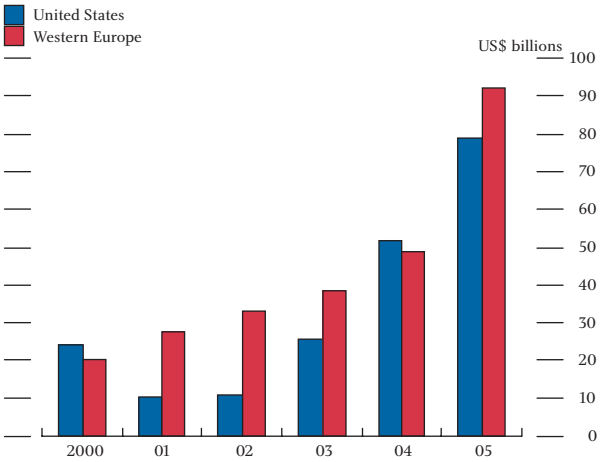


Sources: GlobalFinancialData.com, IBES, Merrill Lynch and Bank calculations.

(a) Corporate bond yields before 2001 from GlobalFinancialData.com, after 2001 from Merrill Lynch.
(b) Ten-year spot rate from the Bank's government liability curve.
(c) Changes in accounting standards have changed the way companies report earnings per share, which could affect the series.

In the United States, LBO lending reached $79 billion, (Chart 17), which is the highest level since the late 1980s. In Western Europe, LBO lending was a record $92 billion in 2005 and total syndicated lending remained strong.

Chart 17
Leveraged buyout volume(a)



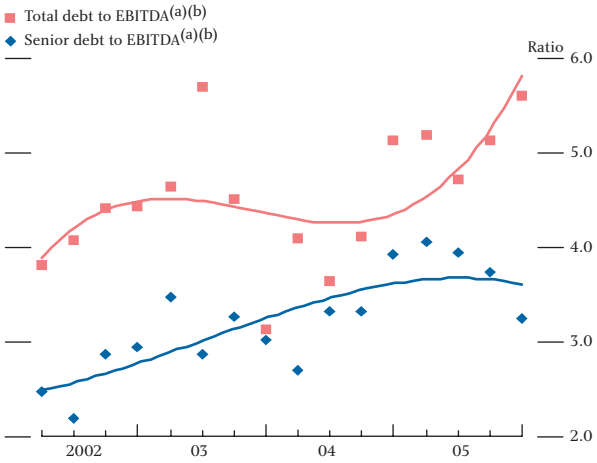
Source: Loan Pricing Corporation.

(a) Excludes recapitalisations.

There were also indications that loan pricing may have become more favourable for borrowers recently. The Federal Reserve's Senior Loan Officer survey and the ECB's Bank Lending survey, both conducted in January, showed a slight loosening in credit standards.

Leverage in the European LBO market also appears to have increased over recent months, with the average total debt to EBITDA[2] ratio rising from 5.1 in 2004 to 5.6 at the end of 2005 (Chart 18). Deal structures have reportedly been re-engineered so that the additional leverage has typically been in the form of second-tier and mezzanine loans ranking above the bondholders but below the senior debt. In part, this development appears to reflect demand for higher yielding loans from institutional investors, including via collateralised loan obligations (CLOs). Hedge funds have also become more involved in the LBO market, at all levels of the debt capital structure.[3]

Chart 18
Leverage in Western European leveraged buyouts



Source: Loan Pricing Corporation.

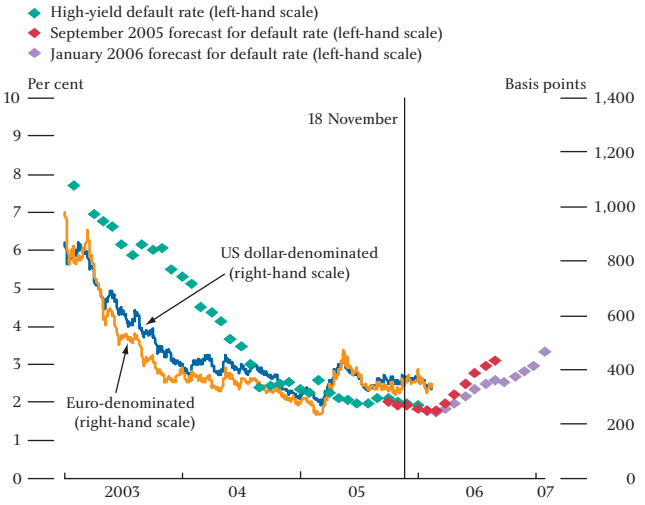
(a) EBITDA refers to earnings before interest, taxes, depreciation and amortisation have been deducted.
(b) Individual data points refer to debt to EBITDA ratios averaged across LBO deals in each quarter (weighted by deal size). Solid lines represent fitted lines through the data points based on a polynominal regression of order three.

In high-yield bond markets, credit spreads narrowed further over the period (Chart 19). And despite a few isolated cases of default (discussed on page 18), default rates remained low. Going forward, market commentators expect forecast default rates to pick up, albeit only modestly. But compared with rating agency forecasts made in September 2005, default rates are expected to rise more gradually.

The projected pickup in default rates appears to reflect idiosyncratic factors rather than a more broad-based

(1) The forward earnings yield is often used by market participants as a crude measure of equity valuation. It is the expected level of earnings in twelve months' time (from survey data) divided by the current price level.
(2) Earnings before interest, taxes, depreciation and amortisation have been deducted.
(3) For more information see the box entitled 'Hedge funds and leveraged loans' on pages 33–34 of the December 2005 *Financial Stability Review*.

Chart 19
High-yield option-adjusted corporate bond spreads and global default rates

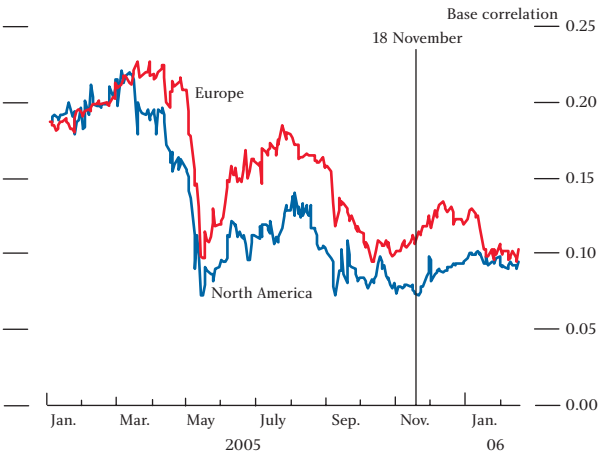


Sources: Merrill Lynch and Moody's Investor Service.

deterioration in credit quality. Market contacts suggest that idiosyncratic risk is currently one of the most important factors affecting credit traders and portfolio managers, as credit spreads react quickly to firm-specific news such as rumours of LBOs.

Consistent with this, implied default correlation, as inferred from the first-loss tranches on European CDS indices, declined over the period (Chart 20). In the United States, implied correlation picked up a little but from a low base. Taken together, this suggests the perceived likelihood of systematic defaults and/or the general level of credit risk premia remained low.(1)

Chart 20
Default correlation implied by equity tranches of credit default swap indices(a)



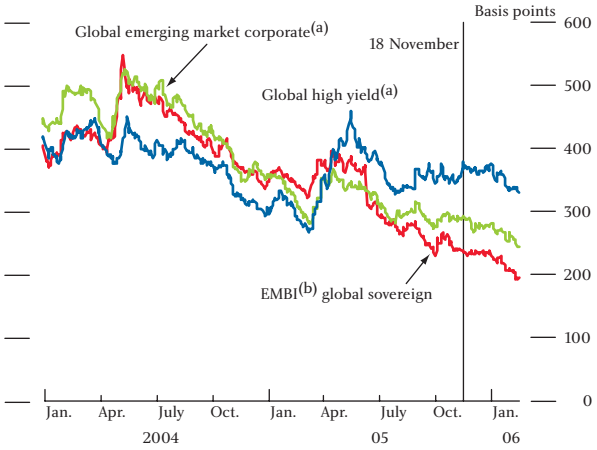
Source: JPMorgan Chase and Co.

(a) Five-year on-the-run Dow Jones North American Investment Grade (CDX.NA.IG) index and five-year on-the-run iTraxx Europe investment grade index.

Emerging markets

Spreads on emerging market economy (EME) corporate and sovereign bonds narrowed further, and by more than corporate spreads on industrial country bonds (Chart 21). Indeed, at the beginning of 2006, sovereign and corporate EME credit spreads touched all-time lows. The narrowing of spreads has been broadly based across EMEs but was most pronounced for bonds with the highest yields.

Chart 21
Emerging market and high-yield bond spreads



Sources: JPMorgan Chase and Co. and Merrill Lynch.

(a) Option-adjusted spreads.
(b) Emerging Markets Bond Index.

The box on pages 14–15 examines some possible explanations behind the continued falls in emerging market economy (EME) bond spreads. Specifically, using simple regression analysis, it evaluates how far the recent sustained narrowing in EME spreads reflects changes in perceptions of default risk and external financing conditions. It concludes that some of the change in spreads might be associated with improvements in EMEs' underlying credit quality, reflecting stronger macroeconomic performance. But improved fundamentals appear to account for only a part of the decline in emerging market spreads.

Accompanying the narrowing in EME credit spreads, emerging market equity indices rose sharply in 2005 and by more than developed economy equity indices (Chart 22).

Both corporates and governments in emerging markets have taken advantage of narrower credit spreads and buoyant equity markets by increasing issuance. Gross

(1) For details on CDS index tranches and interpreting measures of implied correlation, see Belsham, T, Vause, N and Wells, S (2005), 'Credit correlation: interpretation and risks', *Bank of England Financial Stability Review*, December, pages 103–15.

A simple model for emerging market bond spreads

Net bond issuance by emerging market economies (EMEs) increased sharply during 2005. At the same time, credit spreads on EME sovereign bonds tightened, and have continued to do so in early 2006 to reach record lows.

This box uses a simple regression model to analyse how much of the recent compression in EME credit spreads is due to an improvement in EMEs' economic performance rather than benign external market conditions.

An empirical framework for analysing EME spreads

The framework used is a parsimonious regression model that relates the aggregate emerging market bond spread(1) to three explanatory variables:

- (Country-weighted) sovereign credit ratings (*RAT*). This captures changes in EMEs' economic fundamentals — the higher the rating, the lower the expected spread.
- Short-term US dollar nominal interest rates (*TBY*). This is included as a measure of global liquidity.(2) Greater liquidity would be expected to reduce the cost of financing investments in emerging market debt and, in turn, lead to narrower spreads.
- A forward-looking measure of equity price volatility (*VIX*) to proxy for investors' risk appetite:(3) greater uncertainty would tend to widen spreads as investors require higher compensation for bearing the additional uncertainty.

More formally, the regression model on the (log of the) EME spread (*LSP*) can be written as:

$$LSP_t = \alpha + \underset{(-)}{\beta_1} RAT_t + \underset{(+)}{\beta_2} TBY_t + \underset{(+)}{\beta_3} VIX_t + \xi_t$$

where the terms in brackets represent the expected signs of the coefficients and ξ captures random disturbances that cannot be accounted for by the model.

The regression equation can be thought of as representing the long-run or 'equilibrium' relationship between the variables. In reality, it may take time for EME spreads to respond to changes in underlying credit quality or external financing conditions. But over the medium to long term, if the model adequately captures the long-run relationships, it suggests spreads should tend to move together with credit ratings, global liquidity conditions and investors' risk appetite.

Of course, this does not mean that the right-hand side variables necessarily 'cause' changes in EME bond spreads. Without a structural model of the underlying demand for and supply of emerging market bonds it is not possible to identify the exact mechanism by which spreads on emerging market bonds over the risk-free rate are determined.

Estimation results

Table 1 summarises the results of regressions using different sample periods. The signs of the coefficients are in line with expectations and all are statistically significant. In terms of economic significance, based on the estimation results for the full sample period (January 1998–January 2006), a one-notch improvement in the average credit rating would imply an 18% tightening of the EME spread; a 100 basis points increase in US dollar short-term interest rates is associated with 1.4% widening; and a one unit decrease in the implied volatility index suggests a 1.7% compression in spreads.

Table 1
Estimated model coefficients

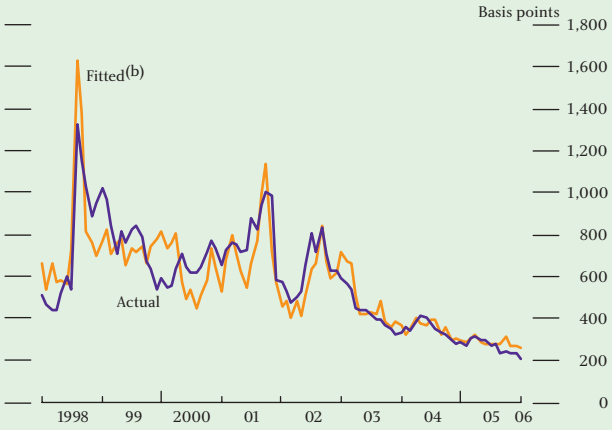
	Dependent variable: *LSP* Estimation period		
	(1) Jan. 1998–Feb. 2003	(2) Jan. 1998–Feb. 2004	(3) Jan. 1998–Jan. 2006
RAT	-0.11	-0.12	-0.18
	(-3.44)	(-3.80)	(-6.91)
TBY	1.68	2.00	1.40
	(3.30)	(4.25)	(2.83)
VIX	0.01	0.02	0.02
	(12.80)	(15.06)	(14.75)
α	3.48	3.54	4.11
	(10.46)	(10.69)	(14.67)
R^2	0.60	0.74	0.84

Note: Figures in brackets show t-statistics for the estimated coefficients.

(1) The index used in the estimations is JPMorgan's Emerging Markets Bond Index Global excluding defaulted bonds.
(2) There are a number of ways to measure global liquidity conditions although none are ideal. Alternative regressions including US *long-term* interest rates produced qualitatively similar results.
(3) VIX is the implied volatility from option prices of the S&P 500 stock index and is an imperfect measure of investors' risk appetite. A number of alternative measures for risk appetite were also considered. Although most of these were statistically significant, the regression including the VIX measure had the highest explanatory power.

The full sample estimation indicates that the three explanatory variables can account for 84% of the variation in spreads and suggests that the EME spread is currently around 50 basis points below the long-run level suggested by the model (Chart A).

Chart A
EME sovereign bond spreads[a] — actual versus fitted



Sources: JPMorgan Chase and Co., IMF, Bloomberg and Bank calculations.

(a) Refers to the composite JPMorgan EMBI (Emerging Markets Bond Index) Global excluding defaulted bonds.
(b) The fitted values are based on a regression of log values of EME sovereign bond spreads on ratings, US dollar three-month market interest rates and the VIX index over the January 1998 to January 2006 period.

Decomposing the movements in the spread over the past two years that can be explained by the model suggests that improvements in credit quality have been the most important influence. Specifically, as shown in Table 2, the model suggests that the improvement in country credit ratings has contributed around two thirds of the total explained compression in spreads since January 2004.(4)

Table 2
Accounting for the change in EME spreads
January 2004– January 2006

Percentage contribution of:	
Credit rating (*RAT*)	65
US interest rates (*TBY*)	-25
Risk appetite (*VIX*)	30
Unexplained (ξ)	30

However, there is some evidence that the sensitivity of spreads to changes in the explanatory variables may have altered over the recent past (Table 1). In particular, spreads appear to have become more sensitive to changes in credit ratings and less sensitive to changes in US interest rates over the full sample than in the earlier period. On the face of it, this indicates that the estimated impact of credit ratings on percentage changes in spreads may have increased over time, while the effect of US short-term interest rates has fallen.

However, these changes in model parameters over time could be symptomatic of model misspecification. Specifically, the equation may be missing one or more variables which have asserted a stronger influence on spreads in recent years than in the past. For example, there is anecdotal evidence that pension funds and insurance companies from the major economies have progressively allocated more funds to EME assets, attracted by the recent higher returns and perceived diversification benefits. Pension funds' allocations are likely to be particularly sensitive to improved credit ratings, since they are more likely to be given a mandate to invest in EME assets once EME sovereign bonds attain investment grade status. Alternatively, since the model uses proxy variables to capture particular influences on EME spreads, measurement error problems could be important. In turn, this may have led to some biases in the estimated model coefficients. For example, an increase in the sensitivity to credit ratings might be associated with investor exuberance, which may not be fully captured by the proxy for risk appetite.

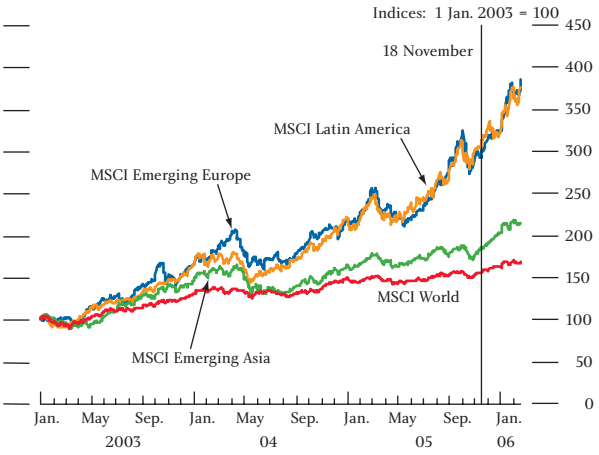
Summary

Given the parsimonious nature of the model for EME spreads and importantly the potential for misspecification, it is important not to draw too definitive conclusions about the size of any departure from long-run equilibrium. But to the extent that spreads are currently below levels implied by the model, then going forward one might expect spreads to widen.

Nonetheless, the estimated model is silent over both the mechanism and the speed with which any adjustment might occur. It may be that one of the external drivers will change, thereby pushing spreads wider. For example, there is much debate about the causes and sustainability of the current level of risk appetite. Alternatively, an exogenous shock to one or more emerging bond markets may push EME spreads back towards (or beyond) their long-run sustainable levels.

(4) See also the article 'Capital flows to emerging markets' in the December 2005 *Financial Stability Review*.

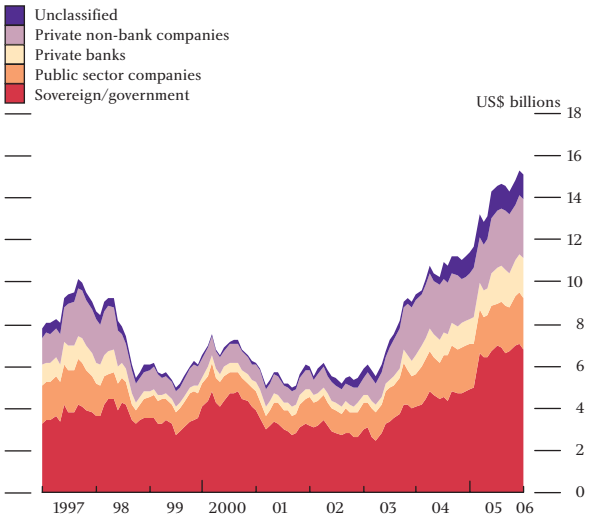
Chart 22
Global and emerging market equity indices



Sources: Bank of England and Bloomberg.

external debt issuance in January was higher than in the period prior to the late-1990s Asian crisis (Chart 23). And equity issuance was strong, reaching $53 billion in 2005 compared with $33 billion in 2004.

Chart 23
Emerging market gross monthly external debt issuance by sector(a)



Source: Dealogic.

(a) Twelve-month moving average.

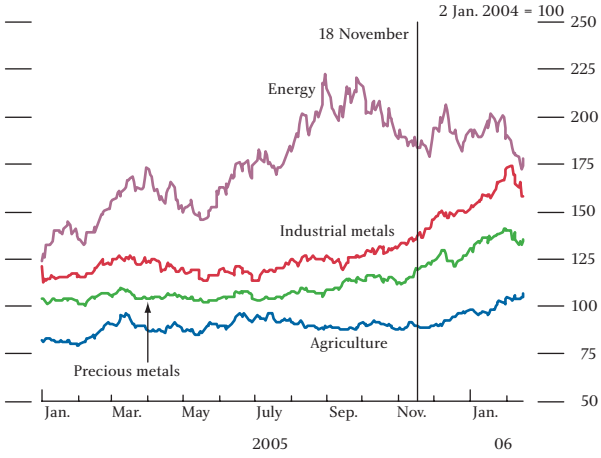
Pension funds and insurance companies in the major economies have reportedly allocated an increasing proportion of their assets to emerging markets over the past year, attracted by the recent higher returns and the perceived diversification benefits. Similarly, the latest CSFB-Tremont survey showed that net asset flows into emerging market hedge funds were $8.1 billion in 2005 up from $6.6 billion in 2004. The survey also suggested that hedge funds investing in emerging markets posted the highest returns in 2005, up by 17% on average, compared with an average return of around 7% for the overall CSFB-Tremont hedge fund index.

Other assets and commodities

Oil and commodities markets provide another example of investors looking to a wider class of assets to augment overall returns and/or diversify their portfolios. According to market contacts, established investors in commodity markets, such as hedge funds and commodity trading advisors (CTAs), have increasingly been joined by longer-term investors (for example, mutual funds and pension funds) which have been shifting their asset allocations away from more traditional sectors.

The growth in investment in commodities by long-term institutional and speculative investors has been facilitated by new instruments, principally the development of new commodity investment vehicles and, in particular, exchange-traded funds (ETFs). For example, the implicit holdings of gold through ETFs has risen sharply over recent months. The increase in investment demand for commodities could be one reason behind the increase in some commodity prices since last autumn (Chart 24).

Chart 24
Goldman Sachs commodity indices



Sources: Bloomberg and Bank calculations.

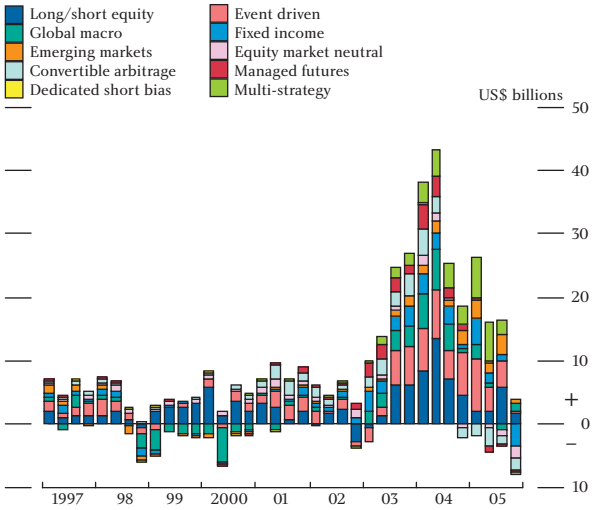
Risk appetite and the search for yield

Over the review period, developments across asset markets do not suggest any broad-based decline in investors' willingness to take risk. Credit spreads remained narrow by recent historical standards, equity prices rose and there was evidence of investors continuing to switch into alternative asset classes and leveraged investment strategies. At the same time, average trading book Value-at-Risk (VaR) measures for

large complex financial institutions (LCFIs) that have reported 2005 Q4 results, have not changed significantly since the previous quarter.

One contrary indicator could be investment flows into hedge funds, which continued to slow during the review period. Indeed, Tremont Capital Management reported an overall net outflow of around $4 billion from hedge funds in 2005 Q4, the first for three years (Chart 25). But according to market contacts, withdrawals appear to have been from high-net-worth individuals, perhaps seeking higher expected returns in other asset classes, rather than reversals of investment mandates from institutional investors. Moreover, there was a further increase in the number of new funds launched in Europe during 2005 H2.

Chart 25
Net capital flows into hedge funds

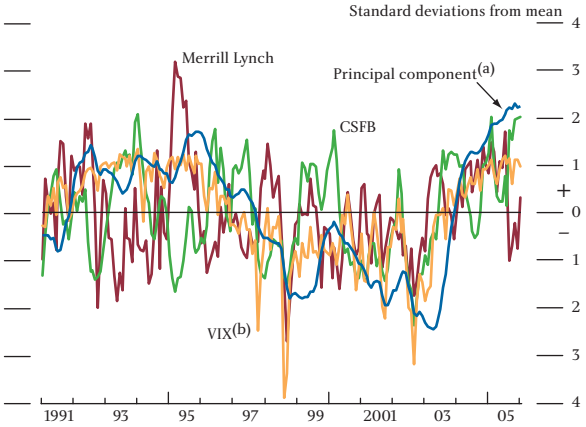


Source: Tremont Capital Management, Inc.

Assessing the direction of any change in the general level of risk appetite is difficult, not least because, *ex ante*, risk premia are unobservable and depend crucially on the preferences of investors. Put another way, it is difficult to know if recent asset price rises mean that risk premia are currently abnormally low (and will therefore revert to more normal levels at some point following a downward asset price adjustment) or whether there has been a structural decline in the compensation investors require for bearing risk.

A number of financial institutions calculate proxy measures for overall investor risk appetite — that is the willingness of investors to bear risks — based on surveys of investors or derived from movements in asset prices themselves.(1) These measures are typically quite volatile and often do not give consistent information. But attempting to extract the common signal in some of these series using principal component analysis indicates that risk appetite may currently be unusually strong (Chart 26).

Chart 26
Proxy measures of risk appetite



Sources: Chicago Board Options Exchange, CSFB, Merrill Lynch and Bank calculations.

(a) Principal component analysis was applied to twelve-month rolling moving averages of the three individual measures of risk appetite. The blue line shows the first principal component. Qualitatively similar results were found when a wider set of risk appetite proxy measures was used, but these series were only available for shorter time periods.
(b) The VIX is an index of volatility in the S&P 500 implied from option prices. On the chart it is inverted.

Overall, recent developments would seem to be consistent with continued high risk appetite, low risk premia across financial markets and little, if any, unwinding of the so-called 'search for yield' (a topic which has been discussed in recent *Quarterly Bulletins* and issues of the Bank's *Financial Stability Review* since June 2003).

How long can risk premia stay low? The answer is likely to depend on the underlying factors driving the falls. As discussed in the December 2005 *Financial Stability Review*, there are two broad sets of influences that might have contributed to the reduction in required risk premia. First, it may reflect some combination of a perceived decline in uncertainty in the macroeconomic environment, together with financial innovations that have brought about greater dispersion and diversification of risk. Second, other, less fundamental, factors may have led to risk being mispriced, perhaps because investors have underestimated the financial risk taken on or because they have overestimated the ability of policymakers to offset shocks to the macroeconomy.

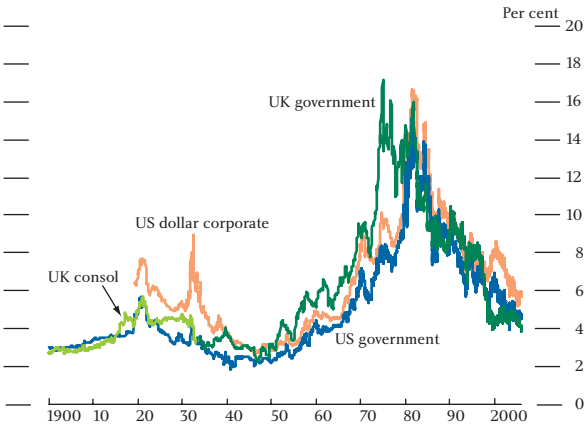
(1) For a discussion of the theory behind risk appetite measures see Gai, P and Vause, N (2004), 'Risk appetite: concept and measurement', *Financial Stability Review*, December, pages 127–36.

At the same time, some firms may have been reluctant to scale back risk taking, despite the possibility of risk being underpriced, owing to the potential for missed trading opportunities if any market correction does not occur for some time. Put another way, they face a potential trade-off between business and financial risk.

To the extent that the reduction in risk premia has been based more on fundamentals — the fact that financial markets have seemingly coped well with the withdrawal of monetary accommodation in the United States and a number of idiosyncratic credit events over the past year might provide some support for this view — then arguably the falls may be more persistent.

Indeed, current levels of risk premia may not be unprecedented. Despite recent rises in asset prices, nominal yields on government and corporate bonds have remained above the low levels experienced in the early 20th century (Chart 27). Moreover, the current spread between the yield on the Dow Jones US corporate bond index and an index of US government bonds, of around 109 basis points, is only a little below the long-run average value of around 130 points.

Chart 27
Indicative sterling and dollar bond yields(a)



Source: GlobalFinancialData.com.

(a) UK government bond is a 20-year gilt. US government bond is a spliced series of the yields on several long-term bonds. US dollar corporate is a composite series of yields on long-term corporate securities rated 'A' by Moody's. UK consol is a government bond with no fixed redemption date.

However, if risk has been mispriced, a sufficiently large disturbance could cause asset prices to correct sharply as investors reassess the outlook for returns. For example, a number of market contacts considered leverage levels in loan markets to be high and credit spreads to be very tight. And a recent survey by Mercer Investment Consulting of 17 funds of hedge funds, albeit only accounting for around 15% of global assets managed by this type of fund, found that most managers expected credit spreads and market volatility to increase in 2006. So the possibility of a correction in risk premia on asset prices cannot be ruled out.

Such an adjustment could have widespread and potentially destabilising effects across asset markets, particularly if a generalised reduction in risk appetite limited the ability of certain investors, such as hedge funds and the proprietary trading desks of LCFIs, to perform a stabilising role. This might be the case if the search for yield had led investors to build up leverage and move into increasingly illiquid assets particularly in markets for more risky or complex instruments where liquidity may prove ephemeral. In volatile market conditions, these investors could switch from being marginal liquidity suppliers in a wide range of markets, to being liquidity demanders.

It is impossible to know the mechanism through which any widespread adjustment in the price of risk could occur. In light of this uncertainty, investors and policymakers alike need to be alert to potential vulnerabilities in financial markets. Drawing on market intelligence from its contacts, the Bank will continue to assess these risks and report its views through future editions of the *Quarterly Bulletin* and *Financial Stability Review*.

Developments in market structure

Developments in credit derivative markets

There were a number of high-profile defaults in the United States at the end of last year, such as auto-part maker Delphi and the utility company Calpine. These defaults were significant because of the amount of credit derivative protection that had been bought and sold on these names (both single-name credit default swaps (CDS) and through trades in CDS indices that included the defaulted firms, eg the Dow Jones CDX indices). In the event of default, CDS agreements usually specify settlement by physical delivery of the debt of the defaulted company in exchange for its par value.

Given the large notional value of CDS contracts outstanding relative to the amount of cash debt, there was the potential for a disorderly settlement process, which could have dented confidence in the wider credit derivatives market. In the event, CDS dealers and trade associations organised auctions to obtain an agreed value for cash settlement of the CDS index trades, and there was little disruption to credit markets.

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

£ billions

Liabilities	17 Feb. 2006	18 Nov. 2005	Assets	17 Feb. 2006	18 Nov. 2005
Banknote issue	40	40	Short-term and long-term repos	29	29
Settlement bank balances	<0.1	<0.1	Ways and Means advance to HMG	13	13
Other sterling deposits, cash ratio deposits and the Bank of England's capital and reserves	10	10	Other sterling-denominated assets	4	4
Foreign currency denominated liabilities	14	15	Foreign currency denominated assets	18	19
Total[c]	**64**	**65**	**Total**[c]	**64**	**65**

(a) For accounting purposes the Bank of England's balance sheet is divided into two accounting entities: Issue Department and Banking Department. See 'Components of the Bank of England's balance sheet' (2003), *Bank of England Quarterly Bulletin*, Spring, page 18.
(b) Based on published weekly Bank Returns. The Bank also uses currency, foreign exchange and interest rate swaps to hedge and manage currency and non-sterling interest rate exposures — see the Bank's 2005 *Annual Report*, pages 38 and 61–65 for a description.
(c) Figures may not sum to totals due to rounding.

Credit derivative indices

The market for credit derivatives referenced to asset-backed securities (ABS) has grown significantly since the launch of the standardised International Swaps and Derivatives Association terms in mid-2005. A further innovation in January 2006 was the launch of a tradable CDS index, known as ABX, referencing US sub-prime residential mortgage-backed securities (RMBS). The index is a family of five sub-indices tracking tranches of different credit quality bonds, each of which references a pool of 20 sub-prime RMBS. Contacts expect one consequence of the index to be further issuance of collateralised debt obligations (CDOs) of ABS, which have been popular recently.

London foreign exchange markets

Thirty banks participated in the most recent semi-annual survey of foreign exchange turnover in London undertaken by the Foreign Exchange Joint Standing Committee (JSC). Average daily turnover reported in October 2005 was $863 billion, an increase of 31% on the previous year. The share of turnover accounted for by major currency pairs fell slightly from 85% to 82% over the same period.(1)

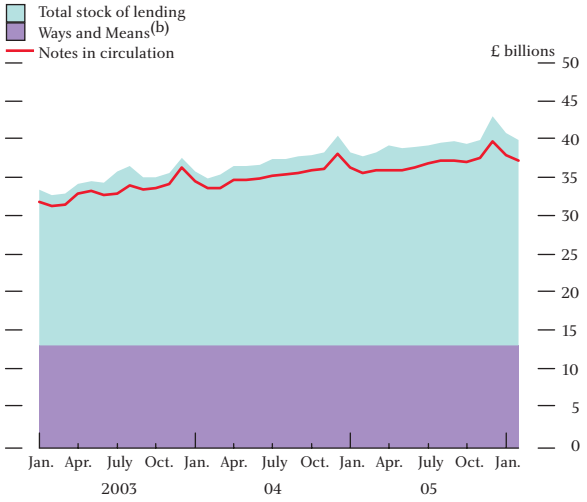
Similar surveys were also conducted for the New York market in October 2005 by the New York Foreign Exchange Committee, and for the Singapore market by the Singapore Foreign Exchange Market Committee.(2)

Bank of England official operations

Changes in the Bank of England balance sheet

The size of the Bank's balance sheet decreased slightly over the review period, owing to a small fall in the foreign-currency components (Table B). Notes in circulation, the largest liability on the Bank's balance sheet, changed little over the review period as a whole, although it rose as normal over the Christmas period (Chart 28).

Chart 28
Banknotes in circulation, the stock of lending through OMOs and 'Ways and Means'[a]



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

On 27 January 2006, one of the Bank's outstanding euro-denominated notes matured. The maturing note, which had a maturity of three years at issue, is being replaced by a new €3 billion three-year euro note maturing on 27 January 2009. The first €2 billion tranche of the new euro note was sold by auction on 24 January 2006. The auction attracted bids totalling 2.6 times the amount of notes on offer. The weighted average yield across all accepted bids was 3.048%, corresponding to an indicative spread of 11.5 basis points below the euro swaps curve at the time of the auction. The expected date for the €1 billion auction of the second tranche of the new euro note is 28 March

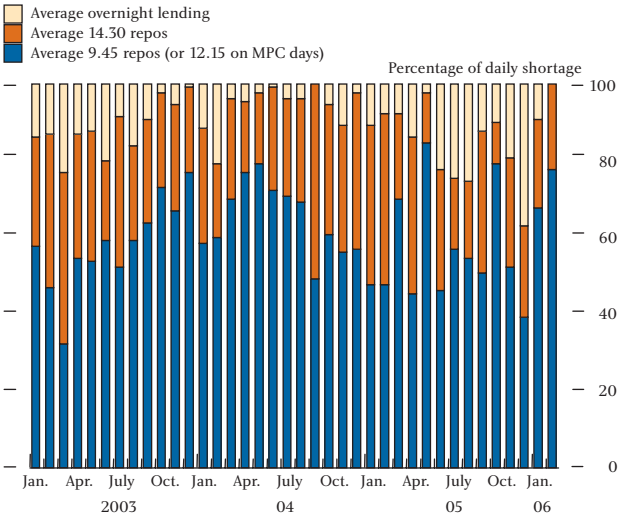
(1) The detailed results were published on 23 January 2006 and can be found at www.bankofengland.co.uk/markets/forex/fxjsc/index.htm.
(2) The results of these surveys can be found at www.newyorkfed.org/fxc/ and www.sfemc.org respectively.

2006. The proceeds of all euro note (and bill) issues will be added to the Bank's foreign currency bond holdings, of which around €3 billion is used to facilitate the UK commercial banks' participation in TARGET, the trans-European payment system.

As set out in previous *Bulletins*, the Bank holds an investment portfolio of gilts (currently around £2 billion) and other high-quality sterling-denominated debt securities (currently around £1.2 billion). These investments are generally held until maturity. Over the current review period, gilt purchases were made in accordance with the published screen announcements; £32.0 million of 4.75% 2010 in November, £48.0 million of 5% 2012 in January and £47.0 million of 5% 2014 in February. A screen announcement on 1 March 2006 detailed the purchases to be made over the following three months.

Over the period, the majority of lending in the Bank's open market operations (OMOs) in the sterling money market continued to be carried out at a two-week maturity, at the MPC's official rate (Chart 29). However, counterparties' use of overnight borrowing, at 25 basis points above the official rate, increased in December. End-year balance sheet constraints may have deterred counterparties from taking on two-week borrowing that crossed the year-end. In January and February, most shortages were cleared in the two-week rounds.

Chart 29
Lending via the Bank's short-term open market operations(a)



(a) Monthly averages.

In January, as a further step towards the planned introduction of fundamental reforms to the Bank's operations in the sterling money market, the Bank began lending via longer-term repos alongside its existing short-term repos. The box on page 22 sets out the motivation for these long-term repo operations. Table C shows the results of the tenders on 17 January and 14 February. Cover was substantial and yield 'tails' (the difference between the weighted average rate and the lowest accepted rate) were small, particularly in the nine and twelve-month repos. The February tender was similarly well covered.

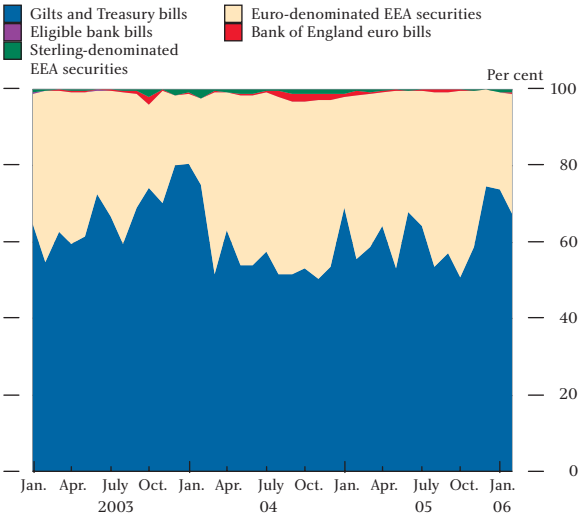
Table C
Long-term repo operations

	Three-month	Six-month	Nine-month	Twelve-month
17 Jan. 2006				
On offer (£ millions)	1,800	750	300	150
Cover	3.15	4.25	5.67	8.23
Weighted average rate(a)	4.407	4.416	4.425	4.435
Highest accepted rate(a)	4.471	4.451	4.425	4.453
Lowest accepted rate(a)	4.385	4.390	4.425	4.425
Tail(b) (basis points)	2.2	2.6	0.0	1.0
14 Feb. 2006				
On offer (£ millions)	1,800	750	300	150
Cover	2.61	3.32	3.25	3.93
Weighted average rate(a)	4.400	4.386	4.386	4.405
Highest accepted rate(a)	4.420	4.400	4.400	4.405
Lowest accepted rate(a)	4.390	4.385	4.385	4.405
Tail(b) (basis points)	1.0	0.1	0.1	0.0

(a) Per cent.
(b) The yield tail measures the difference between the weighted average bid rate and the lowest accepted rate.

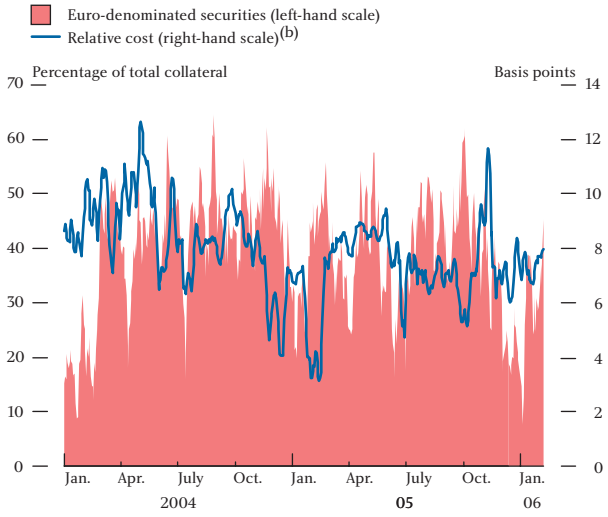
There was a rise in the use of gilts and Treasury bills and a corresponding fall in the use of euro-denominated European Economic Area (EEA) government debt as OMO collateral (Chart 30), despite the cost of euro-denominated EEA debt falling relative to gilts (Chart 31). In part, this was reflected in greater recourse to the overnight lending facilities in December. EEA securities cannot be delivered in the late lending

Chart 30
Instruments used as OMO collateral in short-term operations(a)



(a) Monthly averages.

Chart 31
Relative cost and use in OMOs of euro-denominated EEA government securities(a)



(a) Includes collateral used in short-term and long-term OMOs.
(b) Relative cost calculated as the difference between one-month BBA repo and Libor fixing spread and one-month European Banking Federation repo and Euribor spread. A larger spread indicates a lower cost of repoing euro-denominated debt relative to repoing gilts.

facilities, due to settlement constraints, unless prepositioned by counterparties.

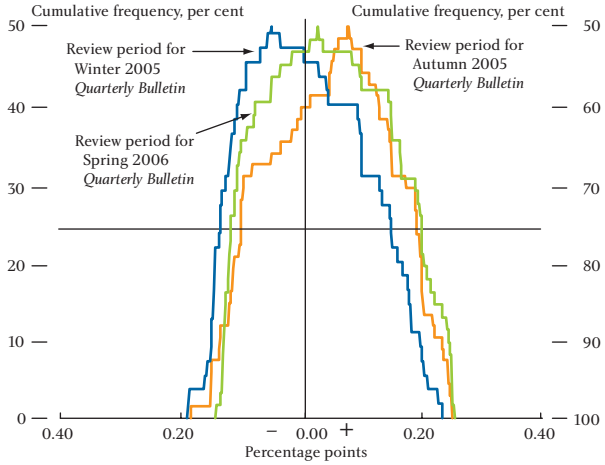
So far, counterparties have used a somewhat greater proportion of euro-denominated EEA debt collateral in the Bank's long-term repo operations compared with the short-term operations.

Short-dated interest rates

The distribution of the spread between the sterling secured (gilt GC repo) overnight rate and the Bank's official rate moved up during the current review period (Chart 32), indicating an increase in the number of days on which the overnight rate traded above the official rate. In part, this reflected greater use of overnight borrowing from the Bank in December.

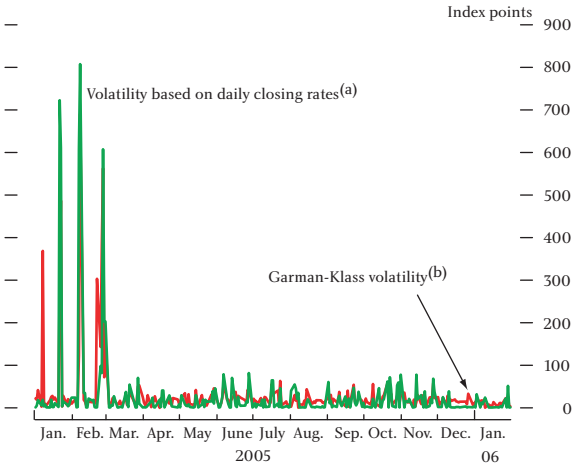
Volatility in sterling overnight rates has remained at the lower levels experienced since the narrowing of the 'corridor' between the rates available on the late lending and deposit facilities to +/- 25 basis points on 14 March 2005 (Chart 33). But, despite relatively low volatility based on daily closing rates, periodic spikes in the intraday volatility of sterling overnight rates have remained. Chart 33 also shows an alternative volatility measure that takes account of daily highs and lows (known as the Garman-Klass measure of volatility). At times this has been higher than the volatility measure based only on daily closing rates. Measures of volatility should fall further after the Bank's money market reforms are introduced.

Chart 32
Cumulative folded distribution of sterling secured overnight rates(a)



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

Chart 33
Volatility of overnight interest rates



(a) This measure is derived by taking the squared difference of the log of the daily closing overnight rate, C_t, and the previous day's closing overnight rate, C_{t-1}. Algebraically, it is simply a time series of $(1n\ C_t - 1n\ C_{t-1})^2$.
(b) The Garman-Klass measure includes additional terms to account for the intraday highs and lows of the overnight rate, as well as the opening and closing values. It is calculated using $(1n\ O_t - 1n\ C_{t-1})^2 + 0.5(1n\ H_t - 1n\ L_t)^2 - 0.3862(1n\ C_t - 1n\ O_t)^2$, where O_t, H_t, L_t are, respectively, daily opening level, high and low of the overnight rate.

Forecasting the liquidity shortage

The accuracy of the Bank's liquidity forecast improved slightly over the review period (Table D). During the final quarter of 2005, accuracy was greater than in

Table D
Intraday forecasts versus actual liquidity shortages

Mean absolute difference, £ millions

	9.45 forecast	14.30 forecast	16.20 forecast
2002	83	43	30
2003	99	58	41
2004	105	60	36
2005 Q1	117	79	44
2005 Q2	119	67	50
2005 Q3	195	72	32
2005 Q4	121	64	31
3 Jan.–17 Feb.	103	56	43

The Bank's long-term repo operations

The Bank has recently introduced longer-term repo lending as part of its open market operations (OMOs). The new long-term repo operations are conducted monthly at maturities of three, six, nine and twelve months. Because these maturities extend beyond the next MPC interest rate decision, the Bank operates as a price taker rather than lending at the MPC's official rate, as it does in its short-term repo operations. The long-term repos are at fixed market rates, determined in discriminatory (bid-price) tenders.

The Bank introduced long-term repos in order to help manage its balance sheet ahead of the launch of the fully reformed framework for its operations in the sterling money market, currently expected in May or June. The new framework will be based on averaging of voluntary reserves alongside widely available standing lending and deposit facilities.(1) The structure of the Bank's short-term OMOs will change as a result, moving from daily to weekly operations, of one-week maturity, so that the entire stock of short-term repo lending will roll over once each week. In addition, the introduction of reserves will increase significantly the amount of funds that the Bank needs to provide via OMOs. Effective implementation of monetary policy does not require the Bank to roll over its entire stock of financing each week. Indeed, that would be inefficient. Following consultation with market participants last year,(2) the Bank announced on 14 December that it intended to introduce long-term repo lending in order to limit the size of its short-term repo lending.(3) The Bank also said that it would build up the portfolio of long-term repo lending gradually, over a number of months ahead of launch.

The first long-term repo tender took place on 17 January (see Table C, on page 20 for the results of the January and February tenders). The amounts offered at each maturity have been skewed towards the shorter maturities, reflecting the greater liquidity of the repo market at those maturities. The Bank has initially planned to build up a portfolio of around £15 billion by the time reserve-averaging is launched. The Bank is also considering over time providing longer-term financing through outright purchases of bonds.

Long-term repo tenders are conducted for next-day settlement and usually take place at 10 am on a Tuesday, for settlement on the third Wednesday of each month. All four maturities are normally offered at each tender. The tenders are open to counterparties in the Bank's OMOs, and each counterparty is allowed to submit a maximum of ten bids at each maturity (with a maximum of five in the final ten minutes of the half-hour bidding window). No counterparty is allowed to bid for more than 40% of the total amount on offer in a tender. Funds are then allocated in descending order of the rate offered until the amount on offer has been allocated in full. The eligible collateral that can be used in the long-term repos is the same as that for the Bank's short-term repo operations.

(1) For more information on the new framework, see *Reform of the Bank of England's Operations in the Sterling Money Markets — A paper on the new framework by the Bank of England*, April 2005, available at www.bankofengland.co.uk/markets/money/smmreform050404.pdf.
(2) The consultative paper *Reform of the Bank of England's Operations in the Sterling Money Markets: Transitional Arrangements — A consultative paper by the Bank of England*, August 2005, is available at www.bankofengland.co.uk/markets/moneymarketreform/transarrang050823.pdf.
(3) Available at www.bankofengland.co.uk/markets/moneymarketreform/long_term_repos051214.pdf.

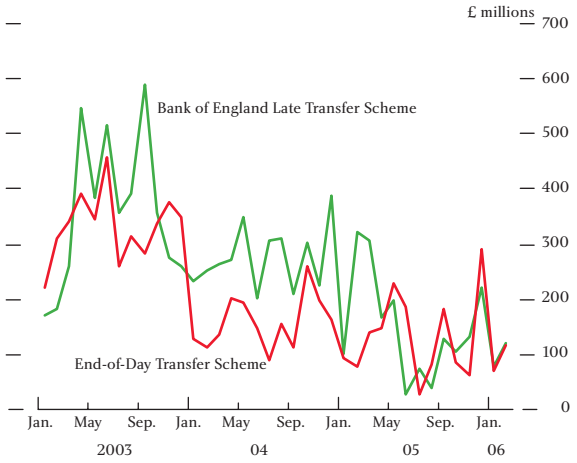
2005 Q3, even though the period included potential additional volatility in the Bank's forecast as a result of seasonal demand for notes around the Christmas period.

A welcome development has been the low level of flows in the end-of-day settlement bank schemes in recent quarters. Average daily payments in both the Bank of England Late Transfer Scheme (BELTS) and End-of-Day Transfer Scheme (EoDTS) have tended to be below £200 million, suggesting the CHAPS-Sterling settlement banks have continued to make accurate forecasts of their end-of-day positions (Chart 34). Flows can be lumpy with many days on which only negligible payments occur in the facilities. The Bank monitors use of these facilities to ensure that, where possible, settlement banks make payments ahead of the CHAPS deadline at 4.20 pm so as to minimise flows in these end-of-day facilities.

Progress on money market reform

The Bank currently expects to launch the reformed system in May or June 2006. A notice was published on

Chart 34
Bank of England Late Transfer Scheme and End-of-Day Transfer Scheme(a)



(a) Monthly averages.

22 December 2005 setting out the key milestones for both the Bank and external participants. These include the Bank undertaking exercises to help ensure that all participants in the reserve scheme, OMOs and standing facilities are familiar with the associated processes. Following these familiarisation exercises, the Bank will invite participants to take part in a 'dress rehearsal' in order to demonstrate to all parties that IT systems and processes, both internal to the Bank and involving external participants, work together effectively. The application period for all institutions wishing to take part in the new system began on 3 January and closed on 17 February. The Bank is currently expecting around 40 reserve scheme banks and building societies, more than 30 OMO counterparties and over 50 standing facility banks and building societies at the launch of the new framework.

New information from inflation swaps and index-linked bonds

By Matthew Hurd and Jon Relleen of the Bank's Monetary Instruments and Markets Division.

Prices of index-linked financial instruments can be used to obtain market-based measures of inflation expectations and real interest rates. These measures are regularly used by the Bank's Monetary Policy Committee to inform its assessment of economic conditions. In the United Kingdom, the index-linked gilt market is long established and has been used to infer such measures for many years. More recently, international index-linked markets have developed further, with increased issuance of index-linked bonds and greater use of index-linked derivatives. This article outlines how new market data provide useful additional information. We show that inflation swap rates can be used to estimate market expectations of inflation, and how the larger range of information from index-linked markets facilitates analysis of market-based expectations for inflation and real interest rates across countries.

Introduction

Index-linked financial instruments can be used to infer market-based measures of inflation expectations and real interest rates. These measures have the advantage of being forward looking, timely and frequently updated for a range of maturities. They are regularly presented to the Bank's Monetary Policy Committee to inform its assessments of economic conditions.

For some time the Bank has used the prices of index-linked and conventional bonds to derive real and nominal yield curves for the United Kingdom.(1) And these curves are used to infer a market-based measure of inflation expectations.(2) Recent developments in international index-linked markets have provided a larger set of market data. We can use this to derive a greater range of market-based measures, both for the United Kingdom and abroad. This facilitates analysis of implied inflation expectations and real interest rates across countries.

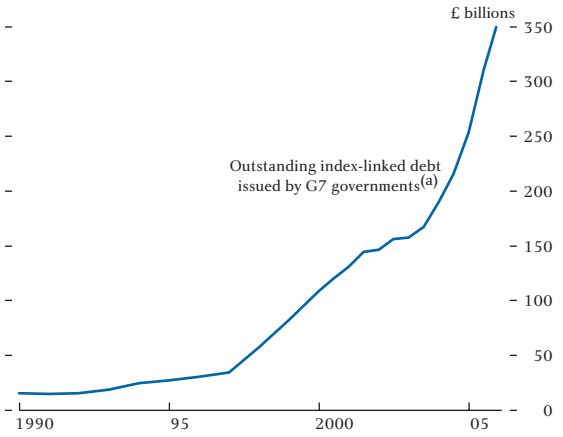
The structure of the article is as follows. First, we describe developments in index-linked financial markets. Second, we outline how these developments provide additional information. In particular, we show that inflation swap rates can be used to infer market-based measures of inflation expectations, and look at how increased issuance of foreign index-linked bonds has provided additional information. The third section discusses the consistency between measures derived from inflation swaps and index-linked bonds, both in theory and in practice. And the fourth section considers what the derived measures imply about expectations for economic prospects. Of particular interest to central banks are measures of markets' long-term inflation expectations, reflecting their confidence in the ability and determination of monetary authorities to control inflation. The final section summarises and concludes.

Developments in index-linked markets

The inflation indexation of financial instruments dates back hundreds of years. But the development of large international markets in government-issued index-linked debt started in the early 1980s, when the United Kingdom began issuing index-linked gilts. Governments of other industrialised countries also began to issue index-linked bonds during the 1980s and 1990s. In global terms index-linked markets remained relatively small with a reputation for poor liquidity. But the market has grown significantly in recent years: the value of issued index-linked debt has more than doubled since 2002 (Chart 1). This change reflects increased issuance by the US Treasury, as well as governments of some other major countries starting to issue index-linked bonds (notably Italy from 2003 and Japan from 2004).

(1) For a full description of the Bank of England's yield curve fitting techniques, see Anderson and Sleath (2001). Estimates of UK yield curves are published at www.bankofengland.co.uk/statistics/yieldcurve.
(2) The derivation and interpretation of breakeven inflation from index-linked gilts is outlined in Scholtes (2002).

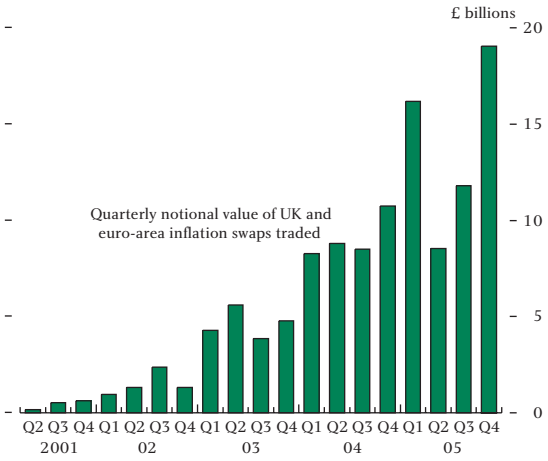
Chart 1
The size of index-linked bond markets



Source: Reuters.

(a) Excluding Germany.

Chart 2
Notional value of inflation swaps traded



Source: ICAP estimates.

During recent years, markets for inflation-linked derivatives have also grown quickly. The largest is the market for inflation swaps, which allow counterparties to exchange a fixed interest rate for payments linked to inflation.(1) (The structure of an inflation swap contract is outlined below.) The inflation swap market is transacted over-the-counter (OTC), rather than via an exchange, so comprehensive data on market activity are not available. However, data from a large broker give an indication of how quickly trading activity has increased (Chart 2).(2) The growth of this market resembles that of the interest rate swap market in the early 1980s. And like that market, the size of the inflation swap market is not constrained by the supply of cash bonds, so the potential for further growth is unlimited.

The euro area has the most active inflation swap market. An initial driver of this was Italian demand for products designed to protect investors from high inflation. The providers of these products could use index-linked bonds or inflation swaps to hedge their resulting inflation exposure. And as demand for the products grew, the inflation swap market was increasingly used for this purpose. UK and US inflation swap markets have seen increased activity during the past year or so. UK demand is dominated by pension funds which have long-term liabilities linked to inflation that they would like to hedge.

Estimating market-based expectations — new possibilities

These developments mean there now exists an increasingly liquid global market in index-linked bonds and derivatives.(3) The greater range of index-linked instruments and increased market activity provide additional market data. We can use this to derive a larger set of market-based measures of expectations of inflation and real interest rates than was previously the case.

It is important to mention that our derived measures are likely to encapsulate more than just market participants' expectations. Market-based measures of inflation expectations are also likely to incorporate inflation risk premia, which investors demand as compensation for uncertainty about future inflation, and possibly other premia related to institutional factors.(4) Likewise, derived real yields may contain risk premia and be affected by institutional factors.(5) These caveats are important when using the curves to infer market expectations, as we do in the final section of this article.

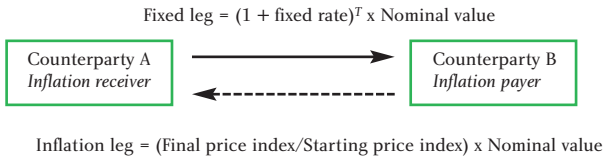
Using market rates on inflation swaps

An inflation swap is a bilateral contractual agreement. It requires one party (the 'inflation payer') to make periodic floating-rate payments linked to inflation, in exchange for predetermined fixed-rate payments from a

(1) Transactions in other index-linked derivatives, such as options and futures, are becoming more common and these markets are likely to expand significantly over time.
(2) Data are only for UK and euro-area contracts and do not include trades between banks and clients. ICAP's market share is subject to variation.
(3) Trading volumes are much lower than those for conventional government bonds or nominal interest rate swaps but those markets are the most deep and liquid in the world.
(4) See Scholtes (2002) for a detailed description.
(5) See 'Interpreting long-term forward rates', *Bank of England Quarterly Bulletin*, Winter 2005, page 418.

second party (the 'inflation receiver'). Inflation swap contracts are arranged OTC so the pay-off structure can be matched to the needs of the counterparty. Hence a variety of contracts are traded, incorporating different cash-flow structures and/or added characteristics such as floors and caps.(1) However, the most common is the zero-coupon inflation swap. This has the most basic structure with payments exchanged only on maturity.

Cash-flow structure of zero-coupon inflation swap of maturity *T* years



The zero-coupon inflation swap has become the standard contract for which rates are quoted in the wholesale market by brokers, and is the data source we use here.(2) The rates observed represent the fixed rate paid by the inflation receiver — that is, the fixed rate agents are willing to pay (receive) in order to receive (pay) the cumulative rate of inflation during the life of the swap. Hence the quoted rate, termed the breakeven inflation rate, will depend on expected inflation over the life of the swap (as well as any risk premia). Thus we can use the quoted rate to derive market-based measures of expectations for inflation.

The box outlines how we can then estimate an inflation forward curve from zero-coupon inflation swap rates. Having estimated an inflation curve we can also derive a real interest rate curve, on the basis that a nominal yield can be decomposed into a real yield and an inflation component. Hence we deduct the inflation forward curve from a separately estimated nominal forward curve to obtain a real forward curve.

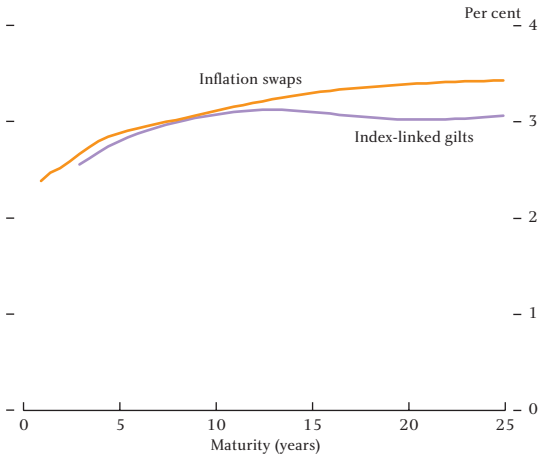
UK inflation forward curves

Potentially inflation swaps offer information beyond that provided by index-linked bond markets, even for the United Kingdom which has a long-established index-linked bond market. This is because our ability to estimate curves using bonds depends on the number of bonds available and the range and dispersal of their maturities. Both will change over time. However, for inflation swaps we observe daily quoted rates for contracts with a wide range of maturities that are evenly spread. For the United Kingdom, maturities range from one to 25 years.(3) And there are contracts for each year up to ten years and subsequently for maturities of 12, 15, 20 and 25 years.

The additional information allows us to derive UK inflation and real curves that begin at short horizons, as UK inflation swaps offer a measure which starts at about ten months.(4) In contrast, the shortest index-linked gilt included in our curve estimation matures in October 2009, more than three years hence.(5) One caveat here is that short-dated contracts are the least traded UK inflation swaps (market factors are discussed later).

Chart 3 compares UK curves derived from inflation swaps and from index-linked and nominal bonds. Between three and ten years the curves are virtually identical. At the longest horizons the curves diverge somewhat with the curve derived from inflation swaps being slightly higher than the curve derived from index-linked bonds. (The consistency of the two measures is discussed below.)

Chart 3
UK inflation forward curve for 21 February 2006



Sources: Bank of England and Bloomberg.

International breakeven inflation curves

We are also able to derive a range of international curves. This follows recent issuance of US and euro-area index-linked bonds, together with the development of international inflation swap markets.

(1) For explanations of some common inflation swap structures see 'Inflation-protected bonds and swaps', *Quarterly Bulletin*, Summer 2004, pages 124–25. Greater detail and other examples can be found in Deacon *et al* (2004).
(2) Our data are composite series from Bloomberg that incorporate rates available across a selection of brokers.
(3) A few brokers quote longer maturities, up to 50 years.
(4) The one-year contract less the two-month indexation lag.
(5) The curve is evaluated at the bond maturity minus the lag length.

Estimating an inflation forward curve from inflation swap rates

This box outlines how we can use inflation swap rates to estimate an inflation forward curve. This involves adjusting the observed swap rates to account for the imperfect indexation of the contracts, before using our standard curve estimation technique.

In practice, inflation swap contracts have indexation lags. This means a contract is referenced to inflation for a period that begins before the date on which the contract is priced and ends before the contract matures. We can say that a contract of maturity T years traded at time t will be referenced to inflation over a period $t - L$ to $t + T - L$, where L is the indexation lag expressed as a fraction of a year. The (annually compounded) swap rate can therefore be expressed as:

$$\left(1+swap\ rate_t\right)^T = \left(1+\tilde{\pi}_{t-L,t+T-L}\right)^T \qquad \textbf{(1)}$$

where $\tilde{\pi}_{i,j}$ represents the inflation compensation required by investors for the period between i and j, expressed as an annual rate.(1)

Our aim, however, is to derive an estimate for expected inflation from today, time t, whereas the swap rate depends on expected inflation from $t - L$ to $t + T - L$. We would like to be able to strip out inflation that has already accrued, $\hat{\pi}_{t-L,t}$. Essentially to be able to decompose the swap rate into:

$$\left(1+\tilde{\pi}_{t-L,t+T-L}\right)^T = \left(1+\hat{\pi}_{t-L,t}\right)^L \left(1+\tilde{\pi}_{t,t+T-L}\right)^{T-L} \qquad \textbf{(2)}$$

Expressions **(1)** and **(2)** enable us to derive an estimate of inflation compensation from today:

$$\left(1+\tilde{\pi}_{t,t+T-L}\right)^{T-L} = \frac{\left(1+swap\ rate_t\right)^T}{\left(1+\hat{\pi}_{t-L,t}\right)^L} \qquad \textbf{(3)}$$

Unfortunately, the denominator is not directly observable. This is because price indices are compiled monthly and published with a lag, so we are never in possession of a price index for today.

We encounter this 'publication lag' problem when deriving real interest rate forward curves from index-linked bond prices. To get round it we assume that today's price level, P_t, can be extrapolated using the latest available annual inflation rate, π_{t1}, and the latest available price level value, P_{t1}, which refer to time t_1:

$$P_t = \left[1+\left(t-t_1\right)\pi_{t1}\right]P_{t1}, \text{where } \pi_{t1} = \frac{P_{t1}-P_{t1-1year}}{P_{t1-1year}}$$

This assumption is rather simplistic. But it has the advantage of being consistent with the technique already in use to estimate real interest rate curves from index-linked bonds, as set out by Anderson and Sleath (2001).(2)

We then calculate an estimate of the inflation that has already accrued, $\hat{\pi}_{t-L,t}$, using this estimate for today's price level and the swap's reference price index level (specified according to market conventions set out in the appendix). Hence we can use **(3)** to estimate rates for inflation compensation from today. Once we have these rates we use our standard yield curve estimation technique to fit a forward curve.(3)

(1) As discussed in the main text, inflation compensation may differ from expected inflation.
(2) In future, we may be able to obtain a less 'naïve' estimate of today's price level from inflation futures. Futures based on near-term outturns for US and euro-area inflation have recently started trading on the Chicago Mercantile Exchange.
(3) We use the 'Variable Roughness Penalty' technique, which we also employ for curves based on bonds. The methodology is outlined in Anderson and Sleath (1999) and explained in more detail in Anderson and Sleath (2001).

To estimate US and euro-area real interest rate curves from index-linked bonds we employ the same methodology used to derive UK real curves.(1) However, we have to adjust the way we treat the price data to reflect differences in the bond conventions and specifications used in different markets (these are set out in the appendix). Before presenting these curves it is important to highlight a couple of issues related to the index-linked bonds used to estimate the curves.

There are now a relatively large number of bonds indexed to US CPI inflation issued by the US Treasury — commonly referred to as Treasury Inflation Protected Securities (TIPS). However, at longer horizons there is a range of maturities for which no bonds are available. Maturities are evenly spread out to ten years, but after that the next bond's maturity is 20 years ahead (Chart 4). So our curve estimation is based on a detailed set of data points out to ten years, but relies

(1) Described by Anderson and Sleath (2001).

heavily on our yield curve modelling technique between ten and 20 years. Hence inferences about real rates and inflation expectations near this range of maturities are more limited. In contrast, inflation swap contracts linked to US CPI inflation provide an even spread of maturities.

Chart 4
Distribution by maturity of index-linked bonds(a)

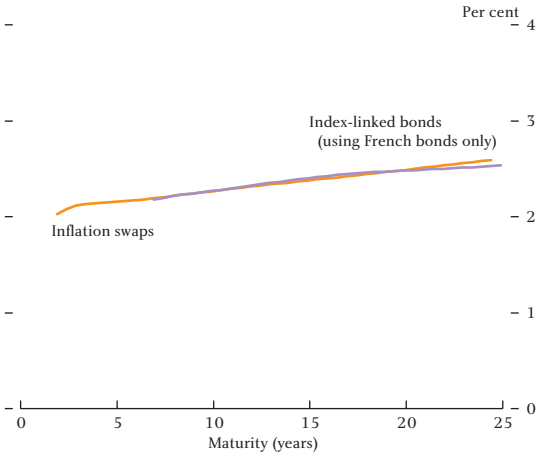
Source: Reuters.

(a) This summarises the current situation, which will change through time as bonds mature and others are issued. The chart does not include the 2055 UK index-linked gilt.

Chart 4 also shows government bonds linked to the euro-area HICP inflation index, which can be used to estimate a euro-area curve. Although there are fewer bonds, the spread of maturities is relatively even. However, an additional complicating factor is that the bonds were issued by three different governments — those of France, Greece and Italy. This could be a problem if investors view each government differently in terms of default risk. If so, the prices of different governments' debt may trade with different credit premia. This problem does not occur for zero-coupon inflation swap contracts since these euro-area contracts are standardised and homogeneous.

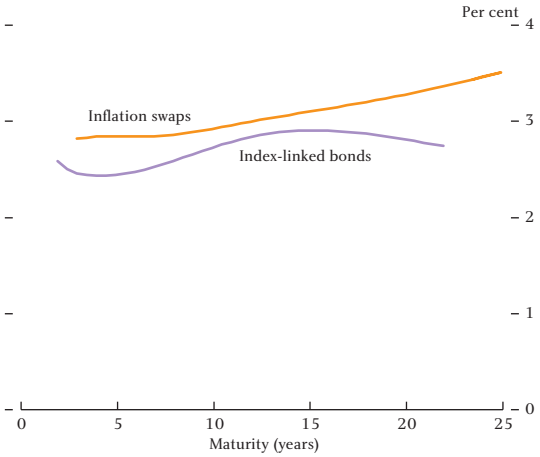
Charts 5 and 6 compare curves derived from index-linked bonds and inflation swaps for the euro area and United States respectively. For the euro area, which has the most developed inflation swaps market, the curve derived from inflation swaps extends to shorter maturities — the shortest-horizon contract being the two-year inflation swap. Where comparable, the two curves are virtually identical. For the United States, the shortest inflation swap contract we observe rates for is the three-year contract. Here there are differences between the two curves at all maturities.

Chart 5
Euro-area inflation forward curves for 21 February 2006



Sources: Bank of England and Bloomberg.

Chart 6
US inflation forward curves for 21 February 2006



Sources: Bank of England and Bloomberg.

Why might there be differences between curves derived from the two sources?

The inflation curves shown are for a specific date, but are fairly typical of the period for which we have comparable data. UK curves derived from the two sources are very similar at shorter horizons but diverge a little at the longest horizons. Curves for the euro area are almost identical, although small gaps are sometimes observed at the longest horizons. For the United States, there are persistent differences, with curves derived from inflation swaps being slightly higher than curves derived from index-linked bonds. Gaps between the US curves have tended to be about 10 to 30 basis points, across the maturity spectrum.

Theoretical consistency

In theory, the inflation compensation implicit in the prices of nominal bonds relative to index-linked bonds

should be the same as that embodied in inflation swap rates. The two should be consistent due to arbitrage. That is because the pay-offs of index-linked bonds can be replicated using inflation swap contracts. And two portfolios with identical future pay-offs should have the same price via arbitrage. Hence, with perfect markets we would expect perfect substitution between breakeven rates available in the inflation swap and bond markets.(1)

Practical differences

In theory, inflation curves derived from inflation swaps and index-linked bonds should be identical, but in practice there can be differences. The primary cause is likely to be that market factors inhibit investors from arbitraging or hedging fully between inflation swap and index-linked bond markets.(2) This might occur because of barriers to arbitrage caused by incomplete markets. The ability to arbitrage or hedge across markets is dictated by the availability of assets for that purpose, so a lack of suitable assets would hinder these transactions. Another possibility is that trading costs create barriers to arbitrage. In broad terms, trading costs are likely to be inversely related to levels of market activity and competition.

If barriers to arbitrage are relevant here, this might partly be a symptom of some of the markets being relatively young. Hence these factors might recede over time as markets mature and activity increases. Also, these barriers may affect certain maturities more than others. For example, at maturities where a range of index-linked instruments are available, relative pricing may be better than at 'missing' points on the curve, where there is a lack of instruments. Similarly, trading costs may be lower at maturities where there is more market activity, and *vice versa*.(3)

If barriers to arbitrage do exist, prices in the two markets would be set more independently. In this case, relative supply and demand in each market would determine pricing and might cause breakeven rates to be different in one market versus the other. For example, if index-linked bonds are considered illiquid they will be less attractive to investors and so prices may be lower than otherwise. And an often cited feature of inflation swap markets is an excess of those wishing to receive inflation relative to those wishing to pay inflation. Other things being equal, this would raise breakeven rates — the price of receiving inflation — compared to otherwise. A further factor is that any distortions to the relevant nominal yield curve would affect inflation curves derived from index-linked bonds, but not those derived from inflation swaps.(4)

It is perhaps worth noting that we would not expect differences to be caused by counterparty risk premia in the inflation swap rates we use. That is because transactions make use of standard agreements, which require collateral to be posted and provide some legal protection in the event of counterparty default.(5) And even in cases where there is a significant credit differential between counterparties, any premia would be built into transactions on a bilateral basis rather than affecting the data we observe (which are rates quoted by brokers in the wholesale markets). Neither would we expect any differences to be caused by systemic banking sector risk. This contrasts with the nominal interest rate swap curve, which generally lies above the relevant nominal government bond curve because interest rate swaps are referenced to future interbank market rates — usually six-month Libor — which contain premia that reflect systemic banking sector risk.(6)

So, in summary, inflation curves derived from inflation swaps are theoretically consistent with those from index-linked bonds. However, if assumptions underlying this theory are not met, curves derived from the two sources may differ in practice. The curves we derive generally provide a very similar read on expectations. In some cases there are differences and hence the practical caveats mentioned in this section should be borne in mind when interpreting the curves.

(1) Perfect markets describe theoretical ideal conditions for markets to function. This involves numerous assumptions, including no trading costs; no barriers to entering or leaving the market; complete access to information by all parties; and the rationality of all parties.
(2) For a description of how arbitrage/hedging transactions work in practice see Chapter 5 of Benaben (2005).
(3) At the time of writing, inflation swap market activity is concentrated at different maturities in different markets. Most trading in UK contracts is in maturities over 15 years. For the euro-area and US markets, most activity is in contracts with maturities under ten years.
(4) When using index-linked bonds we first estimate a real curve and then subtract this from the relevant nominal curve to obtain an inflation curve. In contrast, inflation curves are derived directly from inflation swap rates.
(5) Typically agreements developed by the International Swaps and Derivatives Association are used. These are also used for nominal interest rate swaps and mitigate bilateral counterparty risk to the extent that credit premia on observed swap rates are typically considered negligible.
(6) In practice, a number of other factors may also influence nominal swap spreads. A discussion of observed swap spreads can be found in Cortes (2003).

What do our curves tell us?

Inflation and real interest rate curves are regularly used by the Monetary Policy Committee to inform its assessments of the prospects for inflation and economic conditions. This section outlines how they might be employed. As mentioned earlier, when using the curves it is important to remember they are likely to encapsulate more than just market participants' expectations. They are likely to incorporate risk premia and may also be affected by institutional factors. So in conducting our analysis we accept the curves may provide an imperfect proxy of market expectations.

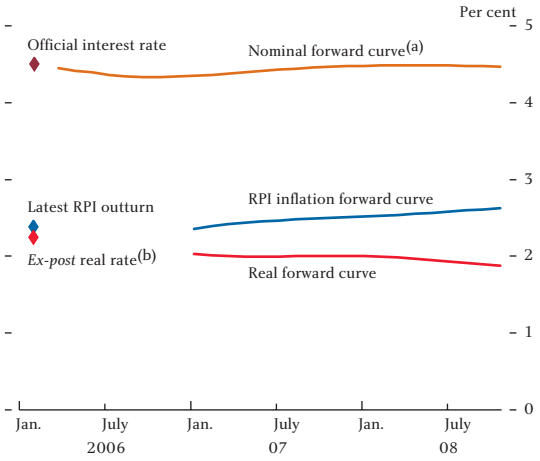
Prospects for the current economic cycle

Chart 7 compares recent UK interest rates and inflation with forward curves at short horizons. These imply that, on 21 February, RPI inflation was expected to remain fairly close to its level for the year to end-January 2006 (which was then the latest available outturn). The real interest rate forward curve can be used to indicate market expectations for prevailing monetary conditions in the future. It indicates that UK real rates were expected to fall slightly over subsequent years. It is worth noting that the real and inflation curves presented here relate to RPI inflation, rather than CPI inflation which is now targeted by the MPC. It is possible to derive expectations for CPI inflation, although this requires making assumptions about the future difference between CPI and RPI inflation and hence ceases to be a purely market-based measure.

Charts 8 and 9 show inflation and real interest rate forward curves for the euro area and the United States, also on 21 February. These imply that markets expected inflation to be about 2% and 2.5% respectively over the medium term. This seems fairly consistent with the inflation objectives of the ECB and the Federal Reserve.(1) And this also seems to suggest that any inflation risk premia were relatively small. Over the medium term, real forward rates are expected to rise in both the euro area and the United States. The euro-area real forward curve has a steeper gradient, possibly reflecting their position in the economic cycle relative to the United States.

Overall, it is apparent that despite the increase in oil prices over the past two years, medium-term market implied inflation expectations in the euro area, the United Kingdom and the United States appear to have remained broadly consistent with the objectives of the respective central banks.

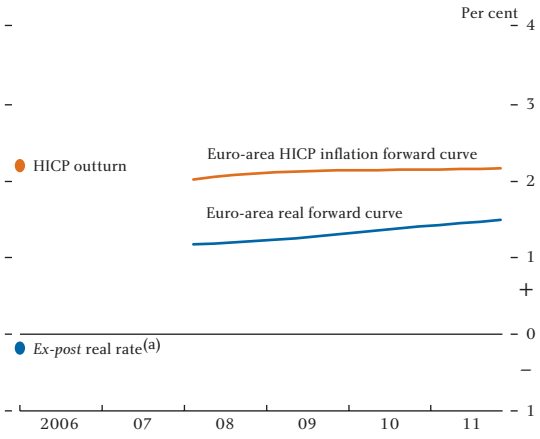
Chart 7
UK forward curves for 21 February 2006



Sources: Bank of England and Bloomberg.

(a) Curve derived from instruments that settle on Libor, and then adjusted for credit risk.
(b) Calculated as the average official interest rate during the year to end-January 2006 less RPI inflation over the same period.

Chart 8
Euro-area forward curves for 21 February 2006



Sources: Bank of England and Bloomberg.

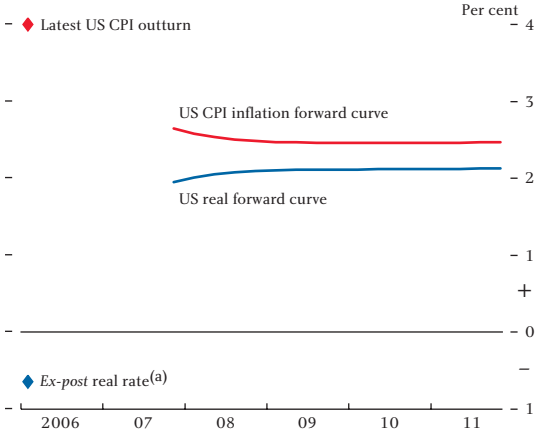
(a) Calculated as the average official interest rate during the year to end-December 2005 less HICP inflation over the same period.

Long-term real interest rates

Chart 10 shows time series of long-term real interest rates. This highlights a recent trend for falls in the level of long-term real interest rates, as discussed in two boxes in recent Bank publications.(2) These noted that the trend might be due to increases in world saving rates, particularly in emerging Asian economies, and possibly

(1) The ECB aims at inflation rates of below, but close to 2% over the medium term; the Federal Reserve does not explicitly aim for a specific rate of inflation.
(2) See 'The economics of low long-term bond yields', *Bank of England Inflation Report*, May 2005, page 6; and 'The fall in global long-term real interest rates', *Bank of England Quarterly Bulletin*, Spring 2005, page 12.

Chart 9
US forward curves for 21 February 2006

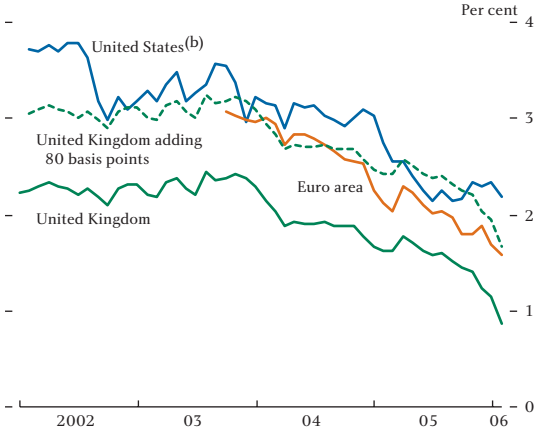


Sources: Bank of England and Bloomberg.

(a) Calculated as the average official interest rate during the year to end-January 2006 less CPI inflation over the same period.

lower levels of planned investment in developed economies. The boxes also highlighted the possibility that changes in risk premia or market factors, such as increased institutional demand for certain government bonds, may have affected the market rates we observe. It is also possible that the continuing development of index-linked markets may have made index-linked instruments more attractive to investors and hence reduced any liquidity premia they demand. This would increase the price of index-linked bonds and hence reduce real rates, but this factor would not explain the magnitude of the fall in real rates we observe.

Chart 10
International real ten-year forward curves(a)



Sources: Bank of England and Bloomberg.

(a) Data are monthly average rates.
(b) US data are nine-year forward rates.

Chart 10 also allows us to compare the level of international ten-year real rates. Theory predicts that at long horizons real rates of return (on similar assets) should be the same internationally.(1) Hence we might expect our derived real rates to converge toward a 'world real interest rate' at long maturities.

For this comparison, UK rates have been adjusted upwards by 80 basis points to reflect the long-run average difference between RPI and CPI inflation and hence crudely make them more comparable with US and euro-area rates.(2) To the extent that this is the correct adjustment, the chart shows that UK and US rates have been relatively close since mid-2002.(3) The euro-area series covers a shorter period. Initially euro-area rates were at a very similar level, but during the past year have been consistently at a slightly lower level. So there appears to be some evidence for ten-year real rates being at similar levels internationally, although we do not observe total convergence. However, it is less clear whether there is any evidence of convergence at maturities much longer than ten years.

There are several potential explanations for the absence of full convergence. First, if international markets were in practice segmented, real interest rates would be influenced by domestic economic prospects. Second, differences in regulatory requirements and tax regimes could affect the demand schedule of the marginal investor for each country. Third, it is possible that investors demand risk premia for investing in bonds, and that the size of these premia might be different for bonds issued by different countries. Finally, the inflation indices on which the real rates are based are not fully comparable. The different composition of the index used for UK index-linked instruments has only been crudely accounted for. Furthermore, the CPI indices vary in their precise construction and potentially their ability to proxy the 'true' deflator facing individuals in each country.

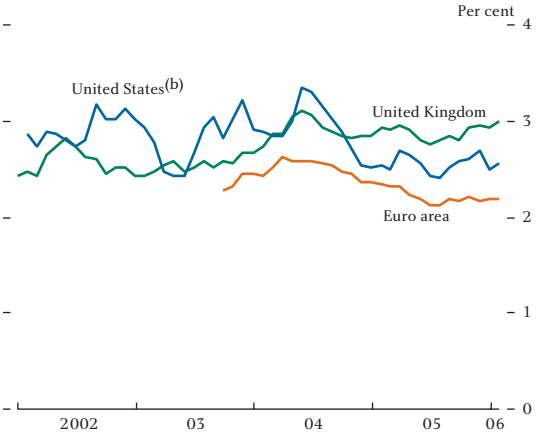
The longer-term outlook for inflation

A primary driver of investors' long-term inflation expectations is their confidence in the ability and determination of the monetary authorities to control

(1) This result is based on a world with perfect capital mobility, freely floating exchange rates and where uncovered interest rate parity holds. For a fuller discussion see Jenkinson (1996) or Brooke *et al* (2000).
(2) UK index-linked instruments are linked to RPI inflation whereas US and euro-area instruments are linked to CPI and HICP indices respectively, which have a more similar construction. Hence the UK time series has been adjusted upwards by the average difference between UK RPI and UK CPI since 1989 when CPI data are first available. This is not necessarily an accurate guide to future differences between RPI and CPI inflation. For further details see 'The wedge between RPI and CPI inflation', *Inflation Report*, November 2005, pages 29–30.
(3) Mid-2002 is around the time the US TIPS market became more liquid.

inflation. As explained above, our inflation forward curves will encapsulate market participants' expectations for inflation and also inflation risk premia that reflect uncertainty about future inflation. Although it is difficult to decompose forward rates into these components, both are likely to be (inversely) related to the perceived credibility of the monetary authority in controlling inflation.

Chart 11
International inflation ten-year forward rates(a)



Sources: Bank of England and Bloomberg.

(a) Data are monthly average rates.
(b) US data are nine-year forward rates.

Chart 11 shows long-horizon inflation forward rates for the United Kingdom, the United States and the euro area. In each case the level of the forward rates appears broadly consistent with the central bank's inflation objective of price stability. This appears to indicate that investors believe central banks are likely to meet their inflation objectives of broad price stability over the long term, and that any inflation risk premia are relatively small. US inflation forward rates have been slightly more volatile than those for the United Kingdom and the euro area. This might reflect more variation in investors' long-term expectations for US inflation and inflation risk premia, or institutional factors such as liquidity in the TIPS market.

Summary and conclusions

Recent developments in international index-linked markets have provided new market data. We can now estimate a greater range of international inflation and real interest rate forward curves using either inflation swaps or index-linked bonds. These curves facilitate analysis of inflation expectations and real rates across countries, and are regularly used by the Monetary Policy Committee to inform its assessments of economic conditions. At short to medium-term horizons the curves are a useful guide to market expectations about the evolution of the current economic cycle. At long horizons, inflation forward rates can be used to gauge financial markets' confidence in the ability and determination of monetary authorities to control inflation. In the United Kingdom, the United States and the euro area these currently appear broadly consistent with each central bank's inflation objective of broad price stability.

Appendix
Details of inflation swaps and index-linked bonds across countries

There are variations in the design of index-linked bonds and inflation swap contracts across countries. The tables in this appendix outline the design features of the index-linked bonds and inflation swaps whose prices are used in this article. In particular, the price index to which each instrument is referenced; the indexation lag, which identifies which month the contract is referenced to; the method used to calculate the reference price level (described in more detail below); and whether the contract has a floor, which protects investors from deflation.

Table A
Index-linked bonds

	Reference index	Lag length (months)	Calculation of reference price level	Floor[a]
United Kingdom	UK RPI	8 [b]	End of month[b]	No
United States	US CPI (urban consumers NSA)	3	Interpolated	Yes
France	Euro-area HICP excluding tobacco	3	Interpolated	Yes
Greece	Euro-area HICP excluding tobacco	3	Interpolated	Yes
Italy	Euro-area HICP excluding tobacco	3	Interpolated	Yes

(a) When deriving curves using index-linked bonds with an inflation floor (to protect investors against deflation) we assume the floor has a negligible impact on the bond prices.
(b) All new UK bonds issued since September 2005 have used a three-month indexation lag and the interpolated reference price level method.

Table B
Standard zero-coupon inflation swaps

	Reference index	Lag length (months)	Calculation of reference price level	Floor
United Kingdom	UK RPI	2	End of month	No
United States	US CPI (urban consumers NSA)	3	Interpolated	No
Euro area	Euro-area HICP excluding tobacco	3	End of month	No

Calculation of the reference price level[1]

The reference price level is important for both index-linked bonds and inflation swaps. For index-linked bonds it determines the scaling applied to each coupon and the redemption payment. For inflation swaps it determines the calculation of payments on the floating leg of the contract.

The reference price level is either an end-of-month value or a value interpolated between levels for two consecutive months. For the end-of-month method, the price level is just the published index value for the month specified by the indexation lag. For example, euro-area inflation swaps traded in April are based on the index value for January. Under the interpolated method, a new value is calculated each day. For the first day of any month the reference value is the same as for the end-of-month method. But for subsequent days the value is calculated by interpolating between that index value and the following month's index value. For example, US inflation swaps traded in mid-April will be referenced to a value interpolated between the index values for January and February. This is calculated as follows:

$$CPI_{ref} = CPI_{M-L} + \left(\frac{d-1}{D}\right).\left[CPI_{M-L+1} - CPI_{M-L}\right]$$

where M is the current month (in which the contract is traded), L is the indexation lag (in months), d is the day of the current month, and D is the number of days in the current month.

(1) For more detail see Deacon *et al* (2004).

References

Anderson, N and Sleath, J (1999), 'New estimates of the UK real and nominal yield curves', *Bank of England Quarterly Bulletin*, November, pages 384–92.

Anderson, N and Sleath, J (2001), 'New estimates of the UK real and nominal yield curves', *Bank of England Working Paper no. 126*.

Benaben, B (ed) (2005), *Inflation-linked products*, Risk Books, ISBN 1-904339-60-3.

Brooke, M, Clare, A and Lekkos, I (2000), 'A comparison of long bond yields in the United Kingdom, the United States and Germany', *Bank of England Quarterly Bulletin*, May, pages 150–58.

Cortes, F (2003), 'Understanding and modelling swap spreads', *Bank of England Quarterly Bulletin*, Winter, pages 407–16.

Deacon, M, Derry, A and Mirfendereski, D (2004), *Inflation-indexed securities*, 2nd edition, Wiley Finance, ISBN 0-470-86812-0.

Jenkinson, N (1996), 'Saving, investment and real interest rates', *Bank of England Quarterly Bulletin*, February, pages 51–62.

Scholtes, C (2002), 'On market-based measures of inflation expectations', *Bank of England Quarterly Bulletin*, Spring, pages 67–77.

The distribution of assets, income and liabilities across UK households: results from the 2005 NMG Research survey

By Richard Barwell of the Bank's Inflation Report and Bulletin Division and Orla May and Silvia Pezzini of the Bank's Systemic Risk Assessment Division.

This article summarises the key results from the latest survey carried out for the Bank by NMG Research about the state of household finances. A relatively small proportion of households accounted for a large amount of the assets owned, income earned and debts owed by the whole sample. The majority of households appeared to be comfortable with their finances. But there were a small number of households who appeared to be in distress: typically they had below-average incomes and no or not many assets to draw on. The proportion of the sample in financial distress was little changed from a year earlier. The survey indicated that very few people viewed bankruptcy as a solution to debt problems.

Introduction

In September 2005, NMG Research conducted a survey of around 2,000 individuals which asked a range of questions about assets, income and debts. The answers to those questions provide a useful snapshot of the state of household finances.(1) The latest survey is the third that the Bank has commissioned NMG Research to conduct on this issue.(2) Taken together with information from successive waves of the British Household Panel Survey (BHPS), the latest survey can shed light on trends in financial distress at the household level.(3) However, survey data have to be interpreted with care: the NMG Research survey only asks a sample of the population and may not give a completely reliable picture of the true state of household finances. The limitations of these survey data are explored in the box on pages 38–39.

Distribution of debt

Debt was not evenly distributed across the households who participated in the survey. Two out of every five households had no debts whatsoever, and among those who held debt, there was a wide variation in the amount owed.

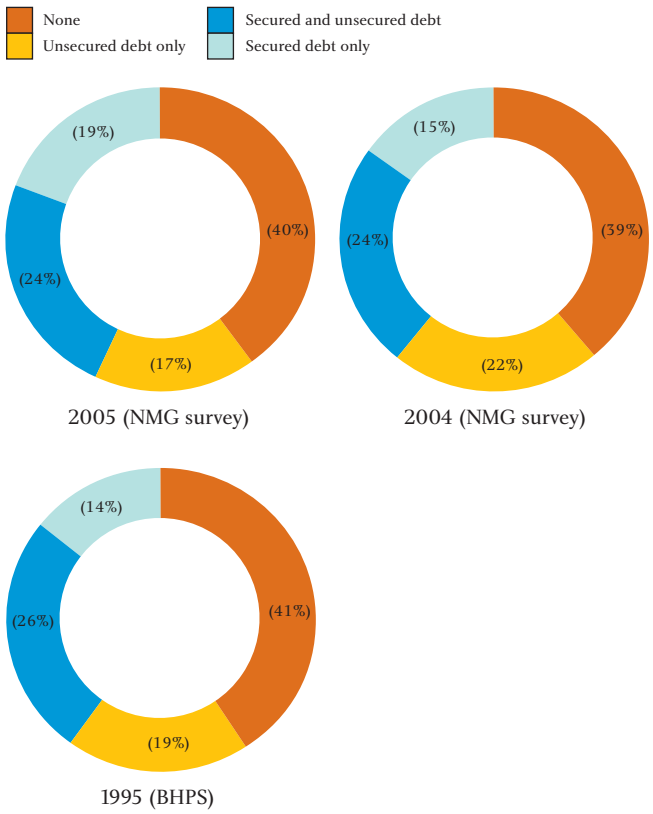
The fraction of households in the survey who did not hold any debt was unchanged on a year ago. In fact, the proportion without debt was little changed on a decade earlier (Chart 1).

However, there was a shift during the past year in the fraction of the sample holding different types of debt over the year to September 2005. The fraction of households with mortgages (debt secured on property) had risen (from 39% to 43%), and the fraction with unsecured debt had fallen (from 46% to 41%).

The survey indicates that the amount of debt held by indebted households increased over the year to September 2005 with secured debt continuing to account for the lion's share (almost 90%).(4) The distribution of that debt burden remained uneven. Of those holding secured debt, almost one in four had secured debts of less than £20,000, while around one in six had secured debts in excess of £100,000 (Chart 2(a)). Similarly almost one in four of those with unsecured debts had debts of less than £500, while around one in six had debts in excess of £10,000 (Chart 2(b)). It is not easy to judge from Charts 2(a) and (b) whether the burden of debt became more or less evenly distributed over the year to September 2005.

(1) The raw survey data are provided at www.bankofengland.co.uk/publications/quarterlybulletin/nmgsurvey2005.xls.
(2) The previous surveys, which were carried out in September 2003 and 2004, are discussed in Tudela and Young (2003) and May, Tudela and Young (2004) respectively.
(3) The British Household Panel Survey (BHPS) data used in this article were made available through the UK Data Archive. The data were originally collected by the Economic and Social Research Council Research Centre on Micro-social Change at the University of Essex, now incorporated within the Institute for Social and Economic Research. Neither the original collectors of the data nor the Archive bear any responsibility for the analyses or interpretations presented here. For more details on the BHPS see Cox, Whitley and Brierley (2002).
(4) Consequently homeowners account for the vast majority of debt.

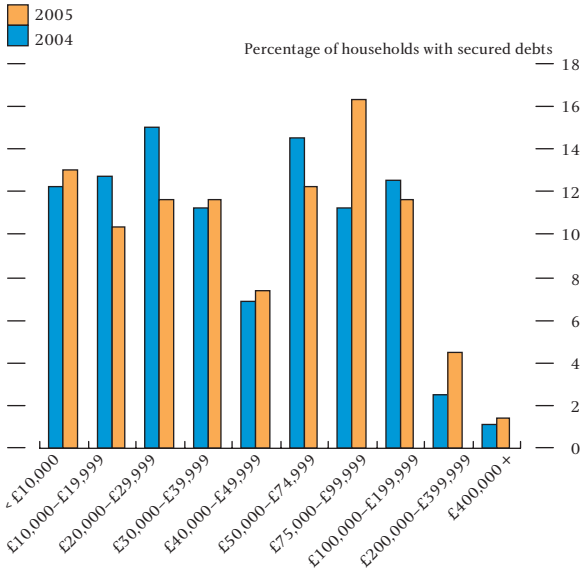
Chart 1
Households' debt holdings (proportion of respondents)



Sources: BHPS, NMG Research and Bank calculations.

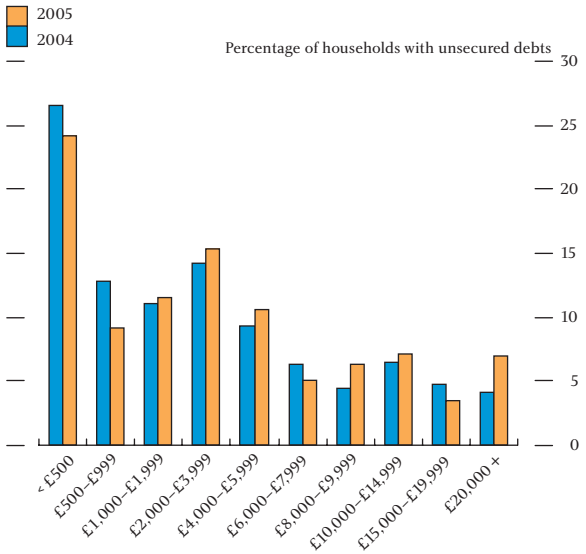
Chart 2
The distribution of debt

(a) Secured debt



Sources: NMG Research and Bank calculations.

(b) Unsecured debt



Sources: NMG Research and Bank calculations.

One way to identify shifts in the distribution of debt is to use a so-called Lorenz curve.

The Lorenz curve traces out the cumulative share of successive people in the sample against the cumulative share of total debt accounted for by those people, when the sample is arranged from the lowest to the highest amount of debt held. If debt was equally distributed across the sample (all individuals held the same amount of debt), the Lorenz curve would lie on the 45° line. At the other extreme, if one individual held almost all the debt, the Lorenz curve would lie close to the x and y axes. So the further the Lorenz curve is from the 45° line the more unequal the distribution of debt.

Chart 3 indicates that the distribution of debt (across those households holding some debts) was broadly unchanged on a year earlier. The distribution remained highly skewed: a small fraction of the sample continued to account for a large proportion of the debt.

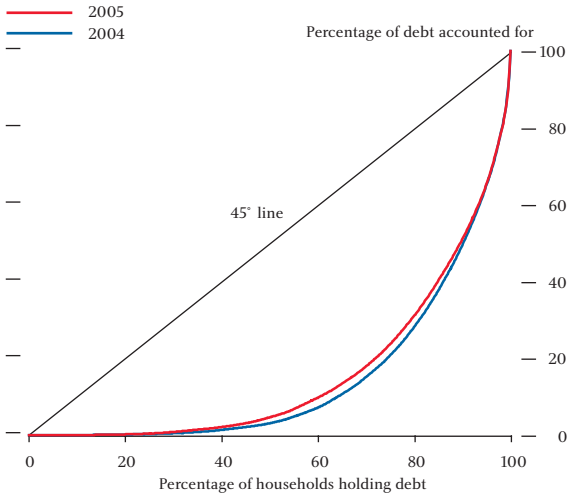
Affordability of debt: the costs of servicing debt

A key question for policymakers is whether debt is affordable. One way of answering that question is to compare households' debts to the resources they currently have at their disposal to service them.

Measures of affordability typically focus on the share of household income currently devoted to servicing debt. Like the distribution of debt, the distribution of gross annual income(1) was highly skewed across the sample:

(1) In most cases household income is defined by labour income plus any government benefits the household receives. But some households will also receive income from investments.

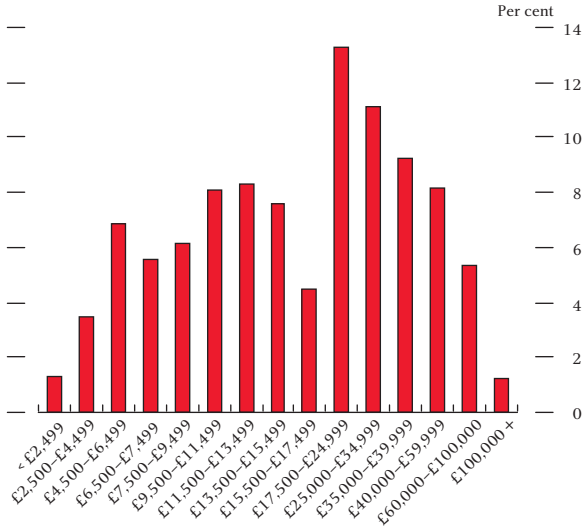
Chart 3
Distribution of debt: the Lorenz curve



Sources: NMG Research and Bank calculations.

half of the sample earned less than £17,500 a year, but a quarter of the sample earned more than double that amount (Chart 4). The question is: do the households with the largest debt burdens (in terms of interest and principal repayments) also have the highest incomes to service those obligations?

Chart 4
Distribution of gross annual income

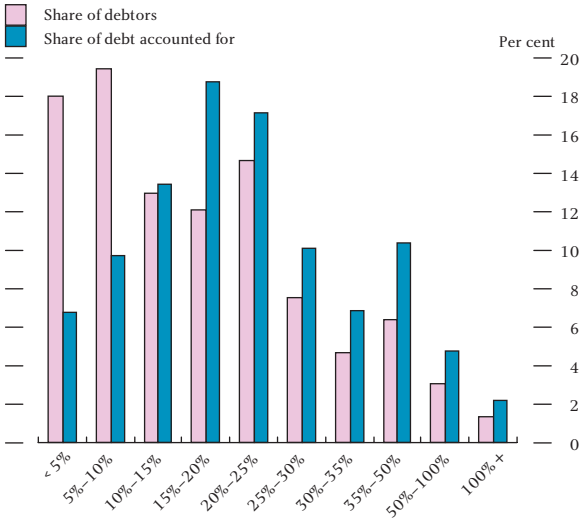


Sources: NMG Research and Bank calculations.

The problem with this measure of affordability is that it focuses on the amount of income that a household currently earns. Whether the current debt burden proves to be affordable will depend on how income evolves in the future relative to the costs of servicing debt. The current share of household income devoted to servicing debt — or current affordability — may be a poor guide to affordability in the future. Income may rise, allowing households to devote a smaller share of their budget to servicing debt.(1) So debts which look unaffordable today, given the current levels of income and interest rates, may not be a cause for concern if income is expected to increase significantly in the future. But future income streams are not guaranteed, and if official interest rates rise the costs of servicing debt are also likely to rise. So debts which look affordable under current income and interest rates may not be affordable in the future if unemployment or interest rates rise.

Over three quarters of the sample spent less than a quarter of their income on debt servicing, and they accounted for two thirds of all debt owed by households in the sample (Chart 5).(2) That reflects the relatively low level of interest rates and the fact that the vast majority of debt is secured on property and typically repaid over several decades. But there was a small minority of households who devoted most of their income to servicing debt. Some of these households also held unsecured debts on which they were not paying interest. As those zero-interest deals expire, these households may face further financial pressure.

Chart 5
Distribution of the ratio of debt servicing costs to income (across debtors)(a)



Sources: NMG Research and Bank calculations.

(a) The chart divides households with debts into different groups according to their debt to income ratio. The pink bar describes how common each group is, and the blue bar shows how much of the total stock of debt each group accounts for.

(1) One of the main reasons why people borrow money is to bring forward some of the consumption that future increases in income will ultimately allow.
(2) Debt servicing costs are defined in this article to include the payments that households make to their endowment mortgage scheme and any premia they pay for life insurance and critical illness cover as part of their mortgage.

Interpreting data from the NMG Research survey

The survey data discussed in this article provide an imperfect gauge of the current state of household finances. The survey covers only a small fraction of the total population and the data that those individuals provide cannot be validated. Like any survey, the quality of the data depends critically on the design of the sample and the accuracy of the responses. This box discusses these features of the NMG Research survey to help clarify its potential value.

A key determinant of the accuracy of any statistics produced from survey data (averages, proportions and other sample statistics) is the size of the sample. The larger the sample, the more likely it is that those sample statistics will approximate the population as a whole. The survey data discussed in this article were collected by NMG Research as part of their consumer tracking survey, MarketMinder. 1,923 people were interviewed between 23 and 29 September 2005, so the sample covers around 0.005% of the adult population of Great Britain. By the standards of other surveys, the sample is reasonable — it is around one fifth of the size of the main BHPS sample.

In practice, the sample size varies from question to question. The survey is voluntary, and not every person answers every question. Sometimes that will reflect the fact that people do not understand the question or do not know the answer. And sometimes it reflects the fact that people choose not to answer a question. The degree of non-response to the questions in the survey varies from zero in the case of questions about people's age to almost 50% in the case of those asked about their income. Unless otherwise stated, this article focuses on only those individuals who provided all the relevant information required to construct a particular chart.(1)

The implications of non-response will depend on the reason why individuals did not respond. If non-response is random then it leads to a reduction in sample size and the reliability of statistics produced from the data. But if non-response is correlated with individuals' characteristics, and in particular the answer that they would have given, then the responses obtained are likely to be misleading. That is because the subset of people who answer the question will not be representative of the population as a whole. For example, individuals earning large incomes may prefer not to say so — so the average income in the sample may be misleadingly low.

If the survey sample is not representative of the population it is unlikely that the data can provide a reliable guide to behaviour. Some demographic groups may be over or underrepresented in the survey sample. If so the survey is likely to produce misleading results whenever variables of interest, like income or debt, are correlated with demographic variables, like age or gender. The MarketMinder sample is randomly selected using standard sampling techniques to generate a sample which is broadly representative of the population.(2) In particular, each member of the sample is allocated a weight depending on their age and sex such that the composition of the weighted sample matches the composition of the population.(3) But this technique cannot correct for changes in the composition of the sample answering a particular question due to non-response.

People can make mistakes when they answer questions, so the survey data are likely to include errors. So long as the probability of people making mistakes is relatively low and those mistakes are small in size (and roughly zero on average) then the survey data should still be broadly informative.(4) But if people systematically misreport data — for example, if they underreport their debts — then the survey data will once again be unreliable.

One way to gauge how reliable the survey data are is to compare statistics produced from the data — like the average level of debt per household — to comparable statistics based on aggregate data. The

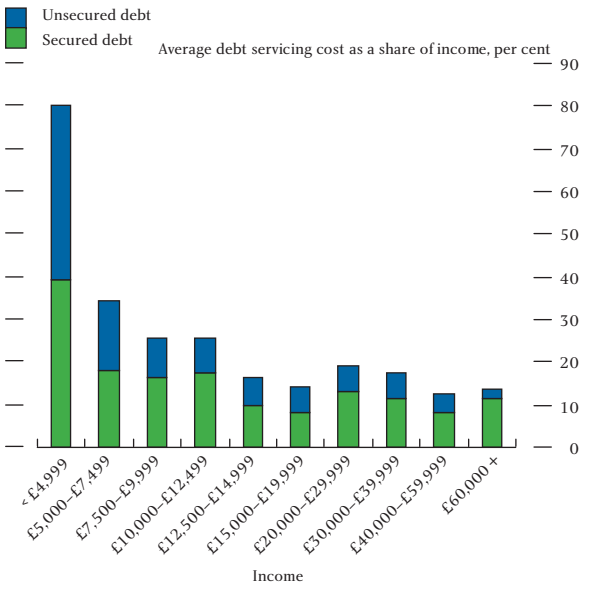
(1) For example, in Chart 11, 'The distribution of net worth', we focus on only those individuals who provide information on all their assets and liabilities.
(2) For more details on the design of the MarketMinder survey sample see the Appendix of May, Tudela and Young (2004).
(3) For more details see Redwood and Tudela (2004).
(4) This means that 'decimal point errors' (when people report £10 or £1,000 when they mean £100) are a cause for concern because these sorts of errors are highly unlikely to cancel out on average.

weighted sample has been designed so that it reflects the demographic composition of the population. But we do not know how representative the weighted sample is in terms of the distribution of assets, income and liabilities. If the sample is representative along these dimensions these statistics should be broadly comparable.

Average incomes and the average stock of debt held by households in the sample are lower than aggregate data imply. The latest NMG Research survey is quite typical in this regard: household surveys usually imply lower average levels of debt than is suggested by the aggregate data. That may indicate that either the survey sample is unrepresentative (whether in selection or through non-response) or that people are making systematic mistakes when answering questions. But the discrepancy could also reflect the fact that the official data and the questions in the survey are measuring different things. For example, people were asked to exclude credit card balances that they intended to pay off at the next payment date when questioned for the latest survey, whereas the official data include those debts. Nevertheless, this discrepancy does raise questions about how representative the survey sample is, and the results discussed in this article should be viewed in that light.

Those households who were devoting a large proportion of their income to servicing debt typically had low incomes. As a result they accounted for a disproportionately small share of aggregate consumption and the total stock of debt (Charts 5 and 6). So if a fraction of these households cut back on spending or defaulted on their debts, the impact on monetary or financial stability would be smaller than if their spending and debts matched those of the average UK household.

Chart 6
Ratio of debt servicing costs to income, by income (across debtors)



Sources: NMG Research and Bank calculations.

Income is not the only resource at households' disposal to service their debts. Households can also liquidate assets to pay debt. For a more complete picture of the state of household finances, we need to consider the assets that households own as well as their liabilities.

Distribution of assets

At the aggregate level the household sector has been building up both sides of its balance sheet, by accumulating assets as well as liabilities. Some of those assets may be illiquid (households may not be able to sell them easily to release funds) and their future value is uncertain. Nevertheless, a large stock of assets does provide households with a financial cushion which they can use to fund consumption or service debt should their income fall. The issue for policymakers concerned with the extent of financial distress is whether the households with the largest debts also hold the most assets.

The largest asset that most households own is property, typically their home. Around one in ten households in the survey also said they owned a second property. Housing is a particularly illiquid asset and the current price of a house may not be a reliable guide to the amount of money that a homeowner could realise if they were to sell their house in the future.(1)

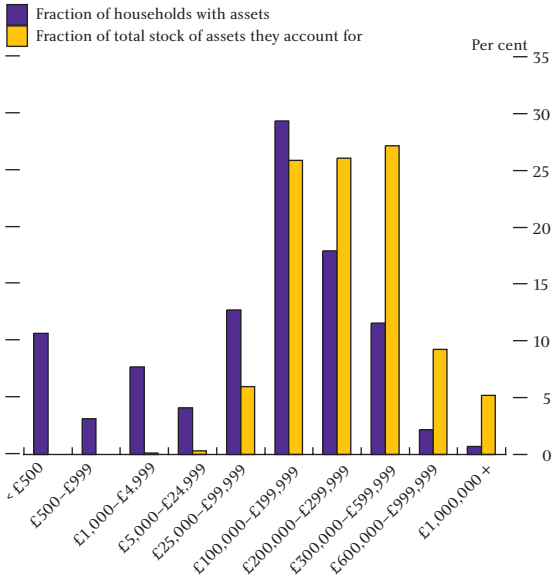
Most households also reported holding some financial assets. These were typically held in one or two financial instruments at most, with savings accounts being by far the most popular. There was a marked variation in the amount of financial wealth held by different households. The typical — or median — household had only a small

(1) The sort of shock that leads to an increase in the incidence of financial distress at the household level — like an increase in interest rates or the unemployment rate — could also affect house prices.

stock of financial assets. But a small number of households owned a much larger stock of assets.

If we combine the wealth held in financial assets and housing, we can create a measure of gross wealth — that is, the total value of all assets held by each household. The distribution of gross wealth across households was highly unequal (Chart 7). Almost one in five households reported having no assets whatsoever. And of those who reported having some assets, a quarter held less than £25,000. At the other extreme, 3% of households held as much as one sixth of the total stock of assets. Nevertheless, Chart 8 indicates that the distribution of assets (across those who held some assets) was less unequal than the distribution of liabilities (across those who held some debts).

Chart 7
Distribution of gross wealth(a)



Sources: NMG Research and Bank calculations.

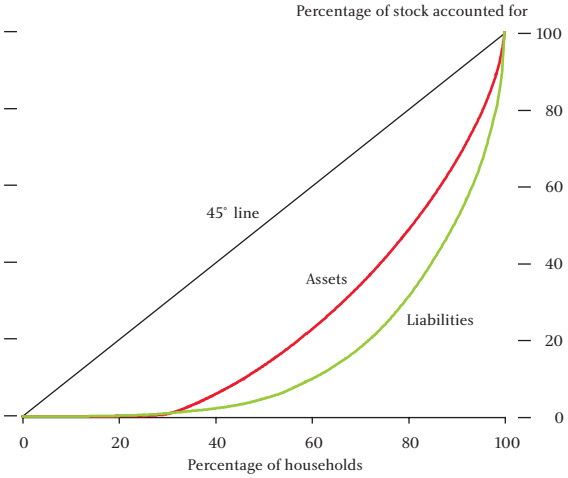
(a) The chart divides households with some assets into different groups according to the amount of wealth owned. The purple bar describes how common each group is, and the yellow bar shows how much of the total stock of gross wealth each group accounts for.

Net worth

The previous sections have identified that the distributions of both assets and liabilities were highly skewed. The overall state of households' balance sheets is determined by their net worth — that is, the relative size of their assets and liabilities.

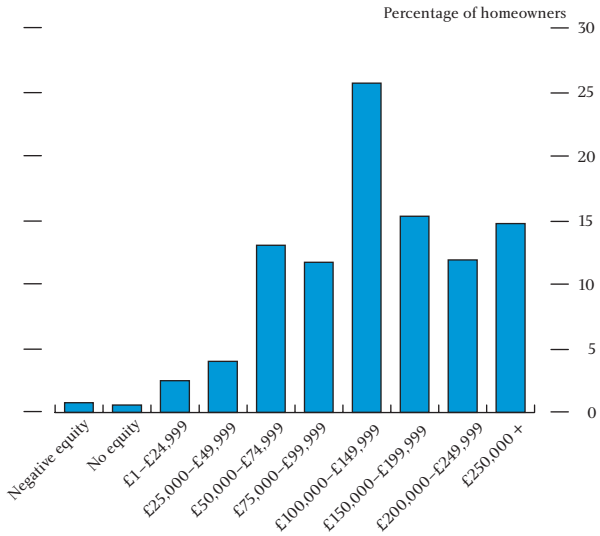
Housing accounted for the largest items on both sides of the typical surveyed household's balance sheet: their mortgage was their main liability, and their house their main asset. For most homeowners the current value of their house exceeded the outstanding mortgage on their property. In other words, most homeowners had some equity in their home, so their house was a source of net worth. However, similar to the previous survey, there were a very small number of households in the survey who reported having negative equity (Chart 9).(1)

Chart 8
The Lorenz curves of the distributions of assets and liabilities



Sources: NMG Research and Bank calculations.

Chart 9
Housing equity(a)



Sources: NMG Research and Bank calculations.

(a) Percentage of those who own a property.

Housing equity is created whenever mortgagors repay a fraction of their debts or their property increases in value. As a result, older homeowners tend to enjoy more equity in their current property because they will have

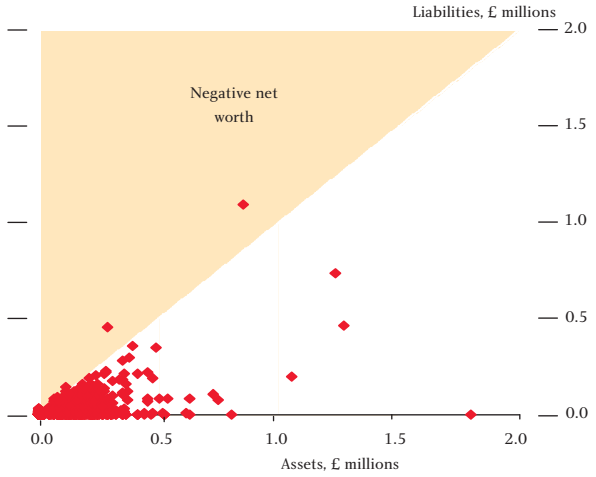
(1) Although house prices have been rising on average, some houses could have fallen in value. But some of the negative equity in the survey data could reflect measurement error, that is people making mistakes when they report the current value of their house or their mortgage. The box on pages 38–39 discusses measurement error.

paid off a larger proportion of their mortgage and because the value of their home will have risen over a longer period of time.

Not all homeowners hold a large amount of equity in their home, even if they have been living in the property for some time. Some homeowners will choose to spend some or all of the equity they have built up.(1) One motivation for withdrawing equity is to fund consumption or to service debt in emergencies — the interest rates charged on secured debt tend to be lower than those on unsecured loans. The survey suggests that a small (but increasing) number of households are using housing equity as a safety valve: of the one in eight mortgagors who extended their secured debts over the past year, a quarter mentioned paying off other debts as one of the reasons why they took on more secured debt.

Chart 10 plots the liabilities of each household against their assets. A large number of households (about one in six of those who reported information on all their assets and liabilities) are clustered on the origin, indicating that they had no assets or liabilities. The net worth of the remainder of the sample can be identified by comparing their position relative to the 45° line, which indicates households whose assets exactly matched their liabilities. Households with more assets than liabilities — those with positive net worth — lie below the 45° line. Chart 10 indicates that the majority of households fell into this category.

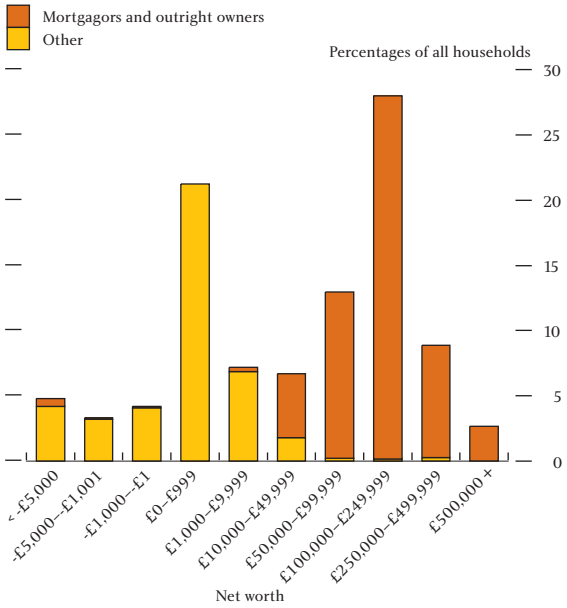
Chart 10
The joint distribution of assets and liabilities



Sources: NMG Research and Bank calculations.

Those who lie above the 45° line had negative net worth — that is their debts exceeded the value of any assets they held. Almost one in eight of the households in the survey who provided information on their assets and liabilities were in this position. In most cases these households had relatively little debt (typically around several thousand pounds) and little if any assets to draw upon, so these negative net worth households typically lie close to the origin. Most homeowners had housing wealth (Chart 9), so these negative net worth households were almost exclusively renters (Chart 11) whose unsecured debts exceeded the value of any financial assets they held.(2)

Chart 11
The distribution of net worth



Sources: NMG Research and Bank calculations.

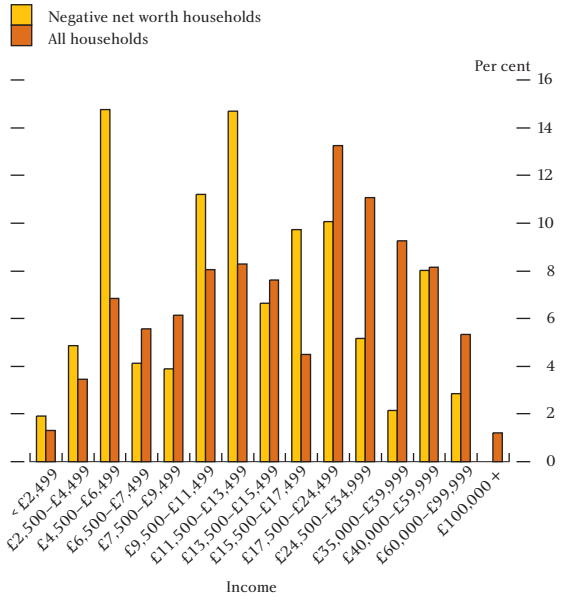
These negative net worth households also tended to have below-average incomes (Chart 12). About half of the households in the sample earned more than £17,500 a year. But only around a quarter of these negative net worth households earned more than £17,500 a year.

Households in distress

This article has discussed the current state of household balance sheets. The previous two sections have identified that a small proportion of households were in a stretched or potentially difficult financial position. Of these, some spent a sizable fraction of their income

(1) If they spend the money on home improvements there is no net withdrawal of equity. The increased liability should be broadly offset by the increase in the value of their asset (their home).
(2) There are a couple of homeowners who report severe negative equity on their property.

Chart 12
Income and the incidence of negative net worth



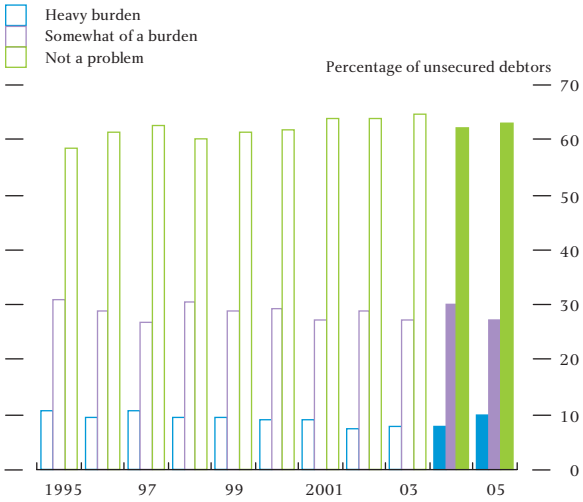
Sources: NMG Research and Bank calculations.

servicing debt; and some did not have a buffer of financial assets or housing equity that could be liquidated in emergencies. These households could run into difficulties in the future if the costs of servicing debt rise or their income falls. In this section of the article, we focus on households who were already in distress.

The survey indicates that around one in ten of those households who had unsecured debts found those debts a heavy burden, and around one in five found them somewhat of a burden (Chart 13). Compared with the previous year, the proportion finding their debts a heavy burden was a little higher. Typically, these households had relatively low incomes and some, but by no means all, had negative net worth.

The 2005 NMG Research survey included a set of questions which investigated people's attitudes towards bankruptcy. People were asked whether they would consider bankruptcy if they were unable to keep up with their debts. The overwhelming majority of households (87%) who gave their views on the subject said they would only consider bankruptcy as a last resort or would never consider it under any circumstances. A small proportion (6%) said they would seriously consider it as an option, although the proportion was a little higher for those who found their unsecured debts a heavy burden (14%). But as this question was not asked in previous surveys, it is unclear whether there have been any changes in households' attitudes to bankruptcy over time.

Chart 13
The burden of unsecured debt(a)

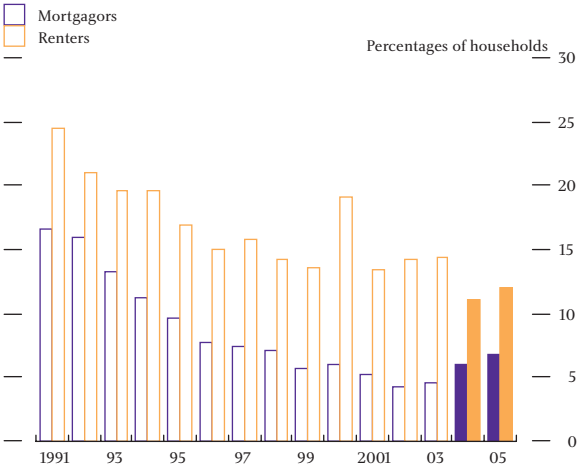


Sources: BHPS, NMG Research and Bank calculations.

(a) Data prior to 2004 are calculated using information from the BHPS, and are indicated by the hollow bars.

The proportion of households who reported problems paying for their accommodation (the mortgage in the case of those who had bought a house, or the rent in the case of those who had not) remained low by historical standards, but edged up on last year (Chart 14). The survey provides some additional information on how households have tried to resolve these problems, where they have occurred. The majority of those reporting problems responded that they had cut back on consumption, while a significant minority had borrowed more money.

Chart 14
Problems paying for accommodation(a)



Sources: BHPS, NMG Research and Bank calculations.

(a) Data prior to 2004 are calculated using information from the BHPS, and are indicated by the hollow bars.

Conclusion

This article has described recent survey evidence on the distribution of assets, income and liabilities across a

sample of British households. The survey reveals a wide variation in the state of their balance sheets in September 2005. The distributions of assets, income and liabilities across households were highly skewed — though, on the whole, little changed from a year earlier. In each case, a relatively small proportion of households accounted for the lion's share of assets owned, income earned and debts owed by the whole sample. Those households with large debts also tended to hold a large asset: for every mortgage there was a property. Most households' assets exceeded their liabilities, largely because most surveyed households owned property in which they had some equity. But there were some households whose liabilities exceeded their assets. Typically they held few assets (in particular they did not own a property), had unsecured debts, and relatively low incomes.

Only a small number of households were having difficulties paying their debts, and they tended to be low-income households struggling with unsecured debts, and accounted for a very small proportion of the total stock of debt owed by British households. The vast majority of debt was secured on property by mortgagors, of whom very few reported problems servicing that debt. The survey indicated that very few people viewed bankruptcy as a solution to their debt problems.

References

Cox, P, Whitley, J and Brierley, P (2002), 'Financial pressures in the UK household sector: evidence from the British Household Panel Survey', *Bank of England Quarterly Bulletin*, Winter, pages 410–19.

May, O, Tudela, M and Young, G (2004), 'British household indebtedness and financial stress: a household-level picture', *Bank of England Quarterly Bulletin*, Winter, pages 414–28.

Redwood, V and Tudela, M (2004), 'From tiny samples do mighty populations grow? Using the British Household Panel Survey to analyse the household sector balance sheet', *Bank of England Working Paper no. 239*.

Tudela, M and Young, G (2003), 'The distribution of unsecured debt in the United Kingdom: survey evidence', *Bank of England Quarterly Bulletin*, Winter, pages 417–27.

Understanding the term structure of swap spreads

By Fabio Cortes of the Bank's Foreign Exchange Division.

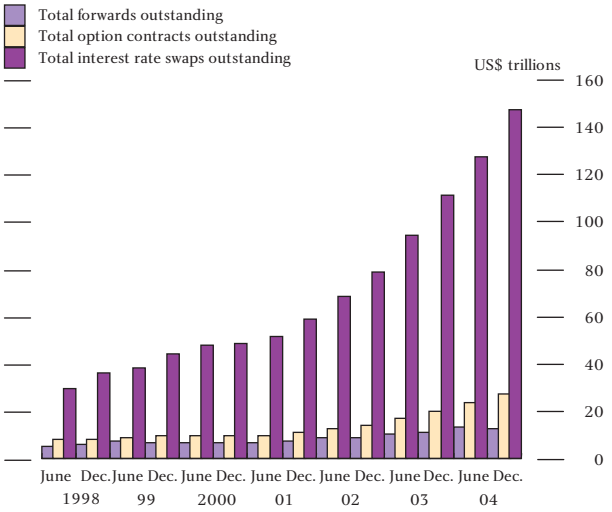
Market expectations about the future path of interest rates can be derived from both government bond and swap yield curves. But at times these curves may provide imprecise signals about interest rate expectations. Understanding what factors can affect the term structure of swap spreads — the difference between government bond rates and swap rates at different maturities — may therefore be helpful to policymakers when interpreting market views of future interest rate developments.

This article reviews past developments in dollar, euro, sterling and yen government bond and swap markets and considers the potential influences on the term structure of swap spreads. Using statistical analysis, it finds that some influences seem to be common across international markets, but others, such as liquidity or preferred habitat issues, tend to be specific to certain markets.

Introduction

A swap is an agreement between two parties to exchange cash flows in the future. The most common type of swap is a 'fixed-for-floating' interest rate swap where one party receives floating (variable) interest rate payments over a given period and is willing to pay the other party a fixed (swap) rate to receive those floating payments. The volume of interest rate swap transactions has grown rapidly in recent years, led by increasing demand from hedging and speculative sources(1) (Chart 1). Swaps are the largest type of traded interest rate derivative in the OTC (over-the-counter)(2) market, accounting for over 75% of the total amount traded of these contracts. The increase in the size and liquidity of the swap market has led the swap curve to become a benchmark curve widely used by market participants when pricing financial assets.

Chart 1
OTC interest rate contracts by instrument in all currencies



Source: Bank for International Settlements.

Differences between swap rates and government bond yields of the same maturity are referred to as swap spreads. A number of empirical studies have examined the possible determinants of swap spreads at specific benchmark maturities such as five and ten years.(3) For example, Cortes (2003) found that swap rates may contain a time-varying default premium over government bond yields to compensate investors for the possible risk of a systemic failure of the banking sector. At the same time, swap spreads may be affected by market factors such as shifts in supply and demand in both the swap and the government bond markets at particular maturities.

(1) Swaps were initially developed as a means of allowing institutions to manage interest rate exposures on their asset and liability portfolios more efficiently. More recent demand has come from hedging and speculative sources. See Cortes (2003) for further detail.
(2) Over-the-counter means an asset that is not traded on an exchange but traded as a result of direct negotiation between counterparties.
(3) Benchmark maturities refer to maturities of bonds that are widely viewed as high quality, liquid investment vehicles and that are actively used for hedging and trading purposes.

However, there are few studies that have considered the determinants of the term structure of swap spreads — that is, the factors that influence swap spreads at different maturities. Understanding what affects the term structure of swap spreads may be helpful to policymakers when interpreting market perceptions of future interest rate developments. Specifically, market expectations about the future path of interest rates can be derived from both nominal government bond and swap yield curves. Indeed, the Bank of England provides estimates for both of these sorts of curves.(1) But at times these curves may provide different signals about market expectations of the path of future interest rates. For example, changes in investors' perceptions of the likelihood of bank defaults may influence swap rates although government bond rates should be unaffected. Similarly, market inefficiencies, associated for example with liquidity conditions in particular financial markets or imbalances in supply and demand for securities of particular maturities, can affect government bond and swap curves in different ways. Identifying when these factors may be important and how they impact on the term structure of the swap spreads might therefore help in assessing expectations of future interest rates derived from estimated yield curves.

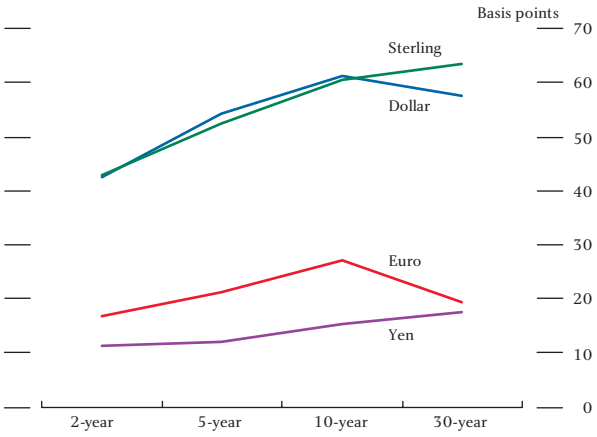
This article reviews developments in the term structure of swap spreads over the past few years for the major currencies and considers a series of explanations for the observed movements. More specifically, using statistical analysis and drawing on discussions with market participants, the article tries to evaluate the possible influences on the term structure of international swap spreads. Among the candidate explanations, this article reviews the possibility that some of the factors suggested in Cortes (2003), such as the default premium embedded in interbank lending rates in the London market (ie London interbank offered rate — Libor) and demand and supply imbalances in the swap and the government bond markets, vary across maturities; and as a result are associated with changes in the term structure of international swap spreads.

The article begins by seeking to establish some stylised facts about the term structures of international swap spreads. It then goes on to employ formal statistical analysis to evaluate possible explanations for these empirical regularities, with a particular focus on the US market where most data are available. An appendix gives further details of the modelling approach employed.

Some stylised facts

Chart 2 plots average swap spreads(2) for dollar, euro, sterling and yen for different maturities over the January 1997–July 2005 period. For maturities up to ten years, the average term structure of swap spreads has been upward sloping in all four markets. In other words, the spread of swap rates over government bond yields has tended to be greater at ten-year than at two-year maturities. But euro and dollar swap spreads have been lower on average at thirty-year than at ten-year maturities: the term structure of swap spreads in these markets has been inverted at the long end.

Chart 2
Average term structure of swap spreads(a)
(January 1997–July 2005)



Source: JPMorgan Chase and Co.

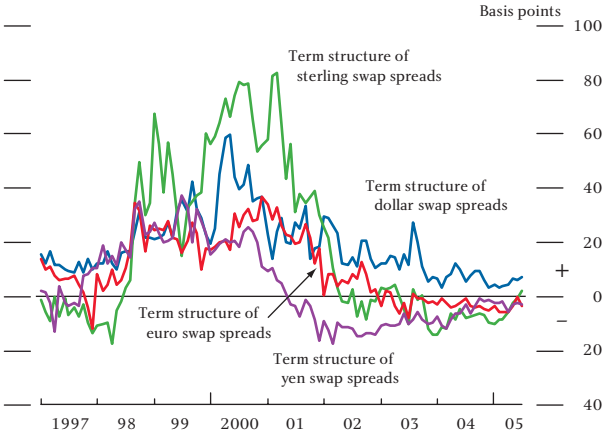
(a) Since Japanese 30-year government bonds were not issued until 1999, this article uses yen swap spreads of 20-year instead of 30-year maturity. Before 1999, deutschmark swap spreads are used to proxy for the euro area.

The averages mask considerable variation over time in swap spreads. The shape of the term structure has moved frequently and with significant shifts over the review period. Some of these shifts appear to have been largely temporary and were quickly unwound. But there were other changes that appear to have been of a more persistent nature (Charts 3 and 4).

Much of the change in the term structures has occurred internationally. Table A shows bivariate correlation coefficient statistics for the two-to-ten year and ten-to-thirty year parts of the term structure in the dollar, euro, sterling and yen markets. The higher the

(1) Nominal government bond yield curves have been estimated in the Bank of England for more than 35 years. The Bank also estimates bank liability curves that are derived from swap rates.
(2) This article uses monthly maturity-matched swap spreads from JPMorgan Chase and Co.

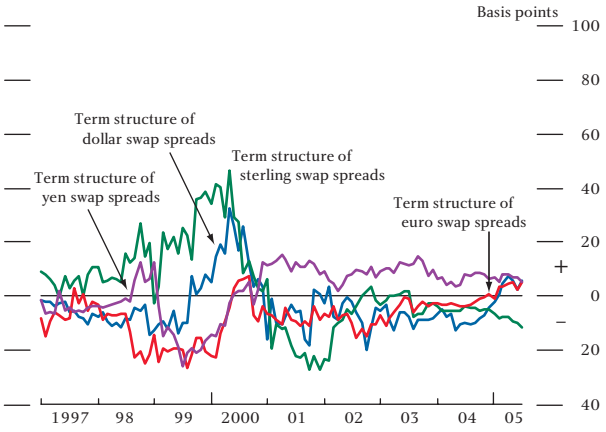
Chart 3
The term structure of swap spreads between two and ten-year maturities(a)



Source: JPMorgan Chase and Co.

(a) Constructed as the ten-year (maturity-matched) swap spread less the two-year (maturity-matched) swap spread.

Chart 4
The term structure of swap spreads between ten and thirty-year maturities(a)



Source: JPMorgan Chase and Co.

(a) Constructed as the thirty-year (maturity-matched) swap spread less the ten-year (maturity-matched) swap spread.

correlation coefficient, the closer the co-movement of international swap spreads.

As Table A shows, movements in the term structure of swap spreads out to ten-year maturities appear highly positively correlated across all four markets. In other words, out to ten years, swap spreads across all four markets tend to move up or down together. In contrast, there is less evidence of co-movement between ten and thirty-year maturities. This may suggest that domestic influences are more important at the very long end of the term structure. For example, there has been increasing (but differentiated) international focus on regulation on the pension funds and life insurance industry over recent years. This may have had

Table A
Bivariate correlations of the term structure of swap spreads between two and ten-year and between ten and thirty-year maturities

Two-to-ten swap spreads(a)

	Dollar	Euro	Sterling	Yen
Dollar		0.73***	0.78***	0.58***
Euro			0.86***	0.64***
Sterling				0.59***
Yen				

Ten-to-thirty swap spreads(b)

	Dollar	Euro	Sterling	Yen
Dollar		0.21	0.41***	-0.22
Euro			-0.41***	0.46***
Sterling				-0.72***
Yen				

(a) Ten-year swap spread less two-year swap spread.
(b) Thirty-year swap spread less ten-year swap spread.
*** Correlation coefficient different from zero at the 1% significance level.

significant effects on government bond markets at long maturities, giving rise to changes in the term structure of swap spreads.

As an illustration, in the United Kingdom, the Minimum Funding Requirement (MFR), applied under the Pensions Act 1995, increased UK pension funds' demand for long-term conventional gilts. The MFR allowed the liabilities of pension funds defined in nominal terms to be discounted using long-term gilts. This gave UK funds an incentive to hold gilts to limit the risk of not matching their liabilities.(1) Also, the decline in long-term gilt yields put pressure on UK insurance companies' solvency levels, prompting them to buy more long-term gilts in an attempt to improve their solvency. This is turn led to a widening of sterling swap spreads, particularly at the longest maturities.

However, expectations of a reform of the MFR began to emerge in the first half of 2000 as market participants anticipated regulatory changes. This caused a gradual increase in gilt yields at long maturities, and this in turn led to a flattening of the term structure of sterling swap spreads at long maturities. These regulatory changes were confirmed by the Myners report into institutional investment on 8 November 2000 and the announcement of the abolition of the MFR by the Chancellor on 7 March 2001.

In summary, the main features of the term structure over recent years are:

- across the major markets, the term structures of swap spreads out to ten years have been on average upward sloping;

(1) See the 'Markets and operations' section of the *Bank of England Quarterly Bulletin*, November 2000, page 334.

- there has been considerable variation over time in the term structure of swap spreads, especially at maturities up to ten years; and

- some of this variation appears to have occurred internationally, particularly at maturities up to ten years. But the term structures also appear to have moved independently in each market, suggesting market-specific features may also have been important.

Empirical analysis

Common factors

In order to investigate further the underlying influences on the term structure of swap spreads, this article employs formal statistical analysis, concentrating on the two-to-ten year part of the term structure of swap spreads.

The previous section found that there appears to be a relatively high correlation in the term structure of international swap spreads at maturities up to ten years. To examine the co-movement further, a statistical technique called principal component analysis (PCA) can be employed to uncover the common variables that might be driving the term structure of international swap spreads.(1) Once the common factors have been isolated, the article will also consider the possible idiosyncratic or country-specific influences on the term structure of swap spreads.

Using PCA, there appears to be one significant principal component, or common factor, that captures over three quarters of the total variance of the two-to-ten year part of the dollar, euro, sterling and yen term structure of swap spreads. There is less co-movement across countries in the term structures between ten and thirty-year maturities than for the two-to-ten year part of the term structure.

In order to help interpret the principal component of the two-to-ten year part of the term structure, it is helpful to consider candidate variables for the underlying sources of the co-movement in the term structure of swap spreads internationally. Two possible influences in particular stand out: a default term premium and global expectations of government bond issuance.

If the swap and government bond markets are priced efficiently, the swap curve should represent the path of expected future interest rates plus a term premium. This term premium will not only reflect uncertainty about future interest rates, but will also include compensation for uncertainty about the risk of systemic failure of the banking sector in the future. Since investors are likely to be more uncertain about the risk of a systemic failure of the banking sector at longer horizons, the term or uncertainty premium might be expected to increase with the maturity of swap contracts. Therefore, the term structure of swap spreads could be affected by a default term premium, which might lead to an upward sloping term structure. To the extent that a default term premium exists, it also seems likely that it will be similar across the dollar, euro, sterling and yen markets. This is because the same international banks tend to feature in the panel of institutions whose lending rates are used to form the Libor benchmark rates in the four markets.(2)

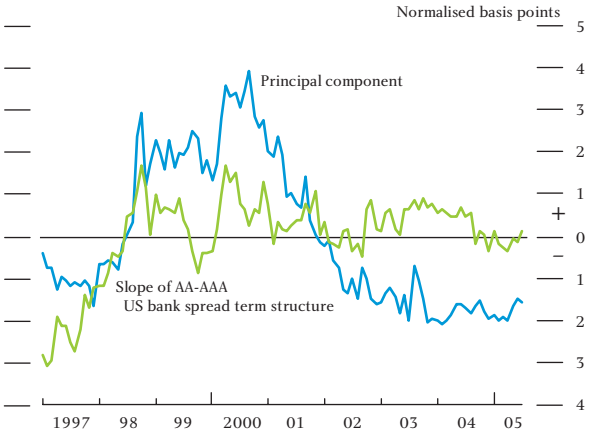
Information about the default term premium of the international Libor panel may be inferred from the term structure of the corporate spread of the Merrill Lynch AA-AAA rated US banking sector index.(3) The term structure of a highly rated corporate bond is usually upward sloping — the probability of the corporate defaulting on its debt is typically negligible in the short run, but there is always uncertainty about the possibility of the corporate defaulting on its debt at long maturities.(4)

Chart 5 plots the principal component of international swap spreads and the term structure of the spread of the AA-AAA rated US banking sector.(5) They tend to move broadly together, although arguably the degree of association appears to be stronger in the earlier part of the sample. Confirming this, Table B shows the results of a simple regression of first differences of the principal

(1) PCA is a statistical technique that can be used to simplify correlation matrices so that only the most important sources of information are retained. For an introduction to PCA, see Jackson (1991).
(2) Of the 16 banks in Libor panels, the same eleven were part of the dollar, euro, sterling and yen panels in 2004. These were Bank of America, Barclays, Deutsche, HSBC, JPMorgan Chase, Lloyds TSB, Rabobank, Tokyo-Mitsubishi, Royal Bank of Scotland, UBS and Westdeutsche Landesbank.
(3) This assumes that there is a relatively high correlation between credit spreads of US banks and non-US banks. Hawkesby, Marsh and Stevens (2005) found evidence of a high degree of commonality in credit spread movements of large complex financial institutions, although there was also evidence of some regional differences.
(4) See Litterman and Iben (1991), Gehr and Martell (1992), Adedeji and McCosh (1995) and Bedendo, Cathcart and El-Jahel (2004).
(5) The series are normalised, by subtracting the sample means and dividing each data point by the corresponding sample standard deviation. Otherwise the principal component would be dominated by the country (market) specific variable with the greatest volatility.

component on the proxy for the default term premium. The sign of the coefficient of the regression suggests that an increase in the default term premium appears to be associated with a steeper term structure of swap spreads, as expected. The coefficient is statistically significant at the 5% level for the January 1997–July 2005 period, though not for the more recent January 2001–July 2005 period, perhaps indicating a weakening influence from any default term premium on swap spreads.

Chart 5
The term structure of highly rated US banks(a) and the principal component of the term structure of international swap spreads between two and ten-year maturities



Sources: JPMorgan Chase and Co, Merrill Lynch and Bank calculations.

(a) The term structure of corporate spreads is estimated as the option-adjusted spread of the five-to-ten year Merrill Lynch AA-AAA rated banking sector index minus the one-to-five year index.

Table B
OLS regression of first differences of the principal component on the default term premium(a)

Variable	Coefficient	Period
D(default term premium)	0.24**	Jan. 1997–July 2005
	0.16	Jan. 2001–July 2005

Note: *D* represents the change in the variable, such that $D(X) = X_t - X_{t-1}$.
** indicates significance at the 5% level.

(a) The default term premium is estimated as the term structure of the spread of the AA-AAA rated US banking sector.

Despite the statistical association, anecdotal evidence suggests that some market contacts seem unconvinced that investors in swaps demand a term premium to compensate for potentially greater uncertainty about the systemic failure of the banking sector at longer relative to shorter horizons. Instead, they suggest that other factors may account for the term premia in swap spreads. In particular, demand and supply imbalances in the government bond and swap markets at different maturities may drive a wedge between government bond yields, swap rates and market expectations of future interest rates.(1)

Cortes (2003) found that government bond prices could fall in response to extra prospective supply, prompting government bond yields to rise and swap spreads to narrow. Expectations of government bond issuance may also have an effect on the term structure of swap spreads. There is evidence of a positive relationship between the slope of government bond yield curves and the amount of government bond net borrowing — the higher net borrowing, the steeper the yield curve.(2) And if there are similar trends in expectations of government issuance internationally, the term structure of swap spreads may, in the absence of any other factors, therefore become flatter internationally as government net borrowing increases.

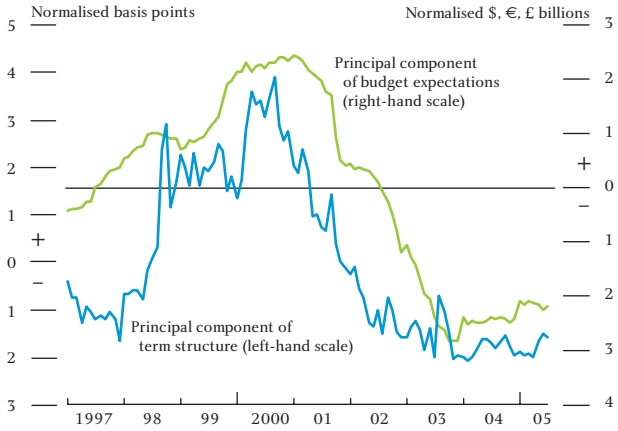
Consensus Economics provides a monthly average estimate of budget balance expectations across different countries for the current and subsequent year.(3) Simple correlation analysis suggests that there seems to be a particularly high association between expectations of government budget balance in the United States, Germany (used as a proxy for the euro swap market) and United Kingdom over recent years.(4) And PCA suggests that there appears to be one significant principal component that accounts for over 95% of the total variance of government budget balance expectations in the United States, Germany and the United Kingdom. These results indicate that expectations of fiscal positions tend to move together across countries, perhaps reflecting similarities in cyclical positions.

In terms of explaining the co-movement in the term structure of swap spreads, Chart 6 shows that there seems to be some association between the principal component of the term structure of swap spreads and the principal component identified for budget balance expectations in the United States, Germany and the United Kingdom. To examine this relationship

(1) See Peacock (2004) for further detail on the existence of a risk premium that can lead to forward rates being a biased measure of expected future interest rates.
(2) Brooke, Clare and Lekkos (2000) found a positive relationship between net borrowing and the steepness of the yield curve in the United Kingdom, United States and Germany during the 1990s.
(3) See Cortes (2003).
(4) The correlation coefficients between US, German and UK budget balance expectations were all above 0.9 over the period from January 1997 to July 2005.

further, Table C shows the results of the regression of the first difference of the principal component of the term structure of swap spreads on the first difference of the principal component of budget balance expectations.

Chart 6
Principal component of the term structure of international swap spreads between two and ten-year maturities and principal component of budget balance expectations in the United States, Germany and the United Kingdom



Sources: Consensus Economics, JPMorgan Chase and Co and Bank calculations.

Table C
OLS regression of the first differences of the principal component of the term structure of swap spreads between two and ten-year maturities on first differences of the principal component of budget balance expectations in the United States, Germany and the United Kingdom(a)

Variable	Coefficient	Period
D(PC of budget balance expectations)	0.38 0.63**	Jan. 1997–July 2005 Jan. 2001–July 2005

(a) *D* represents the change in the variable, such that $D(X) = X_t - X_{t-1}$.
** indicates significance at the 5% level.

The sign of the coefficient of the regression suggests that an increase in government budget balance expectations (ie lower expected government bond issuance) is associated with a steeper term structure of swap spreads internationally, as expected. The coefficient is not statistically significant at the 10% level during the January 1997–July 2005 period. But, in contrast to the default term premium, the coefficient is statistically significant — and at the 5% level — during the later part of the sample (January 2001–July 2005 period).

Idiosyncratic factors

The term structure of swap spreads may also be affected by forces that are idiosyncratic to each market. Some of these influences may be related to movements in the term structure over the whole period. But other influences may be related to movements in the term structure at specific points in time. These idiosyncratic drivers might usefully be categorised into three different groups:

a. *Different liquidity preferences of investors in government bonds relative to swaps.* In particular, there may be a time-varying liquidity term premium, whereby investors demand an extra premium for receiving fixed interest payments via swaps rather than holding 'on-the-run' (ie the most recently issued)(1) government bonds at longer maturities during certain periods.(2)

b. *Preferred habitat influences on the government bond curve.* The preferred habitat theory states that in addition to interest rate expectations, market participants have different investment horizons and require a premium to buy assets with maturities outside their 'preferred' maturity or habitat. These influences may be associated with regulatory changes that affect specific maturities of the government bond curve. They may also be related to demand for government bonds of specific maturities such as the recent purchases of short and medium-run US Treasuries by foreign central banks.

c. *Preferred habitat influences on the swap curve.* These are often related to demand for specific maturities in the swap curve associated with hedging activities, such as mortgage convexity hedging, swapped corporate issuance and banks' hedging of the market risk of their bond portfolios.

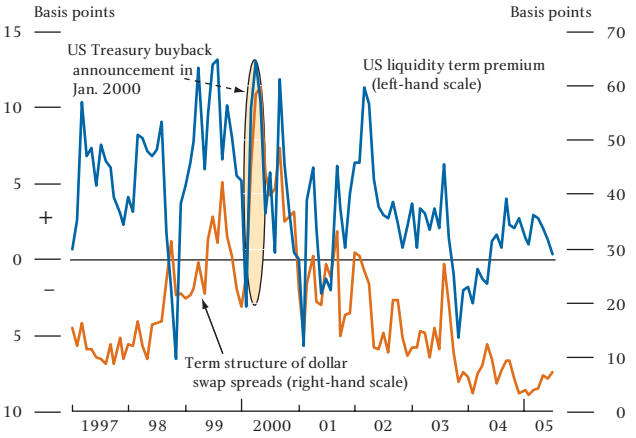
To examine the empirical importance of these sorts of idiosyncratic influences on the term structure of swap spreads, this section concentrates its analysis on the term structure of dollar swap spreads. Ideally, other government bond and swap markets would be included in order to evaluate how these factors differ across countries. Unfortunately, a lack of reliable indicator variables for euro, sterling and yen markets prevents such an analysis.

(1) Previously issued securities of similar maturity are known as 'off-the-run'.
(2) Liu, Longstaff and Mandell (2004) argue that US Treasury yields can represent downwardly biased estimates of the true cost of risk-free borrowing. They find that there is a liquidity premium between the 'true' risk-free rate and US Treasury yields that increases — on average — with maturity and that varies across maturities over time.

US liquidity term premium

The term structure of the spread between the on-the-run benchmark Treasury note and a basket(1) of off-the-run Treasury notes might serve as proxy of the US liquidity term premium in swap spreads since the only difference between these bonds is the lower liquidity of the off-the-run Treasury notes. Chart 7 plots the term structure of this spread between two and ten-year maturities against the term structure of dollar swap spreads between the same maturities. Both the term structure of dollar swap spreads and the term structure of the on-the-run/off-the-run spread steepened significantly following the US Treasury announcement of buybacks in January 2000, suggesting the possible influence of liquidity effects on swap spreads.(2)

Chart 7
The term structure of international swap spreads between two and ten-year maturities and the term structure of the on-the-run/off-the-run spread on a basket of US Treasury notes



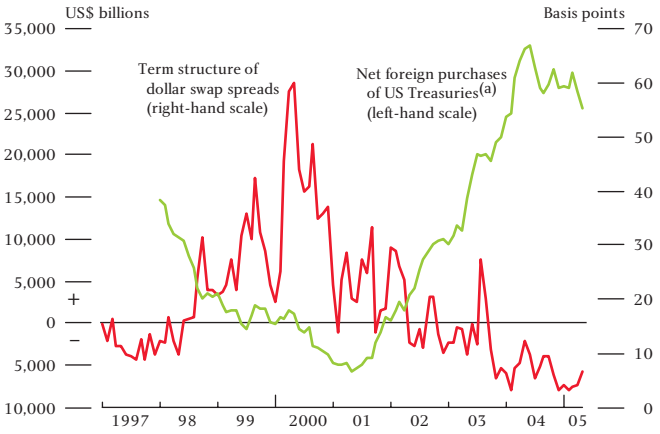
Sources: JPMorgan Chase and Co and Bank calculations.

Central bank purchases of US Treasuries

Net foreign purchases of US Treasuries might reflect preferred habitat influences on the US Treasury curve. In recent years, the large share of US Treasuries among central banks' foreign exchange reserve holdings has made them important players in the US Treasury market. Demand from central banks for US Treasuries at short maturities can prompt US Treasury yields to fall at short relative to long maturities. This could lead to a widening of dollar swap spreads at short-term maturities relative to long-term maturities. There is evidence that a majority of foreign exchange reserve asset purchases have been US dollar denominated in the past two years.(3) This implies that demand from central banks for US Treasuries may have had an effect on the term structure of dollar swap spreads due to the relatively large size of these purchases.

Chart 8 plots the term structure of dollar swap spreads and the twelve-month moving average of net foreign purchases of US Treasuries over the January 1997–May 2005 period. Over the whole period, the two series are not highly correlated. But over the past two years, the large size of net foreign purchases of US Treasuries, driven by central banks, may have contributed to the flattening of the term structure of dollar swap spreads.

Chart 8
The term structure of international swap spreads between two and ten-year maturities and net foreign purchases of US Treasuries(a)



Sources: JPMorgan Chase and Co, US Treasury and Bank calculations.

(a) Twelve-month moving average.

US mortgage-related hedging

For almost all home mortgages in the United States, borrowers are able to prepay their mortgage loans at any time without penalty. As a result of this prepayment option, investors in mortgages and mortgage-backed securities (MBS) face the risk that they will experience a return of principal earlier than anticipated and be left to invest that principal at potentially lower yields.

(1) This basket is calculated using the average yield of the last three previously issued Treasury notes of similar maturity. The term structure of the on-the-run/off-the-run spread is then estimated as the differential between the yield of this basket and the yield of the on-the-run Treasury note at the ten-year maturity minus the same spread at the two-year maturity.
(2) The reduced prospective supply of Treasuries, following the US Treasury announcement of debt buybacks in January 2000, pushed down on-the-run Treasury yields, and widened dollar ten-year swap spreads by over 50 basis points in the following four months. See Cortes (2003).
(3) Higgins and Klitgaard (2004) find that 88% of all global reserve asset purchases were US dollar denominated in 2003.

Because prepayments on mortgages and MBS tend to accelerate when interest rates drop, the increased prepayment risk also causes the duration of the mortgage to shorten, thereby changing the interest rate exposure of the investor's portfolio going forward.(1)

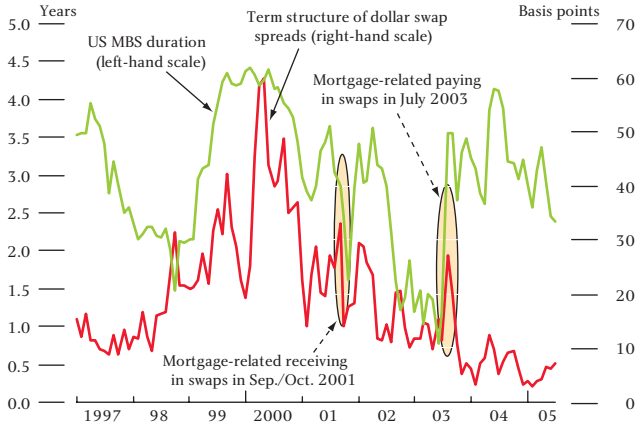
Mortgage holders will typically attempt to offset any changes in duration ie to reduce the sensitivity of their assets and liabilities to future interest rate movements. A key hedging instrument for many investors are swaps — investors generally seek to increase their 'receive-fix' swap positions when interest rates decline and their 'pay-fix' swap positions when rates increase. Cortes (2003) reported evidence that such mortgage-related hedging activity has been associated with changes in the level of swap spreads. Since US mortgage holders usually pay (receive) using five and ten-year dollar swaps(2) in order to reduce (extend) the duration of their assets, this mortgage-related hedging activity can also potentially affect the term structure of dollar swap spreads. In this way, US mortgage-related hedging may be an example of preferred habitat effects on the dollar swap curve.

In the past, periods in which significant US mortgage-related hedging occurred seem to have been associated with sharp movements in the slope of the term structure of dollar swap spreads (Chart 9). For example:

- between mid-September and mid-October 2001, the duration of MBS holdings fell sharply as the US Fed eased interest rates from 3.5% to 2.5% and US mortgage holder refinancing activity increased. This prompted a wave of mortgage-related hedging by investors with 'receiving fixed' concentrated on five and ten-year swaps. In turn, this was associated with the flattening of the slope of the dollar swap spread term structure, as spreads narrowed more at intermediate and long maturities than at shorter maturities; and

- in July 2003, in contrast, there was a sharp rise in long-term interest rate expectations (reflected in long-term Treasury yields) that led to a sharp fall in mortgage refinancing activity. This increased the duration of portfolios of mortgage-backed securities, triggering mortgage-related hedging flows with investors 'paying fixed' in five and ten-year swaps. This demand was associated with a steepening of the term structure of dollar swap spreads over the month.

Chart 9
The term structure of international swap spreads between two and ten-year maturities and the effective duration of US mortgage-backed securities



Sources: JPMorgan Chase and Co, Merrill Lynch and Bank calculations.

Combining the common and idiosyncratic factors — US market example

To capture the potential influence of common and idiosyncratic factors on the persistent changes (medium-run trends) of the term structure of swap spreads, we use an error correction model (ECM). This allows us to identify an 'equilibrium' relationship of the term structure of swap spreads over our sample period (January 1997–July 2005), indicating the direction in which the term structure of dollar swap spreads needs to move following short-run shocks in order to re-establish the medium-run trends in the data. More formally, the ECM can be represented by the regression equation:

$$
\begin{aligned}
&D(\text{term structure of dollar swap spreads}) = \\
&\beta_1 * D(\text{principal component}) \\
&\alpha_1 * D(\text{US liquidity term premium}) + \\
&\alpha_2 * D(\text{net foreign purchases of US Treasuries}) + \\
&\alpha_3 * D(\text{effective duration of MBS}) - \\
&\lambda * \text{MREC}(-1)
\end{aligned}
$$

Note: D represents the change in the variable, such that $D(X) = X_t - X_{t-1}$.

MREC is the medium-run adjustment (error correction) variable that accounts for the persistent deviations in swap spreads.

(1) More formally, mortgages and MBS have what is referred to as 'negative convexity'. This means that, unlike most bonds, the value of these assets/securities tend to fall as interest rates fall.
(2) See the 'Markets and operations' section of the *Bank of England Quarterly Bulletin*, Spring 2001, page 10.

Given the description of the factors already discussed, Table D indicates the expected signs of the model coefficients.

Table D
Expected relationship between the term structure of dollar swap spreads and explanatory variables

Variable	Influence[a]	Coeff. sign	Initial movement	Impact on the term structure
Default term premium	Common	+	Increase	Steepening
PC of budget balance expectations	Common	+	Increase	Steepening
US liquidity term premium	Idiosyncr.	+	Increase	Steepening
Effective duration of mortgage-backed securities (MBS)	Idiosyncr.	+	Increase	Steepening
Net foreign purchases	Idiosyncr.	–	Increase	Flattening

(a) Common influences are factors related to the term structure of international swap spreads while idiosyncratic influences are US (dollar) specific.

Some of the candidate factors are likely to be associated with both short-run movements and medium-run trends in the term structure of swap spreads. For example, both the default term premium and potential demand/supply imbalances might have a persistent effect on the term structure of swap spreads. Others might be only related to short-run developments such as sudden increases in the liquidity term premium, net foreign purchases of US Treasuries and mortgage hedging related demand to pay/receive in swaps.

Table E shows the regression results. Regression 1 uses the principal component from the PCA analysis to capture the common (ie international) influences on the US term structure of swap spreads. Changes in the principal component of the term structure of international swap spreads and the US liquidity term premium are significant at the 1% level. The medium-run adjustment variable is also significant at the 1% level, suggesting that the principal component has a statistically significant association with persistent deviations in the term structure of swap spreads. All the coefficients have the expected sign.

It is also possible to evaluate via the same regression framework the impact on the term structure of US dollar swap spreads of the two candidate factors for observed international co-movement in the term structure of swap spreads — a default term premium and global expectations of government bond issuance — together with the three candidate idiosyncratic variables. Regression 2 in Table E details the regression results where the proxy variables for the default term premium and demand/supply imbalances are used

Table E
OLS regression of the term structure of dollar swap spreads between two and ten-year maturities (January 1997–May 2005)[a]

Variable	Regression 1 Coefficient (T-stat)	Regression 2 Coefficient[b] (T-stat)
D(principal component)	0.59***	
D(default term premium)		0.36***
D(PC of budget balance expectations)		0.50*
D(US liquidity term premium)	0.13***	0.24***
D(effective duration of MBS)	0.11	0.09
D(net foreign purchases)	-0.04	-0.06
MREC(-1)	-0.23***	-0.28***
R-squared	0.62	0.44

(a) Net foreign purchases of US Treasuries data only available until May 2005 at the time of this analysis.
Regression 1: MREC(-1) = $S_{it-1} - 0.37C_{t-1} - 0.01$ where C is the principal component.
Regression 2: MREC(-1) = $S_{it-1} - 0.51DTP_{t-1} - 0.29PCBE_{t-1} + 0.002$ where DTP is the default term premium and $PCBE$ is the principal component of budget balance expectations.
*** and * indicates significance at the 1% and 10% levels, respectively.
(b) The medium-run 'equilibrium' relationship was restricted to include only the default term premia and budget balance expectations. Alternative representations which allowed other variables to influence the medium-run level for the term structure of swap spreads were permitted by the data but this was the preferred specification.

instead of the principal component. The results indicate that both variables have statistically significant short-run and long-run effects on the term structure of international swap spreads. The US liquidity term premium is also significant and has the expected sign.

The R-squared of the regressions in Table E suggests that the explanatory variables can account for a sizable part — between around 40% and 60% — of the variation in the term structure of dollar swap spreads. However, there could be other factors that have a significant effect on the term structure of dollar swap spreads. These factors are often difficult to quantify and may have only a temporary effect. For example, the swapping of corporate issuance at particular maturities may be associated with temporary changes in the term structure of swap spreads. Corporations often 'receive fixed' in swaps when hedging their fixed-rate issuance. An illustration of this is when higher-than-expected demand to 'receive fixed' from international telecoms companies contributed to the flattening of the term structure of dollar swap spreads in 2000 (Chart 10). Fixed-rate bond issuance in dollars by telecoms companies amounted to over $20 billion in the second and third quarter of 2000.[1] Many of these telecoms firms issued fixed-rate dollar bonds at long maturities to pay for licences for the Universal Mobile Telecommunication Systems (UMTS) in Europe. The market had reportedly anticipated such activity, but a greater-than-expected amount was then swapped into floating-rate liabilities in the dollar swap market.

(1) See the 'Markets and operations' section of the *Bank of England Quarterly Bulletin*, November 2000, page 324.

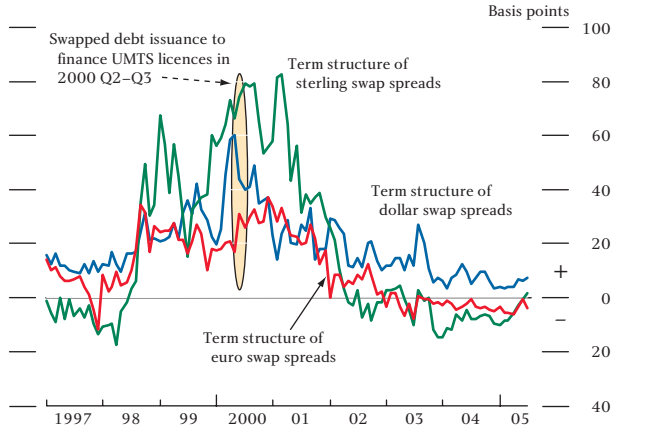
The same fixed-rate issuance by telecoms in the second and third quarters of 2000 had the opposite effect on the slope of both the euro and sterling term structure of swap spreads. The swapping of European telecom companies' dollar-denominated issues into euro and sterling led to an increase in the demand to 'pay fixed' in long-dated euro and sterling swaps in the second and third quarters of 2000. Since the increased demand was largely for long-maturity swaps, this in turn prompted the term structure of euro and sterling swap spreads to steepen (Chart 10).

Conclusion

There are few studies that have previously considered the possible determinants of the term structure of swap spreads. Understanding what affects the term structure of swap spreads may be helpful to policymakers in interpreting market perceptions of future interest rate developments, particularly during periods when market inefficiencies give rise to different signals about market expectations of the path of future interest rates extracted from both government bond and swap curves.

This article finds evidence of international co-movement in the two-to-ten year part of the term structure of swap spreads over the past decade. This co-movement could be associated with the existence of a default term premium that reflects changes in the perception of the risks of systemic failure of the banking sector embedded in the reference rates used to construct Libor. However, as well as compensation for the risk of default, the term premia in swap rates may reflect other influences

Chart 10
Term structure of dollar, euro and sterling swap spreads between two and ten-year maturities(a)



Source: JPMorgan Chase and Co.

(a) January 1997–July 2005 period.

associated with demand and supply for government bonds of different maturities which could be common for a number of international markets.

There may also be market-specific factors that influence the term structure of swap spreads. These may be related to market inefficiencies, associated perhaps with liquidity and preferred habitat issues that distort both the government bond and the swap curves. Concentrating on the US dollar market, this article finds evidence that both common and market-specific influences have had a significant statistical association with the term structure of dollar swap spreads over the past decade.

Annex
Statistical framework

Underlying model

The term structure of swap spreads is assumed to be characterised by a factor structure. That is, the term structure can be decomposed into two parts: a common part, driven by factors which are common to the four international markets, and an idiosyncratic part, which is country (market) specific. In turn, the idiosyncratic part can be decomposed into those market-specific effects that exert a systematic influence on the term structure and those effects that are temporary and discontinuous. More formally, the following static factor model is hypothesised:

$$S_{it} = \underbrace{\beta_i C_t}_{\substack{\text{Common} \\ \text{component}}} + \underbrace{\alpha_i IF_{it}}_{\substack{\text{Idiosyncratic} \\ \text{component}}} + \varepsilon_{it} \qquad \textbf{(1)}$$

where:

S_{it} refers to the term structure of swap spreads (which is approximated by the difference between the ten-year and two-year swap spreads); C_t is a set of r common influences on the term structure; IF_{it} are idiosyncratic factors that affect individual countries' swap and government bond curves which may be correlated both serially and across countries but are orthogonal to the common factors; and β_i and α_i are the sensitivity of the term structure of country i to the common and idiosyncratic influences respectively. ε_{it} are random influences that cannot be accounted for in the model.

Equation **(1)** can be thought of as capturing the persistent influences (medium-run trends) on the term structure of swap spreads. But it may take some time for the term structure to adjust to movements in the underlying drivers. To capture these dynamic effects, the following error-correction form is assumed:

$$D(S_{it}) = \beta_i D(C_t) + \alpha_i D(IF_{it}) - \lambda(S_{it-1} - \beta_i C_{t-1} - \alpha_i IF_{it-1}) + \zeta_{it} \qquad \textbf{(2)}$$

Equation **(2)** isolates the short-run and medium-run influences on the term structure of swap spreads. D represents change in the variable in the short term, such that $D(C_t) = C_t - C_{t-1}$. The λ parameter measures the speed at which the explanatory variables adjust to restore the 'equilibrium' relationship in the term structure of swap spreads over the sample period.

Estimation strategy

Instead of selecting candidate observable variables and undertaking some form of regression analysis for equations **(1)** and **(2)**, statistical data analysis was used first to determine the relative importance of common and idiosyncratic influences on the term structure. Specifically, principal component analysis (PCA) was used to extract the latent common factors for the series of two to ten-year term structures of swap spreads.

Once the common factors were derived, the influence of some candidate market-specific variables was explored by estimating equation **(2)** using regression analysis. Specifically, an error-correction model (ECM)[1] was estimated to help distinguish short-run from more persistent medium-run influences on the term structure of swap spreads. At this stage, it was also possible to examine the relative importance of the common and market-specific factors for the medium-run and short-run movements in the term structure of swap spreads.[2]

(1) See Fernandez-Corugedo, Price and Blake (2003) for an explanation and practical application of error-correction models.
(2) At least one cointegrating relationship was identified for the term structure of dollar swap spreads using Johansen's cointegration test. See Johansen (1995) for further details. Testing restrictions on the medium-run influences suggested the principal component as the key influence in the ECM. The medium-run influence of idiosyncratic factors was also tested but the results were less satisfactory.

References

Adedeji, A and McCosh, A M (1995), 'Determinants of eurobond yields', *Journal of Business, Finance and Accounting*, Vol. 22(8), December, pages 1,107–24.

Bedendo, M, Cathcart, L and El-Jahel, L (2004), 'The shape of the term structure of credit spreads: an empirical investigation', *Working paper*, Tanaka Business School, Imperial College London.

Brooke, M, Clare, A and Lekkos, I (2000), 'A comparison of long bond yields in the United Kingdom, the United States, and Germany', *Bank of England Quarterly Bulletin*, May, pages 150–58.

Cortes, F (2003), 'Understanding and modelling swap spreads', *Bank of England Quarterly Bulletin*, Winter, pages 407–16.

Fernandez-Corugedo, E, Price, S and Blake, A (2003), 'The dynamics of consumers' expenditure: the UK consumption ECM redux', *Bank of England Working Paper no. 204*.

Gehr, A K and Martell, T F (1992), 'Pricing efficiency in the secondary market for investment-grade corporate bonds', *Journal of Fixed Income*, Vol. 2, No. 2, December, pages 24–38.

Hawkesby, C, Marsh, I W and Stevens, I (2005), 'Comovements in the prices of securities issued by large complex financial institutions', *Bank of England Working Paper no. 256*.

Higgins, M and Klitgaard, T (2004), 'Reserve accumulation: implications for global capital flows and financial markets', *Current Issues in Economics and Finance*, September/October, Vol. 10, No. 10, Federal Reserve Bank of New York.

Jackson, J (1991), *A user's guide to principal components*, New York: John Wiley and Sons.

Johansen, S (1995), *Likelihood-based inference in cointegrated vector auto-regressive models*, Oxford University Press (Oxford).

Litterman, R and Iben, T (1991), 'Corporate bond valuation and the term structure of credit spreads', *The Journal of Portfolio Management*, Spring, pages 52–64.

Liu, J, Longstaff, F A and Mandell, R E (2004), 'The market price of credit risk: an empirical analysis of interest rate swap spreads', *Journal of Business*, forthcoming.

Peacock, C (2004), 'Deriving a market-based measure of interest rate expectations', *Bank of England Quarterly Bulletin*, Summer, pages 142–52.

The information content of aggregate data on financial futures positions

By Caroline Mogford of the Bank's Sterling Markets Division and Darren Pain of the Bank's Foreign Exchange Division.

This article uses statistical analysis to investigate the strength of any empirical relationships between data on speculative financial futures positions and movements in asset prices. It finds strong evidence that speculative positions do indeed tend to move closely with changes in the underlying asset prices. But there is little support for the view that these positions data systematically inform about future changes in asset prices.

Introduction

A futures contract is a binding agreement between a buyer and seller to receive (in the case of a long position) or deliver (in the case of a short position) a commodity or financial instrument sometime in the future, but at a price that is agreed upon today. Futures trades take place through a centralised exchange.(1) Customers who trade futures are required to deposit cash or acceptable securities with the exchange — the so-called initial margin. In doing so, they have an incentive to honour their financial commitments and cover any obligations which might arise out of their trading activities. Given the margin deposits, the exchange clearing house will act as the buyer to the seller and the seller to the buyer in every transaction, thereby guaranteeing performance and reducing counterparty risk.

US futures markets are regulated federally by the Commodity Futures Trading Commission (CFTC), which is responsible for ensuring that prices and outstanding positions are communicated to the public. The CFTC provides the most comprehensive positions data on exchange-traded futures which are watched by a sizable share of market participants. In particular, the data from the CFTC's Commitments of Traders Report (COTR) on speculative positioning is sometimes used by analysts and commentators as an indicator of the future direction of prices in asset markets. For example, extreme net short speculative positions are sometimes thought to signal an imminent rebound in the relevant currency, while extreme net long positions can suggest a currency has already appreciated a great deal and may be poised for a downward correction.(2) Is there any statistical evidence to support such views? More generally, what is the information content of the COTR positioning data about movements in financial asset prices?

The purpose of this article is to examine the empirical links between changes in aggregate reported futures positions and changes in prices in a variety of asset markets. More specifically, it undertakes a basic statistical investigation of the relationships between changes in futures positions and changes in the corresponding underlying asset price. Among these, a particular focus is whether changes to futures positions have any leading indicator properties over asset prices, particularly those associated with the accumulation of large aggregate futures positions.

Some background

Traditional models of asset prices, and in particular exchange rates, are based on publicly available macroeconomic information. In such models, incremental information cannot be conveyed by trading because public information is already incorporated in the price (see Evans and Lyons (2001)). However, in recent years a body of literature has been developed that has sought to relax the strong assumption that all price-relevant information is available publicly and has instead stressed the importance of the process by which

(1) In contrast, forward contracts are traded off-exchange or 'over-the-counter' with market-making intermediaries.
(2) According to Business Reuters on 23 April 2004, '…extreme net-long speculative positions often signal a decline in a currency, especially if that position conflicts with the positioning of the more influential commercial players'.

dispersed information becomes widely known to the market. In particular, a number of authors have examined how order-flows (the number of buyers bidding less than the number of sellers offering) can help to explain and predict short-term movements in exchange rates.(1) The rationale is that order-flows can convey dispersed information about the fundamental determinants of exchange rates — for example news about relative macroeconomic conditions in different countries, changes in investors' risk aversion or hedging technologies etc — that currency markets need to aggregate and which should affect but may not yet be embodied in the current exchange rate.

Cast in this light, the data on futures positions may potentially offer incremental information about asset price developments, because they reveal to the market information about the disparate views of traders and their demands for the particular underlying asset. From an investor's perspective, if knowledge about the overall market position is informative about likely future developments, it could be useful in identifying profitable trading opportunities — especially if combined with proprietary information about their own positions or those of the more influential commercial players.

Knowledge of aggregate market positions data might also be useful from a policy perspective. Asset price developments can be an important element of the monetary policy transmission mechanism. In analysing the policy implications of asset price changes, it is important to assess the reasons behind any change. But if it could be shown that aggregate positions data are informative about potential movements in asset prices, they might be useful indicator variables which policymakers could use to assess possible future developments in asset markets and the macroeconomy more generally.

Aggregate data on positioning might also help to assess prospective financial stability conditions. In particular, some past episodes of financial market instability have been associated with the build-up and subsequent unwinding of speculative positions. An example of this is the sharp decline of the dollar against the yen in October 1998. The combination of an appreciating dollar and the large interest rate differential between Japan and the United States during the first half of 1998 prompted many market participants to establish similar positions by borrowing yen and buying dollar assets. This so-called 'yen-carry' trade was very common among hedge funds, proprietary trading desks of investment banks and even treasury departments of large corporations. The unwinding of this 'yen-carry' trade began following the Russian debt default in August 1998 and was exacerbated by stop-loss orders, the cancellation of barrier options(2) and associated hedging positions by dealers. Monitoring speculative positions may possibly be useful in spotting potential vulnerabilities in financial markets that could lead to this sort of dynamics in financial markets.

The COTR data

The COTR provides a breakdown of positions in futures for markets traded on a number of exchanges, including the Chicago Mercantile Exchange (CME).(3) The positioning data are published every Friday, and refer to positions held at the close of business on the preceding Tuesday. The COTR provides positions figures for the futures markets for traders holding positions equal to or above the reporting levels established by the CFTC. Other flow and survey data publicly provided by individual investment banks or custodians are not as comprehensive and may be subject to sampling or response bias and are therefore not included in this analysis.

The COTR data contain the long and short futures positions held in a variety of markets. The *net* position in a future can be defined as the total number of long less short positions for a particular group of participants. Every futures contract has both a buyer (who is long) and a seller (who is short) so the net positions must sum to zero across all traders, although not for different subgroups.

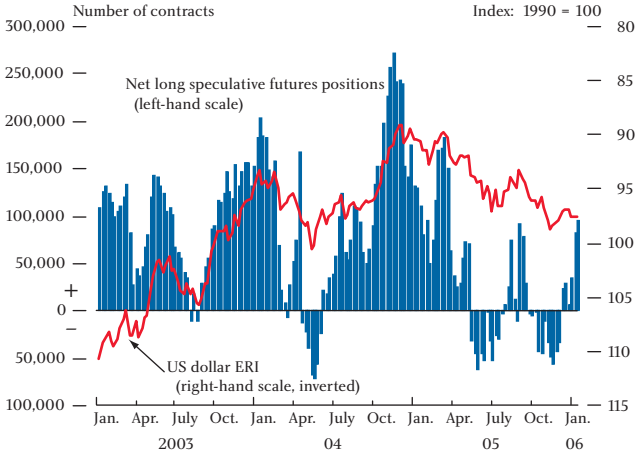
The COTR separates those positions held by commercial and non-commercial traders. This distinction is based on how firms identify themselves to the exchanges, although the exchanges monitor the behaviour of firms to confirm their self-designation. Commercial positions are often transactions of firms that use futures to hedge

(1) See, for example, Evans and Lyons (2001 and 2002), Fan and Lyons (2003), Lyons (2001) and Dominguez and Panthaki (2005).
(2) A barrier option is a type of financial option where the option to exercise depends on the price of the underlying asset crossing or reaching a given barrier level.
(3) The International Money Market (IMM), a division of the CME, was established in 1972 for the trading of seven currency futures contracts. Financial futures markets have since expanded, and the markets analysed in this article, including the IMM, represent a small subsample of the markets regulated by the CFTC.

their business operations, but also include transactions of dealers that are not necessarily in the market to hedge or speculate. Non-commercial data are generally interpreted as reflecting the speculative community's positioning, although some authors have previously questioned this interpretation. For example, Sanders, Boris and Manfredo (2004) maintain that, because position limits are placed on non-commercial investors, there may be some incentive for traders to self-classify as commercials. And as commercial firms' true cash positions are unknown, it is possible that some of their positions could be speculative in nature. Nonetheless, Sanders *et al* suggest that 'reporting non-commercials most likely represent a relatively pure subset of total speculative positions' and, in particular, they may be considered a reasonable indicator of how the large commodity trading advisors (CTAs) are positioned.(1)

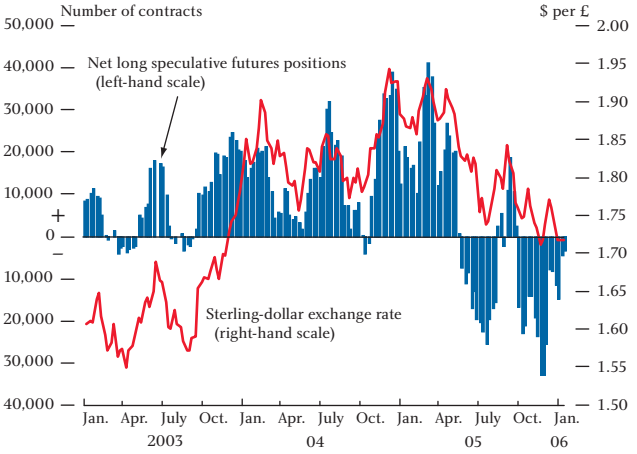
Futures positions are available from the CFTC for a large number of currencies, although this article only considers the seven major currencies for which futures contracts are traded on the CME: euro, sterling, yen, Canadian dollars, Swiss francs, Mexican pesos and Australian dollars. Positions in each currency are typically given against the US dollar. In addition, this article also investigates a selection of other markets traded on the CME: interest rate markets (Libor, eurodollar and US Treasury notes), equity indices (S&P 500, Nasdaq and Nikkei) and oil futures (NYMEX). Weekly net speculative positions for all these markets are calculated from COTR data.(2)

Chart 1
Net long speculative futures positions in all seven currencies (against the dollar) and the dollar ERI



Sources: Commodity Futures Trading Commission and Bank calculations.

Chart 2
Net long speculative positions in sterling (against the dollar) and the sterling-dollar exchange rate



Sources: Commodity Futures Trading Commission and Bank calculations.

Empirical analysis

The box on page 60 outlines some possible theoretical links between movements in asset prices and positioning in futures. A casual review of the empirical data also indicates that there may be a relationship between the strength of a currency and the number of net long speculative positions in that currency. Chart 1 shows total net long speculative positions in the seven available currencies (against the US dollar), plotted against the dollar ERI. And Chart 2 shows net long speculative positions in sterling against the sterling-dollar exchange rate. A general build-up in long (short) positions would seem to be associated with an appreciation (depreciation) in the exchange rate. But more formal statistical analysis can be used to uncover the strength of any relationship and more generally the information content of the COTR data for markets other than foreign currency.

In order to investigate this issue, we consider four empirical questions. First, we investigate whether there is any contemporaneous relationship between changes in speculative positions and changes in asset prices, and whether the strength of this relationship varies between asset markets. Second, we examine whether changes in net speculative positions *precede* changes in asset prices. Third, we consider whether *extreme* net speculative

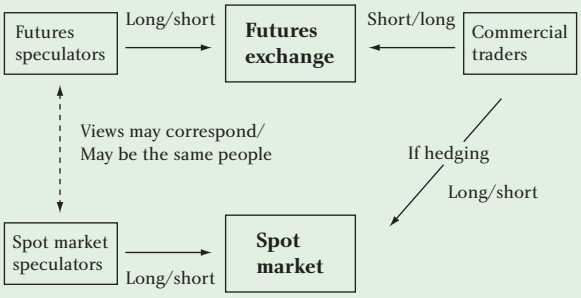
(1) A CTA is an individual or firm which advises others about buying and selling futures and/or futures options and manages associated trades for its clients or on its own behalf.
(2) The data have been published at a weekly frequency since 1993 (with the exceptions of the euro (from 1999), the Mexican peso (from 1995), the US Treasury bills (from 1997), the S&P 500 (from 1997) and the Nasdaq (from 1996)).

Possible links between futures positions and movements in asset prices in spot markets

In the spot or 'cash' market, financial assets are traded for immediate delivery at the prevailing price. This differs from a futures market, where the delivery will be made at a future date. Futures contracts are traded on an exchange, have standardised features and provide a mechanism that gives both parties some form of guarantee that the contract will be honoured.

Figure 1 outlines the possible interactions between the spot and futures markets. There are a number of reasons why changes in net speculative futures positions might be associated with changes in the underlying spot price. First, the views of the main players in the speculative futures community may closely correspond to those of the main players in spot markets. That is, investors take similar directional positions in either 'cash' or futures markets. In fact, it is likely that some speculators are involved in both futures and spot markets. Market news may influence both futures speculators' adjustments to the number of futures positions they hold and spot market participants' views of how the asset price will move.

Figure 1
Possible interaction between changes to net speculative positions and asset prices



A second possible explanation stems from the fact that aggregate *net* speculative positions in the futures market are taken against commercial investors: either firms with hedging requirements or traders. When speculative positions are taken against commercial traders, the traders may hedge their positions in the cash market. This could cause movements in speculative positions to correlate with moves in asset prices. For example, an increase in net speculative positions will correspond to a decrease in net commercial traders' positions. The commercial traders may then hedge this position by buying the asset in the spot market, which might lead to an increase in the asset price.

Another reason for a positive relationship between changes in net speculative positions and changes in an asset price could be that speculators tend to react to asset price movements. If futures speculators trade on 'trend-following' models, they would go long (short) after an asset price increases (decreases). When weekly data are used, this should result in a significant contemporaneous relationship. But, if markets were fully efficient, such trend-following behaviour would not be profitable as movements in the asset price should contain no information about future changes in the asset price.

None of these hypotheses necessarily imply the existence of leading indicator relationships in either direction between changes in net speculative positions and changes in the asset price. However, it is possible that the interaction between spot and futures markets takes some time to work through, so that the transactions in one market have a lagged impact on the other. Such dynamic effects could relate to the perceived asymmetry of information. Large traders in financial markets may be considered to be relatively well informed about financial markets. Adjustments in their positions could therefore be used as a signal for other traders in the market to adjust their positions, and so may precede changes in asset prices. Another reason why spot and futures positions may be dynamically related is that traders with positions in futures may choose to close out or hedge those positions using the spot market at a later date. For example, a trader who is short may choose to close out his exposure by buying the security in the cash market (so called 'short-covering').

positions tend to precede changes in the exchange rate. And finally, using information from options prices, the article assesses whether the views of option speculators tend to correspond to the views of speculators in futures markets.

Do net speculative positions and asset prices tend to move together?

Klitgaard (2004) analysed weekly net speculative COTR foreign exchange data between 1993 and 2004. He found a strong contemporaneous relationship between weekly changes in speculators' net positions and exchange rate moves. This article adopts a similar approach for the seven currencies considered, but also extends the analysis to include oil, interest rate and equity markets.

Table A shows the percentage of weeks between January 1993 and January 2006 in which changes in net speculative positions and percentage changes in asset prices moved in the same direction for the markets under investigation. If there were no contemporaneous relationships between changes in speculative futures positions and changes in asset prices, the two variables would be expected to move together approximately half of the time. This hypothesis can be evaluated using a simple statistical test. Markets for which the percentage is significantly different from 50% at the 5% level are shown in bold in the table.

Table A
Percentage of weeks that changes in speculative positions move in the same direction as the asset price, for all asset markets under investigation (Jan. 1993 – Jan. 2006)[a]

Asset market	Percentage (p-value)[b]
Euro — US dollar	**69% (0.00)**
Sterling — US dollar	**71% (0.00)**
Yen — US dollar	**74% (0.00)**
Canadian dollar — US dollar	**69% (0.00)**
Swiss franc — US dollar	**74% (0.00)**
Mexican peso — US dollar	**67% (0.00)**
Australian dollar — US dollar	**68% (0.00)**
Oil	**71% (0.00)**
Two-year US Treasury yields[c]	46% (0.07)
Five-year US Treasury yields[c]	**43% (0.00)**
Ten-year US Treasury yields[c]	**45% (0.03)**
Libor[c]	47% (0.20)
Eurodollar[c]	50% (0.94)
S&P 500	**56% (0.00)**
Nasdaq	54% (0.09)
Nikkei	52% (0.34)

(a) Start dates differ across markets.
(b) Based on a two-tailed z-test or t-test of the null hypothesis that percentage is equal to 50%. Where the null can be rejected at the 5% significant level, the result is shown in bold.
(c) Test was constructed using yields rather than prices and hence the statistic might be expected to be less than 50%.

In fact, at the 5% significance level, the null hypothesis of zero contemporaneous correlation was rejected for all seven currencies, the oil market and the S&P 500 and long-maturity US dollar government bond yields. For most of these markets, changes in the asset price and changes in the net speculative positions tended to move together significantly more than 50% of the time.

Do changes in net speculative futures positions lead moves in asset prices?

To investigate whether either variable has any predictive power over the other, we use Granger-causality tests.(1) In simple terms, Granger causality measures whether one thing happens before another thing and can help to predict it. More formally, pair-wise Granger-causality tests assess whether a variable (X) can be used to forecast movements in another variable (Y) over and above simply using past values of Y. Thus, in the current investigation, these tests can be used to assess (i) whether past values of net speculative positions have any predictive power over moves in an asset price, beyond using past values of asset prices alone, and conversely (ii) whether past asset price movements can inform about future speculative positions, over and above past movements in futures positions. If movements in speculative positions provide incremental information about future movements in an asset price, then they can be said to 'Granger cause' that asset price and *vice versa*.

Table B shows the results of Granger-causality tests for all markets. For most futures contracts, there was no significant evidence that movements in speculative positions either lead or lag changes in the (spot) asset prices. Indeed, if anything, it is more likely that movements in asset prices 'Granger caused' movements in futures positions. Arguably, changes in net speculative positions do seem to have preceded moves in the ten-year US Treasury and the euro-dollar exchange rate.(2) But it may be that these statistically significant results reflect no more than the random variation in the detectable leading indicator relationships across the markets considered.(3)

(1) It should be stressed that these tests all use weekly data. It is quite possible that closer relationships exist over different time horizons, but data availability limits such research.
(2) At face value, the existence of leading indicator relationships in any of the asset markets could perhaps suggest profit-making opportunities. However, the CFTC data are released three days after the date to which they refer. It is not clear therefore that investors could in practice profit from knowledge of the CFTC data even if after the event, it were found to be useful in anticipating asset price changes.
(3) Put another way, a *joint* test of Granger causality across markets might show little evidence of leading indicator relationships even though they could be marginally statistically significant in a few markets.

Table B
Results of Granger-causality tests[a] between changes in net speculative positions and changes in the underlying asset price (Jan. 1993 – Jan. 2006)[b]

Asset market	p-value of test:[c] changes in speculative positions precede changes in asset price	p-value of test:[c] changes in asset prices precede changes in speculative positions
Euro	**0.05**	0.06
Sterling	0.42	**0.00**
Yen	0.90	0.06
Canadian dollar	0.12	0.01
Swiss franc	0.88	**0.00**
Mexican peso	0.50	0.77
Australian dollar	0.06	**0.00**
Oil	0.24	**0.01**
Two-year US Treasury	0.81	0.99
Five-year US Treasury	0.77	**0.02**
Ten-year US Treasury	**0.05**	0.17
Libor	0.78	0.64
Eurodollar	0.40	0.58
S&P 500	0.64	0.71
Nasdaq	0.29	0.92
Nikkei	0.97	0.49

(a) Formally, the different possible Granger-causal relations between assets prices (S) and speculative futures positions (F) can be expressed using the parameters of equations:

$$S_t = \sum_{i=1}^{n} \alpha_i S_{t-i} + \sum_{i=1}^{n} \beta_i F_{t-i} \qquad (1)$$

$$F_t = \sum_{i=1}^{n} \gamma_i F_{t-i} + \sum_{i=1}^{n} \delta_i S_{t-i} \qquad (2)$$

There is Granger causality from futures positions to asset prices if $\beta_i \neq 0$ and $\delta_i = 0$ for all i. Similarly, there is causality from asset prices to futures positions if $\beta_i = 0$ and $\delta_i \neq 0$ for all i. The causality is considered as mutual if $\beta_i \neq 0$ and $\delta_i \neq 0$ for all i. Finally, there is no link between asset price movements and futures positions if $\beta_i = 0$ and $\delta_i = 0$ for all i.

(b) Start dates differ across markets.

(c) Result of an F-test of coefficient significance; 2 lags used ($n = 2$). Where the coefficients are significantly different from zero, the result is shown in bold. Tests with shorter and longer lags produced broadly similar results.

Do extreme net speculative positions precede changes in the exchange rate?

Some foreign exchange market contacts have reported that their main interest in the net speculative position data is when positions are unusually large or small. The rationale behind this view is that extreme positions are unlikely to persist. This suggests that there could be an inverse relationship between the sign of an extreme position and future changes in the exchange rate.

One way to investigate this is to ascertain whether currencies tend to increase (decrease) in value, ie appreciate (depreciate), the week after net speculative positions are extremely low (high). For the purposes of this article, extreme is defined as outside the range of a 52-week rolling mean plus or minus either one or two standard deviations.

Table C shows the percentage of weeks when extreme speculative positions preceded an inverse move in the relevant exchange rate. Overall, the results provide little support for the existence of a *systematic* relationship of this nature in any of the foreign exchange markets. Co-movements between extreme changes in net positions (those at least one standard deviation larger or smaller than the average weekly position over the sample) and subsequent exchange rate moves were not statistically significant (at the 5% level) over the sample period.

Table C
Percentage of weeks in which an extreme position (against the dollar) preceded an inverse move in the exchange rate (Jan. 1993 – Jan. 2006)[a]

Currency	One standard deviation (p-value)[b]	Two standard deviations (p-value)[b]
Euro	45% (0.28)	48%[c]
Sterling	55% (0.12)	51% (0.88)
Yen	46% (0.23)	60% (0.15)
Canadian dollar	49% (0.63)	41% (0.16)
Swiss franc	51% (0.75)	54% (0.65)
Mexican peso	48% (0.42)	54% (0.59)
Australian dollar	47% (0.33)	38% (0.05)

(a) Start dates differ across markets.

(b) Based on a two-tailed z-test or t-test of the null hypothesis that percentage is equal to 50%. Where the null can be rejected at the 5% significant level, the result is shown in bold.

(c) Too few observations to make test reliable.

Do speculators in options and futures tend to have similar views?

One way of quantifying changes in the views of options purchasers is by considering changes in risk reversals. Risk reversals are a combination of call options on a particular asset (instruments that give an investor the right but not the obligation to buy an asset at a specified price within a specific time period) and put options (instruments that enable the investor to sell an asset on pre-agreed terms). They are commonly traded in foreign exchange options markets and the market price of the risk reversal can be interpreted as a reflection of market participants' views on the balance of risks to an exchange rate. According to market convention, risk reversals are typically expressed so that a positive number indicates that calls are preferred to puts and that the market assesses an appreciation in the underlying currency is more likely than a depreciation. Likewise, a negative number indicates that puts are preferred to calls and that the market perceives a greater risk of a depreciation in the underlying currency than an appreciation.

If risk reversals and net speculative positions in a particular currency pair moved in the same direction, this could suggest that options and futures speculators had similar views regarding the balance of risks to future exchange rate moves. But it should be noted that market participants other than speculators use options (for example for hedging), so changes to risk reversals are not a perfect indicator of changes to the views of options speculators.

The contemporaneous relationship between net speculative positions and risk reversals was investigated for sterling, euro and yen.(1) Table D shows the percentage of weeks in which speculative positions and risk reversals moved in the same direction for these currencies. Over the period considered, net speculative positions and the corresponding exchange rates moved in the same direction significantly more than 50% of the time for all three currencies against the dollar. This indicates that there may be a relationship between the views of futures speculators regarding potential exchange rate changes and those of purchasers of options.

Table D
Percentage of weeks that risk reversals and net speculative positions move in the same directions (Aug. 2001 – Jan. 2006)

Currency	Percentage (p-value)(a)
Sterling	**66% (0.00)**
Euro	**68% (0.00)**
Yen	**73% (0.00)**

(a) Based on a two-tailed z-test or t-test of the null hypothesis that percentage is equal to 50%. Where the null can be rejected at the 5% significant level, the result is shown in bold.

To consider the dynamic relationship between speculative positions and risk reversals, Table E details the results of Granger-causality tests for the two variables. On the basis of this test, there is some evidence that risk reversals preceded changes in net euro speculative positions. That is, changes in risk reversals may provide information about future changes in net speculative positions.

Table E
Results of Granger-causality tests(a) between changes in net speculative positions and changes in risk reversals (Aug. 2001 – Jan. 2006)(b)

Currency	p-value of test:(b) changes in speculative positions precede changes in risk reversals	p-value of test:(b) changes in risk reversals precede changes in speculative positions
Euro	0.26	**0.04**
Sterling	0.85	**0.04**
Yen	0.18	**0.01**

(a) See footnotes on Table C for an explanation of Granger causality.
(b) Result of an F-test of coefficient significance; 2 lags used (i = 2). Where the coefficients are significantly different from zero, the result is shown in bold. Tests with shorter and longer lags produced broadly similar results.

These results for the risk reversal data raise the question as to whether changes in risk reversals, unlike speculative positions data, precede changes in exchange rates. Indeed, comments by contacts in the foreign exchange market suggest that they tend to concentrate more on risk reversals than COTR data, not least because they are more frequently available.

However, the results of Granger-causality tests (shown in Table F) do not indicate a strong relationship between movements in risk reversals and subsequent changes in currency rates. If anything, over the sample period, changes in the euro-dollar exchange rate have tended to precede movements in risk reversals. Moreover, other studies have highlighted that any empirical association between risk reversals and spot exchange rates may not be particularly straightforward to interpret. In particular, Campa, Chang and Reider (1997) found evidence of a strong *positive* correlation between the level of the spot exchange rate and risk reversals — the stronger the currency, the greater the risk of a large appreciation of that currency. This contrasts with the general market view that risk reversals and spot rate are *negatively* correlated: large falls in exchange rates are assigned a greater probability of occurring when the spot rate has previously appreciated significantly and is therefore relatively strong.

Table F
Results of Granger-causality tests(a) between changes in risk reversals and changes in exchange rates (Aug. 2001 – Jan. 2006)(b)

Currency	p-value of test:(b) changes in exchange rates precede changes in risk reversals	p-value of test:(b) changes in risk reversals precede changes in exchange rates
Euro	**0.01**	0.43
Sterling	0.87	0.23
Yen	0.06	0.09

(a) See footnotes on Table C for an explanation of Granger causality.
(b) Result of an F-test of coefficient significance; 2 lags used (i = 2). Where the coefficients are significantly different from zero, the result is shown in bold. Tests with shorter and longer lags produced broadly similar results.

Concluding remarks

Overall, the statistical results reported in this article suggest that a strong *contemporaneous* relationship exists between weekly changes in net speculative positions and changes in exchange rates and oil prices, although this is less true for interest rate and equity markets. One possible explanation is that speculators in foreign exchange and commodity markets may tend to follow trends. It could also be the case that significant market news could move both the futures and spot markets, resulting in a close association between developments in the two markets. Another potential explanation is that commercial traders may choose to simultaneously hedge their futures positions in the spot market.

(1) One-month risk reversals were used in this analysis since they should reflect market participants' near-term views, and the underlying options are reasonably liquid.

However, the empirical results lend little support to the view that the COTR speculative positioning data are systematically informative about *future* changes in asset prices. There is little evidence that changes in non-commercial positions have significant predictive power regarding asset prices. And at least over the sample of currencies and the period considered, there would appear to be little statistical evidence to corroborate the market anecdote that extreme speculative positions systematically precede inverse moves in the major exchange rates. This could be because the publication of these aggregate data does not provide incremental information about the underlying determinants of asset prices. Put another way, asset prices tend to move as soon as the data are released to reflect any news in these data.

References

Campa, J, Chang, P and Reider, R (1997), 'Implied exchange rate distributions: evidence from OTC options markets', *NBER Working Paper no. 6179*.

Dominguez, K and Panthaki, F (2005), 'What defines 'news' in foreign exchange markets?', *NBER Working Paper no. 11769*.

Evans, M and Lyons, R (2001), 'Why order flow explains exchange rates', *mimeo*, Haas School of Business, UC Berkeley.

Evans, M and Lyons, R (2002), 'Order flow and exchange rate dynamics', *Journal of Political Economy*, February, pages 170–80.

Fan, M and Lyons, R (2003), 'Customer trades and extreme events in foreign exchange', published in *Monetary history, exchange rates and financial markets: essays in honour of Charles Goodhart*, Paul Mizen (ed), Edward Elgar: Northampton, MA, USA, pages 160–79.

Klitgaard, T (2004), 'Exchange rate changes and net positions of speculators in the futures market', *Federal Reserve Bank of New York Economic Policy Review*, May.

Lyons, R (2001), 'Foreign exchange: macro puzzles, micro tools', *Economic Review 2002*, Federal Reserve Bank of San Francisco, pages 51–69.

Sanders, D, Boris, K and Manfredo, M (2004), 'Hedgers, funds, and small speculators in the energy futures markets: an analysis of the CFTC's Commitments of Traders reports', *Energy Economics*, Vol. 26, Issue 3, pages 425–45.

The forward market for oil

By Patrick Campbell of the Bank's Foreign Exchange Division, Bjorn-Erik Orskaug of the Bank's International Finance Division and Richard Williams of the Bank's International Economic Analysis Division.

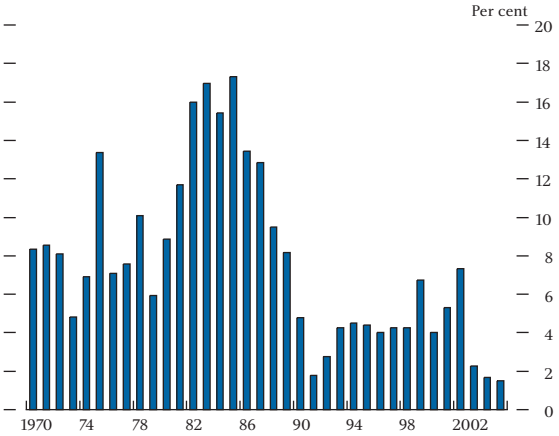
As the spot price of oil has risen in recent years, so has the price of oil for delivery in the future. This article examines the workings of the forward market for oil and considers why producers have not been hedging more of their future oil production following these unusual forward price moves.

Introduction

The price of oil is an important macroeconomic variable. It reflects demand pressures in the global economy, and potentially impacts directly on the inflation rate, at least in the short run. This article looks at how a particular section of the market for oil operates: the forward market.

In February 2006, the price of oil for delivery within the next month was around $60 per barrel, roughly double the price of two years earlier. The rise largely reflects strong growth in global demand for oil at a time when estimated short-term spare production capacity was at historical lows (Chart 1). The rise in the price of oil for near-term delivery has been accompanied by an unusual increase in the price of oil for delivery further in the future, suggesting that higher prices are expected to be a relatively long-lasting phenomenon. But a higher future price of oil ought to allow producers to hedge future production, thus bringing about higher future supply by increasing expected returns on investments in oil production. Unless demand growth continues to exceed supply growth, this process ought eventually to reduce the price of oil for immediate and future delivery.

Chart 1
World spare oil production capacity as a percentage of world oil production(a)



Sources: Bank of England and US Energy Information Administration.

(a) Spare capacity is defined as extra production that can be brought on-line within 30 days and that can be sustained for at least 90 days.

In this article we explore the question of whether the forward market for oil may be less than fully efficient in allowing market participants to hedge future production. We consider first how the forward market for oil operates, both on and off exchange. We then go on to discuss why there is not more hedging activity. It is argued that the lack of hedging may reflect failures in forward markets for other goods and services rather than in the forward market for oil. In addressing these issues, we have consulted a range of market participants and interested parties. These include oil producers, futures exchanges, investment banks, hedge funds, academics and representatives from official institutions.

How the forward market for oil operates

Oil is traded 'forward', for future delivery, both on recognised futures exchanges and directly between market participants (known as 'over-the-counter' or OTC trades). This section examines how exchange trading and the OTC market operate in practice. We then draw out the key features of the forward market: the range of market participants; the available set of contracts; and alternatives to trading in the market.

The exchanges

Exchanges usually allow for trade in both futures and options contracts. The standard futures contract on the

two major exchanges — the New York Mercantile Exchange (NYMEX) and ICE Futures[1] in London — is for 1,000 barrels of oil for delivery on a future date.[2] These exchanges offer contracts for delivery up to and including 2012. Options can be written in many ways, but a common example would allow an oil consumer to pay a premium for the right to buy oil at a fixed price in the future. Only if the price goes above that level will the option be 'exercised'. The two exchanges are dealing rivals but each dominates trading in particular types of oil. The most traded (or 'benchmark') contracts on NYMEX are for the delivery of US light, sweet crude oil[3] such as West Texas Intermediate (WTI). The benchmark for ICE Futures is for another light, sweet crude oil: namely Brent.

There are other exchanges that trade oil-related contracts, notably the Tokyo Commodity Exchange (TOCOM). The Dubai Mercantile Exchange is scheduled to open for oil futures trading in the fourth quarter of 2006, but it is not yet clear which benchmark contract will be offered. NYMEX and ICE Futures are the clear world leaders by volume. In 2005, 59.7 million light, sweet contracts traded on NYMEX[4] while 30.4 million Brent contracts traded on ICE Futures. Both were record volumes.

The exchanges are supported by 'central clearing counterparty' services which are also made available for some OTC trades. The central counterparty (CCP) matches buyers and sellers of contracts (the 'counterparties') and then arranges for payment and settlement. This means that counterparties take no direct credit exposure to each other. If a trader defaults, other market participants are protected by the CCP. The CCP offsets its credit risk by collecting so-called 'margin payments'. These payments reflect both the initial contract position (that is, whether the trader is a seller or a buyer of the futures contract) and changes in the value of the contract as market prices vary.

The over-the-counter (OTC) market

In OTC oil markets, investment banks act as the intermediaries or market-makers, matching buyers and sellers. The most common OTC contracts are swaps and options. Swaps allow, for example, an oil producer to receive a fixed price at agreed future points in time and in return pay the 'floating' spot price — an easy way to hedge future income streams. Conversely, an oil consumer could agree to pay the fixed price and receive the floating spot price, thereby increasing its certainty as to future oil expenditure.

Although the most actively traded contracts expire between the spot date and five years hence, the major intermediaries are prepared to make markets in OTC swaps and options as far out as their customers demand. But the price charged by a market-maker will usually increase to reflect the reduced liquidity available beyond the five-year horizon and, consequently, the time they will have to hold, or 'warehouse', the risk incurred before they can find a counterparty interested in taking that risk off the bank's books.

The swaps/options markets in oil are mostly conducted over-the-counter rather than on-exchange (our contacts suggest up to 90% is OTC). This is because swaps/options are usually used to hedge entity-specific risks rather than to speculate. Contracts are therefore highly individually tailored, or 'bespoke', and, unlike standardised futures contracts which are easily tradable, are usually held to maturity (which underlines their predominantly non-speculative usage).

As noted above, some exchanges provide facilities for OTC trades to be cleared through a CCP and so be protected against credit risk. As in other financial markets, there are alternatives to central clearing to insulate against counterparty credit risk in long-term contracts. Counterparties can agree standard rules calling for the deposit of collateral against the net market value ('marking-to-market') of any long-term contract. These deposits are similar to margin payments and work to minimise the degree of unsecured exposures. It is usually possible also to negotiate the sale back of OTC contracts (at a market-determined price). In our discussions, no current market participants mentioned credit risk or the long-term nature of contracts as an issue constraining the market.

Given that exchanges trade contracts only for up to some six years ahead, all longer-term contracts are made

(1) ICE Futures changed its name from the International Petroleum Exchange (IPE) on 26 October 2005.
(2) NYMEX also offers trading in contracts for the delivery of 500 barrels of light, sweet crude oil.
(3) Crude oils can have different physical characteristics. For example, the density and sulphur content may differ. Less dense, or light, oils are easier to refine than heavy oils to produce valuable light products, such as petrol — rather than less valuable heavy products, such as residual fuel oil. Oils that have a high sulphur content are said to be sour, whereas those with a low sulphur content are sweet. Sulphur has to be removed from oil when it is refined, so sweet oils are generally cheaper to refine.
(4) These include only contracts for the delivery of 1,000 barrels of oil.

over-the-counter. In common with other OTC commodity markets there is only limited information available about the size of the OTC market for oil. But the range of market participants we surveyed were unanimous in reporting that the OTC oil derivatives market is significantly larger than the exchange-traded oil futures market.

Market participants

Oil market participants are a diverse group, trading at different maturities and with different objectives. Major commercial oil producers are involved in the market to varying degrees, with the more active producers involved as both buyers and sellers. Oil producers have expert knowledge about oil production and the different oil-related products which gives them an informational advantage in many trades. Sometimes oil companies will trade around their own oil delivery schedules, to manage cash flows, but generally they do not hedge future production. We explore reasons for this later.

Discussions with oil producers indicate that they do not base investment decisions on one particular forecast of future oil prices, even if such forecasts have to be made for accounting purposes. Producers stress test their production against a range of possible prices to make sure that an investment decision makes a minimum return.

In contrast to the major oil companies, smaller independent oil producers or exploration companies are more likely to be dependent on bank financing rather than equity financing and are thus more likely to be involved in hedging activity.

National oil companies of some Middle Eastern and South American countries participate in the forward OTC oil market, but only to a limited extent. So it is not apparent that oil-producing countries hedge much of their future production (although their foreign exchange reserves managers are likely to invest accumulated oil profits in financial markets more generally). Some oil-consuming countries hold strategic oil stocks. But in discussions with contacts, few, if any, countries were said to be involved in significant hedging of oil consumption needs.

The major investment banks are dealers and also take proprietary risk themselves — including where they take on risk from a counterparty, but cannot immediately find a second counterparty willing to take it off them.

Hedge funds have been increasingly active in the oil market in the past couple of years. They typically concentrate their positions in the most liquid segments of the market, so that positions can be closed out quickly if need be. In general, the entry of hedge funds to a financial market will bring about an increase in arbitrage-type activity, such as speculation on the re-establishment of previously observed historical relationships. An example would be for a hedge fund to buy contracts for the future delivery of oil and coal on the one hand (a 'short' position — betting the price will go down) and the future receipt of petrol and electricity on the other (a 'long' position — betting the price will go up), aimed at exploiting occasional disruptions in refining and power generation. The oil market affords numerous opportunities for hedge funds and other traders to take such views on the price spreads between different petroleum products (such as petrol and heating oil) or types of crude oil.

Other market participants include specialist oil trading firms, pension funds and asset managers. The former are likely to be a more significant factor in the market.

Some of the major global oil consumers (eg airlines) trade oil futures, options and swaps. But they are small players relative to the major investment banks and oil companies. And they reportedly do not make significant use of these markets to hedge their longer-term exposure to the forward price of oil.

Incomplete forward markets for oil

The oil market is clearly not characterised by a complete set of contracts. For example, there are no major benchmark futures contracts for the heavier, sour crude oils that make up much of Middle Eastern output. There is also no specific global oil index that is easily tradable such as a contract based on a basket of major world crude oils (OPEC constructs and monitors, but does not trade, a basket of its members' oils). In the view of most market participants we spoke to, more contracts and longer-term contracts would follow on from an increase in trading volumes, rather than being something that could be introduced in anticipation. Introducing contracts too early could, in the opinion of some market participants, reduce liquidity rather than generate more.

Alternatives to trading directly in oil markets

If someone wants to take a position on the oil price (either outright or as a hedge), they do not have to use a direct oil market contract. The alternatives include:

- buying or selling shares in companies with an exposure to the oil price;
- trading oil-related physical assets such as oil fields, refineries, etc;
- investing in commodity indices such as the Goldman Sachs Commodity Index (GSCI) and structured notes linked to these. Pension and hedge funds in particular appear to buy into commodity markets through these indices; and
- investing in exchange-traded funds (ETFs). These are similar to mutual funds, and their value is backed by the underlying commodity (in this case oil). ETFs are relatively new to the oil market.

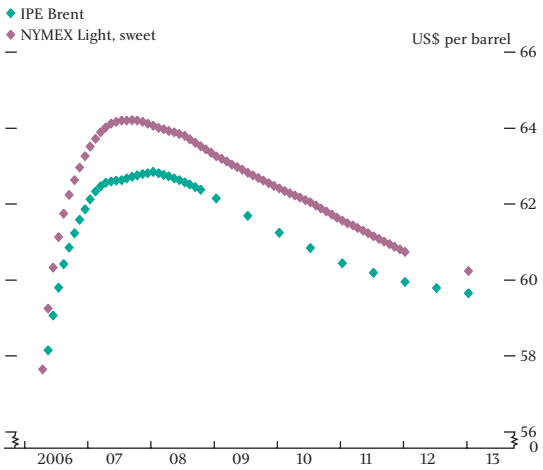
Use of the forward market

A risk that oil companies face when investing in production capacity is that the oil price might fall and that the investment may, in turn, become unprofitable. This may limit the extent to which companies are prepared to expand their productive capacity. Similar issues arise for all business investment. But the problem is more acute for oil given the long time-lags involved before production comes onstream, the relatively high proportion of production cost which is investment related, the absence of alternative uses for that investment, and the potential volatility of the oil price.

As discussed earlier, oil is traded forward, so an oil company should, in principle, be able to reduce, or hedge, an investment project's price risk. Specifically, it could sell a futures contract to lock in the price at which it can sell oil in the future.

Given the current shape of the oil futures curve, an oil company should be able to guarantee itself a high price (Chart 2), and hence a possibly profitable investment, by entering into a contract with a commitment to supply oil in the future from a new project's output. But it seems that relatively little such production hedging takes place via the forward market for oil. For example, at end-2005 the combined volume of oil for future delivery as indicated by outstanding futures contracts on NYMEX and ICE Futures was only 4% of that year's estimated world crude oil production. Most contracts were also for delivery within a year (Chart 3) — too short a time horizon for oil companies to cover investment costs.

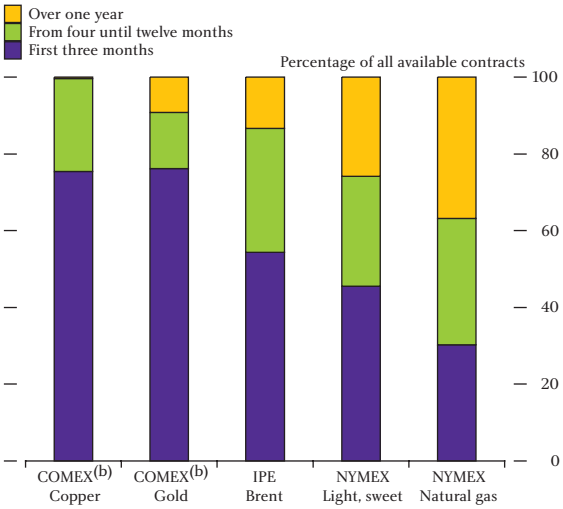
Chart 2
Futures prices and contract maturities for crude oil, 15 February 2006(a)



Source: Bloomberg.

(a) On ICE Futures, trading of an oil futures contract normally ends on the business day immediately preceding the 15th day prior to the first day of the contract's delivery month.

Chart 3
Outstanding futures contracts by expiry date(a)



Source: Bloomberg.

(a) Daily average during January 2006.
(b) COMEX, previously the New York Commodities Exchange, is a division of NYMEX.

Table A
Reported stocks and market turnover of selected commodities, 2004

	Reported stocks(a) (in weeks of production)	Turnover on futures exchanges (in US$ billions)(b)	Turnover on futures exchanges/annual production (per cent)(b)
Aluminium	4.8	1,259	24.5
Copper	1.5	1,406	30.8
Gold(c)	691.4	842 (2,250)	26.2 (70)
Silver	9.5	186	45.3
Oil	6.9	3,171	2.6

Sources: Commodities Research Unit for aluminium, copper, gold and silver. International Energy Agency Monthly Oil Market Report January 2006 for oil production and stocks, and Bloomberg for oil futures turnover.

(a) Consists of both (reported) non-exchange and exchange stock holdings. Exchange holdings are London Metal Exchange (LME), Comex, TOCOM and Shanghai for aluminium; LME, Comex and Shanghai for copper; and Comex and TOCOM for gold and silver. For oil, stocks are those of the OECD (including government stocks).
(b) Turnover figures for aluminium and copper are on the LME and Comex, for gold and silver on Comex and TOCOM, and for oil on NYMEX and ICE Futures. Valued at 2004 average spot prices.
(c) Figures in brackets include activity on the London Bullion Market.

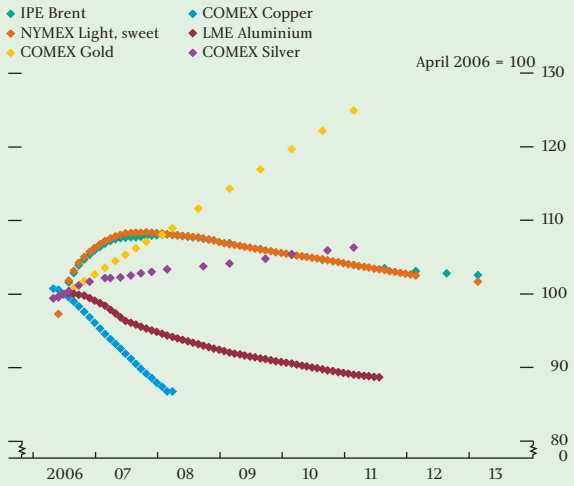
What explains the shape of commodity futures curves?

Perhaps one of the biggest differences between the futures market for oil and those for other commodities is the shape of the futures curve. The simplest theory of the futures curve is by Hotelling (1931)(1) which considers the optimal extraction of an exhaustible resource, such as oil, under perfect competition and no uncertainty about future prices. This suggests that the price of oil (net of extraction costs) should be expected to rise in line with the (risk-free) rate of interest so that a producer is indifferent between extracting and selling an extra barrel of oil today, and keeping it in the ground and selling it in the future.

A similar result emerges from the theory governing the optimal (above ground) storage of non-perishable commodities such as oil.(2) This suggests that the expected price of oil needs to rise by the rate of interest plus the storage cost, so that holders of crude oil stocks are indifferent between selling an extra barrel from their inventory today and holding on to it for future sale.

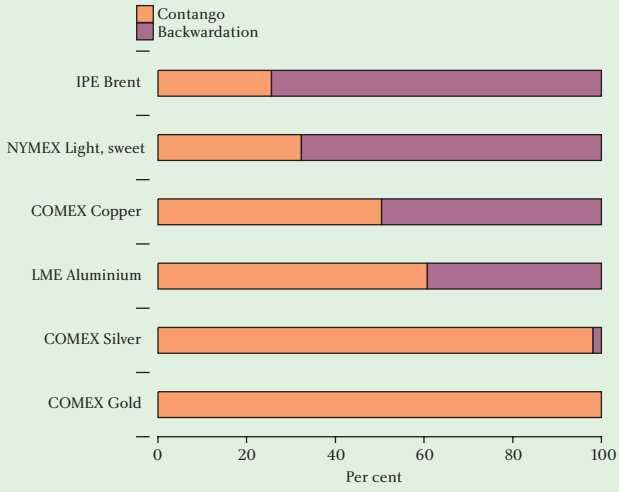
These theories are relevant for the oil futures curve given that the participants in this market both produce and hold positive inventories of crude oil (although the inventory theory may be more relevant for the near-term futures curve given the lags involved in producing and transporting oil). Both theories imply that crude oil prices should be expected to rise over time (a situation known as 'contango'), subject to certain conditions. However, in practice, the oil futures curve is more often than not downward sloping (known as 'backwardation') so that futures prices are lower than the current spot price.(3) Other commodities show backwardation from time to time, including recently industrial metals (Chart A), but are normally in contango (Chart B). The recent backwardation across a number of (non-precious metals) commodity futures markets might suggest that spot prices are indeed expected to fall in the future. But as we mention below, futures contract prices are not necessarily equal to expected future spot prices.

Chart A
Futures prices (April 2006 = 100) and contract maturities for crude oil and other physical commodities, 15 February 2006



Source: Bloomberg.

Chart B
Percentage of time in contango or backwardation(a) in selected commodity markets(b)



Source: Bloomberg.

(a) Contango and backwardation imply up and downward sloping futures curves.
(b) Based on the price difference between one and twelve-month futures contracts, January 1991 to 15 February 2006. LME Aluminium from July 1997 and IPE Brent from April 1994.

(1) Hotelling, H (1931), 'The economics of exhaustible resources', *Journal of Political Economy*, Vol. 39.
(2) Hull, J C (2005), *Options, futures, and other derivatives*, Chapter 5.
(3) Recently, the futures curve has been slightly upward sloping for the first year or so of the curve, but has been downward sloping after that. See Chart 2 in the main text.

Why does the futures curve usually slope downwards?

One possible reason for a persistently downward sloping oil futures curve would be uncertainty about future demand and supply. Given that one has the choice to delay extraction, in the hope of benefiting from a higher price later, the decision to produce oil when there is uncertainty takes on the characteristic of exercising a financial option — there is an option value in holding reserves below ground rather than 'disinvesting'.(4) Because the total return of holding oil reserves in the ground includes this option value, the current price must be higher than the price predicted by Hotelling's theory to make a producer indifferent between extracting oil and leaving it in the ground. And if the uncertainty is large enough this can result in backwardation.

There is also a similar value to the holder of above-ground oil stocks. This value is typically referred to as the 'convenience yield' of having immediate access to oil stocks and is likely to be a more important factor when stock levels are low. For example, oil consumers may be uncertain about future oil supply — especially given the concentration of production and reserves in a few countries, some of which are vulnerable to political factors. The uncertainty about future supply means that consumers of oil may be willing to pay more now to ensure they have stocks of oil than they would be willing to pay in the future. This could lead to the spot price being higher than the futures price.

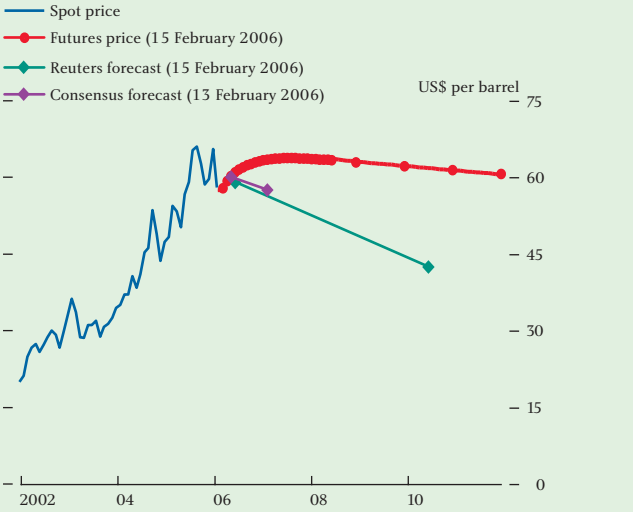
The futures market for gold, however, works quite differently. Gold inventories above ground are very high — equivalent to more than 13 years of production (Table A in the main text) — suggesting that the convenience yield is negligible. This might explain why the gold futures curve is usually upward sloping as predicted by Hotelling's theory (also Chart B).

A further issue arising from the physical nature of oil is that it is cheaper to arrange delivery at some future point than to do so at very short notice. Thus the producer may demand a higher price for near-term delivery and this could add to the backwardation in the market at the very short-end of the curve.

Why does the forecast price of oil lie below the futures curve?

Economists' forecasts of the oil price currently lie, on average, well below the futures curve (Chart C). A factor that could create a wedge between the futures price and the expected spot price is the existence of risk premia. Theory(5) suggests that investors would typically require a different rate of return — including a risk premium — to compensate them for the price risk associated with holding stocks of oil. This would be reflected in the expected future spot price being different from the futures price and could be positive or negative. In the current oil market, if the price of oil is perceived to be negatively correlated with investors' consumption or wealth, then holding physical oil — rather than buying the futures contract — would help investors diversify their risks. As a result, they would be willing to accept a lower rate of return from holding physical oil than otherwise (so the expected spot price would be lower than the futures price).

Chart C
Surveys(a) and market beliefs(b) about future oil prices(c)

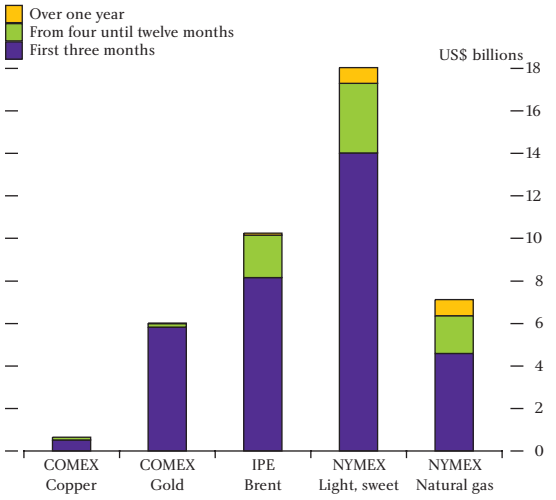


Sources: Bloomberg, Consensus Economics, Reuters and Thomson Financial Datastream.

(a) Diamonds indicate mean survey responses. Consensus forecasts are for the end of May 2006 and the end of February 2007. Reuters forecasts are year averages for 2006 and 2010.
(b) Monthly data.
(c) West Texas Intermediate crude oil.

(4) Litzenberger, R H and Rabinowitz, N (1995), 'Backwardation in oil futures markets: theory and empirical evidence', *The Journal of Finance*, Vol. 50, No. 5.
(5) Keynes, J M (1930), 'A treatise on money', *The Applied Theory of Money*, Macmillan, Vol. 2.

Chart 4
Trading volumes by expiry date(a)



Source: Bloomberg.

(a) Daily average trading volumes during January 2006, valued at daily average spot prices during the same period.

The small scale of outstanding contracts in the exchange-traded market for oil futures may give rise to a relative lack of liquidity. Although the dollar volume of market turnover is higher than in any other commodity futures market, the oil futures market looks distinctly less liquid when measured by turnover relative to production (Table A). This holds even more so for contracts with long delivery dates (Chart 4).

Why the forward market for oil is not used more for hedging

The payback period from investing in oil production depends on the difficulty of extraction from the particular source. Our contacts cited periods from three to ten years or even longer before costs are recovered. The oil field could then be producing oil for the next 20 years or more. The problem for the producer who wants to hedge over such a timescale is whether it can, in fact, sell its oil forward. If not, this may be a barrier to entry for producers.

There are two obvious financial market counterparts to a producer's hedge: financial investors or oil consumers. If the exchange-traded futures market does not go out far enough, then there will be an incentive to hedge over-the-counter. For example, press reports have suggested that Canadian tar sands producers are seeking long-term agreements with refiners and power stations in the United States.

Several market intermediaries we spoke with reported rapid growth in investors' longer-term oil forward positions since the oil price started to rise, but the absence of precise quantitative OTC data makes it difficult to confirm this. The greatest barrier to a more liquid long-run market, in their view, is the lack of hedging by producers and consumers of future oil production and consumption.

Oil consumers

One reason oil consumers do not hedge is the lack of forward contracts for other products. Consider the following example. An airline company hedges its purchase of jet fuel for the next ten years by buying oil forward. But there is no comparative forward market for airline tickets, and the price of airline tickets in the future is likely to vary with the spot price of oil. If competitors' costs reflect the spot oil price and this price fell sufficiently below the hedged price, then the airline could, in the extreme case, be put out of business by an unhedged competitor able to undercut ticket prices by buying cheaper oil in the spot market. So, although the hedge would reduce the volatility of the company's costs, the volatility of its profits is more likely to rise unless, in addition to buying oil forward, it can sell its own output forward at similar time horizons.

Oil producers

We can extend this example to cover oil producers. As discussed earlier, countries do not generally hedge (production or consumption) to any significant degree. Indeed, there is not yet a benchmark contract for Middle East crude oil (partly because of the possibility of price manipulation by monopoly suppliers). The Tokyo Commodity Exchange does offer contracts which are an average of Dubai and Omani oils. But these are only available up to six months ahead, the contracts are priced in yen, and the volumes traded are small. However, the Dubai Mercantile Exchange may trade a new futures contract based on an underlying Middle East crude oil.

A motivation for not hedging oil production could be the inability of oil-producing countries to hedge, say, the prices of their imports. More generally it appears that state-owned producers want to obtain the benefits of any upward movements in prices and are less concerned about downward movements. In fact, for state oil company management, it is likely that there is considerable negative utility attached to the possibility of being seen, after the fact, to have under-priced the sale of a national asset.

Similarly, major commercial oil producers do not routinely hedge their production. The most common explanation offered for this is that their shareholders pressure them to keep their profits, and hence equity prices, exposed to the oil price because shareholders may themselves want to hold oil price exposure as a hedge, as an outright speculative position or as part of a diversified investment portfolio. In fact, if hedging an exposure to the oil price directly is not an easily available strategy, then other hedging strategies may be a rational second-best alternative. For example, it might then be a better hedge for retail investors and investment funds to hold oil company equities (or equity derivatives) or oil-based exchange-traded funds — the prices of which may move closely with the oil price. The investors and funds are likely to have established systems for, and more experience of, these types of investments, rather than taking direct positions in markets like oil, where specialist traders have an informational advantage.

Smaller independent oil companies, dependent to a greater extent on bank loans rather than equity finance, are more likely to hedge some of their production — perhaps because of interest payment obligations. Since their businesses are more specialised, their dependence on the oil price is also likely to be higher and hence the hedge has greater effect. As an example, one smaller UK-based company(1) stated in their 2004 annual report that they hedged about 20% of their forecast total group production over 2005–07.

Data

The availability of relevant data can be crucial in developing confidence and hence liquidity in any financial market. Just as macroeconomic data are important for exchange or interest rate markets, so data on oil reserves, oil consumption, trading, etc are important for the oil market.

Although the quality of data from futures exchanges is good, other data on the oil market appear incomplete. Contacts reported that oil reserve statistics are widely susceptible to inaccuracies as countries and oil companies may have an incentive to overestimate reserves (eg to increase production quotas or share prices). Similarly, while data on OECD countries' oil production published by the International Energy Agency (IEA) are regarded as good quality, non-OECD production data are not viewed by market participants as reliable. One project aimed at remedying this deficiency is the Joint Oil Data Initiative (JODI) which began in 2001 and is now under the direction of the International Energy Forum (IEF). JODI launched a new database in November 2005.

The influence of fiscal authorities on the incentive to invest and hedge

Commercial oil exploration and production companies face uncertainties about their returns not just from the oil price, but also because fiscal authorities can change the tax regime after a commercial investment decision has been made. This has been cited to us as a strong disincentive to invest that cannot easily be hedged against in the market.

Sometimes tax changes are pre-programmed under a production sharing agreement. The government of an oil-producing state might insist that any extra revenue from selling oil above a certain price goes to the state, in return for promises of a lower tax burden if oil prices go below a specified minimum. This effectively imposes a hedging regime on the commercial producer. Indeed, the producer will have no incentive to increase investment significantly, once the forward price of oil goes past the agreed threshold price. Some sources estimated that up to 20% of major oil companies' production was subject to this type of arrangement.

Summary and conclusions

The recent rise in the spot price of oil has been accompanied by an unusual increase in its forward price. There are indications from our discussions with market contacts and from market data of an increase in forward trading volumes and increased hedging activity. But most expected future oil production still remains unhedged. Low levels of hedging activity could be contributing to the high forward oil price and restricting the future supply of oil.

Our discussions with a range of contacts have not suggested any significant market failure regarding the functioning of the existing forward oil market (exchange-traded or OTC) for current market participants. Compared with other commodity markets,

(1) Paladin Resources plc, 2004 *Annual Accounts*.

the oil market is relatively liquid, credit risks can be mitigated, and barriers to entry for potential buyers and sellers do not appear to be significant. On the other hand, the low level of hedging relative to production indicates the potential for more activity. We have identified four main factors which may be acting as restraints on the level of hedging in the forward market for oil:

1. The absence of complete forward markets for goods and services for which oil is a key input (such as air travel and power supplies) means that the second-best solution for consumers may be not to hedge their consumption at all.

2. Many countries with state-owned oil producers also do not hedge forward production. As above, in the absence of complete forward markets for their imports, this could be rational for these states.

3. Shareholders of major commercial oil producers put pressure on those companies not to hedge. This may be a rational way for investors to hedge their own oil exposure or to take a speculative view.

4. The quality and coverage of data on oil reserves, production and consumption, and on the OTC market is widely regarded as being poor. The uncertainty this generates may limit hedging activity.

Modelling manufacturing inventories

Working Paper no. 284

John D Tsoukalas

Changes in the stock of firms' inventories are an important component of the business cycle. In fact, discussion about the timing of a recovery following economic recessions often focuses on inventories. But there is no consistent explanation for their behaviour. Most modelling work focuses on the so-called production smoothing model — where the firm maintains a smooth production plan and uses inventories to satisfy unforeseen changes in demand. Moreover, this model has generally only been applied to manufacturers' finished goods inventories.

This paper offers an extended stage-of-fabrication inventory model that considers not only finished goods inventories, but also input inventories — the sum of raw materials and work-in-process inventories. Stylised facts for UK manufacturing reveal that input inventories are empirically more important than finished goods inventories. This is true not only in terms of their size but also in terms of their volatility.

One of the key facts of the UK manufacturing sector is the significant interaction between finished goods and input inventories. The covariance between input and finished goods (or output) inventories can explain over one quarter of the variance in manufacturing inventory investment. This is an important finding because it points to linkages between different aspects of production. More importantly, it implies that finished goods inventories cannot be considered in isolation from input inventories. Intuitively, an optimising firm that decides to draw down finished goods inventories (as often happens following an unexpected demand shock) will typically increase production in the future to correct this imbalance. This correction will affect input inventories as well because the firm has to draw down input inventories in order to increase production.

The paper demonstrates that ignoring input inventories yields misleading results. In particular, the precision and plausibility (relative magnitudes) of the estimated parameters in the joint model differs from those when input inventories are ignored. To estimate the model, a maximum likelihood approach is used that is shown to be superior to the often-used generalised method of moments estimators (GMM). The sizable interaction between input and finished goods inventories yields very precise estimates. One of the key findings of the model is the familiar production-smoothing result. The estimation results suggest that firms satisfy unexpectedly strong demand from finished goods inventories, resulting in the latter falling below companies' desired levels. Given that estimated costs of changing production are large relative to stockout costs (of deviations of inventories from their desired level), this imbalance corrects rather slowly, implying that inventories deviate from target for long periods. On the cost side of the model, when materials become more expensive companies prefer to cut production temporarily: cutting production implies that companies save on the expensive materials. With sales unchanged, this shortfall is satisfied out of finished goods inventories causing them to fall from their desired level. Moreover, despite the presence of input inventories — where fixed costs of ordering may be substantial — the estimated aggregate marginal cost function is a rising function of output, thus implying decreasing returns to scale in manufacturing.

The New Keynesian Phillips Curve in the United States and the euro area: aggregation bias, stability and robustness

Working Paper no. 285

Bergljot Barkbu, Vincenzo Cassino, Aileen Gosselin-Lotz and Laura Piscitelli

The traditional Phillips curve relates current inflation to lagged inflation and a cyclical indicator, such as the output gap or the unemployment rate. This specification has efficiently characterised the pattern of inflation over most of the post-war period in most industrialised economies. Two concerns have however been raised. First, the traditional Phillips curve is subject to the Lucas critique — its coefficients may not be invariant to changes in policy regimes. Second, the traditional Phillips curve explains recent data for the United States and the euro area less well, where inflation has been low despite positive output gaps. In an attempt to deal with the shortcomings of the traditional approach, the New Keynesian Phillips Curve (NKPC) literature uses microfoundations to derive a relationship between inflation, expectations of future inflation and the current value of the cyclical indicator. However, the pure NKPC lacks sufficient inertia to adequately explain the path of actual inflation. As a result, many authors attempt to improve the degree of fit of the NKPC by inserting a lagged inflation term. Such a curve is often referred to as a 'hybrid' NKPC. We estimate this using generalised method of moments techniques for the United States, the euro area and the three largest euro-area economies.

This relationship between output and inflation is of key importance to monetary policy authorities concerned with price stabilisation. In particular, understanding whether the relationship is stable and how it evolves over time is a primary concern. Therefore, it is somewhat surprising that while numerous papers have estimated the NKPCs for these countries there has been relatively little emphasis on testing the stability of their parameters over time. In other words, the robustness of the NKPC to the Lucas critique has not yet been subject to proper statistical testing. We aim to fill this gap by conducting comprehensive stability and structural break analysis, performing rolling and recursive estimation and applying standard tests for structural breaks.

Overall, our estimates of the structural and reduced-form coefficients on the lagged and expected future inflation terms are broadly in line with previous studies for both the United States and the euro area. One notable exception is the discount factor obtained for the euro area, which is lower than that found in most other studies. On the question of stability, rolling and recursive estimations produce stable and plausible estimates for the United States, but unstable parameters for the euro area. The breakpoint test analysis does not reveal any significant shift in any of the coefficients associated with past and expected future inflation and real marginal cost for the United States. For the euro area, on the other hand, there is some tentative evidence of a structural break affecting the coefficients on past and expected future inflation in the late 1980s, possibly related to the German re-unification. In the disaggregated euro-area analysis, rolling estimation produces unstable estimates for Germany, and, albeit to a lower degree, for Italy. The estimates for France appear to be considerably more stable over the period considered. Consistent with these results, the breakpoint test analysis points to instability in the late 1970s for Italy and in the early 1980s for Germany. There is no evidence of structural breaks affecting inflation dynamics in France. These conflicting country-level results could indicate the presence of an aggregation bias in the results obtained with euro-area data, which could explain the implausibly low estimate of the discount factor obtained for the euro area.

There are several implications for monetary policy makers. Overall, our results suggest that policymakers should treat the forecasts generated by Phillips curves with some caution, as the structural parameters underlying the estimated relationships may be unstable over time. For the euro area, in particular, it may be useful to look at the results of individual countries, in addition to the aggregate results. Moreover, policymakers should examine the results of a broad range of estimation methodologies to assess whether the forecasts generated by a Phillips curve model agree with other evidence. This is consistent with the approach currently taken in most major central banks.

Modelling the cross-border use of collateral in payment systems

Working Paper no. 286

Mark J Manning and Matthew Willison

Over the past decade, there has been a decisive shift towards real-time gross settlement (RTGS) of high-value payments, typically across accounts at a central bank. Settlements in such a system can only be completed if the paying bank has sufficient funds in its account; ie if it has adequate liquidity. Hence, the focus has shifted away from credit risk and towards liquidity risk.

Central banks typically address this risk by making intraday liquidity available to settlement banks on favourable terms. A commonly adopted policy is to provide intraday credit on an unlimited, free, but fully collateralised basis. But given the potential for high collateral costs to encourage payment delays and risk gridlock in the system, it will be optimal for central banks to accept a wide variety of assets as collateral, thereby allowing the efficient management of commercial banks' collateral portfolios.

Restricted eligible collateral lists are a particular issue for banks operating in multiple countries and hence facing settlement obligations in a number of payment systems. If, in each country, the central bank accepts domestic securities only, a bank must hold sufficient (costly) collateral assets to meet its expected liquidity needs wherever it is active. Once liquidity demands have been realised, a bank may find itself with a shortage of collateral in one market and abundant collateral in another. This collateral will then lay idle while the bank obtains additional assets in the country in which it experiences a shortfall. Such a mismatch is inefficient. It also contributes to liquidity risk in the payment system because there could be some disruption to the bank's payments activity while it enters the market to acquire the necessary eligible assets.

One potential policy response is then to broaden the eligible collateral list to include foreign assets; ie to allow cross-border use of collateral. But any change in policy on collateral eligibility may result in a change in market participants' incentives, so the implications of cross-border use of collateral for liquidity risk in payment systems are best analysed in the context of a model that captures full optimising behaviour on the part of commercial banks. In this regard, we develop a stylised two-country, two-bank model in which risk-neutral banks minimise expected costs with respect to their collateral choice in each country. Banks are active in both countries' payment systems and make collateral choices under uncertainty as to both the size and the location of their liquidity needs. In our baseline model, we assume that each bank only realises a liquidity demand in one country at any one time; in other words, banks' liquidity demands are negatively correlated across countries. Using our baseline model, we compare outcomes for liquidity risk for cases in which: (i) there is no cross-border use of collateral; and (ii) both central banks permit cross-border use of collateral. A number of key results emerge.

First we show that, when both countries permit cross-border use of collateral (which we refer to as the symmetric cross-border use of collateral), banks will concentrate their holdings in the country with the lowest collateral costs and may, with sufficiently high costs of experiencing a shortfall (relative to start-of-day collateral costs), reduce collateral holdings in each country. Importantly, even with a decline in total collateral holdings, we find that liquidity risk, as measured by expected collateral shortfalls, will fall in both countries. This reflects the fact that it will always be optimal for a bank to hold a larger amount of collateral across two connected countries than in a single unconnected location. Hence, there will always be a larger pool from which to draw to meet a liquidity need in a single country.

We make a number of extensions to the baseline model to relax some of its simplifying assumptions. First, in the absence of co-ordinated policy, it may be that only one central bank permits cross-border use of collateral. In this case of asymmetric cross-border use of collateral, we show that banks' collateral choices will be driven by two potentially offsetting factors. On the one hand, banks will shift collateral holdings towards the collateral that is eligible in both countries. On the other, banks will still be inclined to accumulate larger holdings of the cheaper collateral. When the cheaper collateral can be used across borders, these two factors are mutually reinforcing and the outcome will be the same as if there were symmetric cross-border use of collateral. When the collateral eligible in both countries is only slightly more expensive, banks will still hold only this collateral, but slightly less will be held overall than in the symmetric case. Again, liquidity risk will decline in both countries. Finally, when the collateral eligible in both countries is significantly more expensive, collateral will be held in both countries and the expected shortfall in the country accepting foreign collateral will be the same as in the case with no cross-border use.

Another extension allows some probability that a bank experiences a liquidity need in both countries simultaneously. In our model, banks adjust collateral holdings to take account of this possibility. But as there remains a chance that banks could experience a liquidity need in just one country, it may, under certain conditions, still be optimal to reduce total collateral holdings relative to the case with no cross-border use of collateral. Such a reduction would imply higher expected shortfalls in at least one country when a bank faces simultaneous liquidity needs, compared to the case with no cross-border use of collateral. The size of the respective shortfalls experienced in each country will depend on how the available collateral is ultimately allocated between countries.

Finally, we also consider an extension in which central banks have the option of accepting collateral in stressed situations only. Under such a regime, and with a sufficiently low probability that the emergency facility will be triggered, banks' reductions in collateral holdings may be more muted than if cross-border use of collateral were allowed routinely. As a result, should a stressed situation arise in one country, banks may have a larger pool of collateral to draw upon than they would have in the case of routine cross-border use of collateral. Expected shortfalls would, in such a case, be lower. If central banks place a higher weight on liquidity risk mitigation in times of stress, and recognise that it may be more difficult to access additional collateral during a crisis, such a policy may be attractive.

Assessing central counterparty margin coverage on futures contracts using GARCH models

Working Paper no. 287

Raymond Knott and Marco Polenghi

Financial markets benefit from a sound and stable environment. For this reason, central banks follow developments in the financial markets and their associated infrastructure closely. Central counterparties (CCPs), which help to protect market participants against counterparty default have become an increasingly important part of this infrastructure, as they have expanded into new markets, and undergone both vertical and horizontal consolidation. Many regulators and central banks concerned with systemic stability have, as a result, increased their focus on how CCPs manage their risks. The present paper examines some key aspects of risk control in these institutions.

In order to reduce counterparty credit risk for market participants, exchange-traded and some non exchange traded derivatives contracts are guaranteed against counterparty failure by a CCP. In providing this service, however, CCPs themselves become exposed to the risk of counterparty default. To protect themselves, they have developed a system of collateralisation, or margining, by which members of the CCP are required to place a sum of initial margin in a CCP account when they register positions. The initial margin is designed to provide protection against potential changes in the market value of a member's positions over a time horizon of one or more days.

CCPs typically select the appropriate level of initial margin by inspecting the historical distribution of price movements, focusing particularly on recent price changes. After being set, however, initial margin levels will often remain unchanged for some time. During this period, the coverage they provide can change substantially, varying according to market conditions.

This paper describes a model that can be used to assess the coverage provided by initial margins. Previous studies have largely concentrated on assessing long-run average coverage levels. The present study shows how coverage can be assessed on a day-by-day basis. In order to measure variations in coverage, we use a model of returns which assumes a time-varying volatility (a so-called GARCH process). This is used to model the returns of two heavily traded derivatives contracts, the Brent oil and the FTSE 100 futures contracts. Different variants of the GARCH process are estimated, which assume that the changes in volatility are distributed according to either Student t, extreme value or historical distributions. To select the best-performing variant, a backtesting procedure is applied in which the models' forecasts of returns are compared against actual outcomes. Overall, across all coverage levels, we find that the Student t and historical distribution variants offer the best fit to actual returns.

The modelling approach described allows us to estimate the probability that initial margin will be used up, as that probability changes from day to day. Although we find that the average probability of exhaustion for initial margins is low, we note that the probability can increase in volatile markets. That suggests a need to reset the initial margin more often in such circumstances, as most CCPs do in practice.

Regulators and central banks are also interested in understanding what the impact on the market, or the CCP's post-margin resources, would be of more extreme price moves. In particular, they would like to know what the additional liquidity demands might be if a margin-exhausting price change were to occur. To illustrate how the model could be applied to this question, we calculate the conditional expected loss for the FTSE 100 and Brent futures contracts, ie the expected loss the CCP would suffer when the initial margin is used up completely. This is then used to generate an estimate of the additional liquidity demands that each market would experience. We find that, if the initial margin for the Brent contract were to be exceeded, it would require a greater percentage increase in margin, compared to the FTSE 100, largely due to the higher tail-thickness of the Brent return distribution. We note that, for the sample window chosen, the additional liquidity demands are relatively modest compared to typical intraday margin calling mechanisms.

The price puzzle: fact or artefact?

Working Paper no. 288

Efrem Castelnuovo and Paolo Surico

The initial positive response of prices to a contractionary monetary policy shock is a stylised fact of most empirical studies measuring the effects of monetary policy on the aggregate economy. This behaviour is often referred to as 'puzzling' because macroeconomic models either cannot explain it theoretically (eg a standard sticky-price model) or, even when capable of explaining it in principle, they do not produce a positive price response empirically (eg models of the cost channel transmission of monetary policy).

The presence of a price puzzle is important because it casts serious doubts on the possibility of correctly identifying a monetary policy shock. If the central bank monitors and responds to a larger information set than that of the econometrician, what may be referred to as a policy shock by the latter is actually a combination of a genuine policy shock and some endogenous policy reactions. The result of this omission is that a policy tightening in anticipation of future inflation could be wrongly interpreted by the econometrician as a policy shock, delivering a spurious correlation between a tightening of policy and a rise in inflation: the price puzzle.

In a speech as Fed Governor, Bernanke offered a new interpretation of the mis-identification of structural shocks. He noted that '*[...] changes in inflation expectations, which are ultimately the product of the monetary policy regime, can also be confused with truly exogenous shocks in conventional econometric analysis. [...] insufficiently anchored inflation expectations have led to periodic 'inflation scares', in which inflation expectations have risen in an apparently autonomous manner. Increases in inflation expectations have the flavor of adverse aggregate supply shocks in that they tend to increase the volatility of both inflation and output, in a combination that depends on how strongly the monetary policy makers act to offset these changes in expectations*'.

This paper offers a theoretically and empirically consistent explanation for the price puzzle using a micro-founded New Keynesian model and structural vector autoregressions (VARs). A major contribution is to show that the price puzzle has been historically a feature of specific monetary policy regimes. These regimes are the period prior to the appointment of Paul Volcker as Fed Chairman in August 1979 for the United States and the period prior to the introduction of the inflation-targeting regime in 1992 for the United Kingdom. This result is robust to using two different identification strategies, as well as augmenting the VARs with unit labour costs and a commodity price index. Moreover, the subsample evidence on the price puzzle is found to be independent from using real GDP, detrended output, the output gap or output growth as a measure of real activity.

A wide number of contributions to the empirical literature on monetary policy rules finds that a shift in the conduct of monetary policy occurred at the end of 1979 in the United States and at the end of 1992 in the United Kingdom. We therefore investigate the link between these shifts in the conduct of policy and our results about the price puzzle, modelling monetary policy using simple mechanical rules. It should be emphasised that this paper does not suggest that monetary policy in the United States and United Kingdom was in fact conducted using these mechanic policy rules: rather, they are simply a useful empirical representation of monetary policy.

A sticky price model is calibrated to the magnitude of the historical shift in the conduct of US monetary policy. This model is used to simulate artificial data and then the structural VARs are estimated on the artificial data. A main finding is that only when the central bank does not raise the interest rate sufficiently in response to inflation (and thus inflation expectations are not well anchored in the theoretical model) do the structural VARs estimated on the artificial data generate a sizable price puzzle. In contrast, the theoretical model is not capable of generating an initial positive response of the price level to a monetary policy shock, even when the nominal interest rate responds less than fully to inflation.

Our results suggest that the price puzzle is in fact an artificial result that arises from expected inflation being omitted from the VAR. Expected inflation is remarkably more persistent when expectations are not fully stabilised by the monetary policy. Furthermore, such omitted variable bias is found to account for the apparently puzzling response of inflation to a policy shock observed on actual data, consistently with Bernanke's argument.

Our results suggest that when the policy framework does not mandate sufficient response to inflation, the behaviour of private sector expectations gives rise to perverse dynamics, like inflation persistence and the price puzzle, that are not necessarily intrinsic characteristics of the economy.

The Governor's speech[1] in Ashford, Kent

Two weeks ago Trafalgar Square was packed with revellers celebrating the New Year. A century ago it was crowded with hop-growers and pickers. On 16 May 1908 — 'Hop Saturday' — around 30,000 people working in the hop trade travelled to London to demonstrate against unfair foreign competition and to demand the introduction of a tariff on imported hops. It was the largest demonstration in Trafalgar Square for many years. Special trains were laid on to London Bridge from where the demonstrators marched to Trafalgar Square, accompanied by bands playing and banners flying. According to *The Times*, "One of the most conspicuous banners bore the words: 'And shall hops picked by Chinamen make England's hop trade die, here's 50,000 Kentish men will know the reason why'". Another, appropriately above the plinth of Nelson's column, read 'England expects that every hop shall pay a duty'. A resolution was proposed demanding the imposition of an import duty of 40 shillings per hundredweight on all foreign hops. Having carried the resolution, the assembled gathering sang 'Rule Britannia', after which the massed bands played the National Anthem and a verse of 'Auld Lang Syne'.

Colourful and moving though the occasion was, the decline of the hop industry was inexorable and inevitable. Nothing could stem the tide of changes in technology and in tastes for new lighter — foreign — beers, and attempts by government through higher excise duties to reduce the consumption of beer. A willingness to adapt and embrace, rather than resist, change is the key to greater prosperity. That road may at times be hard going — as I know many of you will have experienced in your own businesses — but it leads ultimately to a more prosperous destination.

To follow the right road we need signposts. In a market economy those signposts are movements in prices. If a particular product becomes more abundant or less in demand, its price will fall relative to the prices of other products. That relative price change is the signal which encourages consumers to buy more or producers to supply less. Over recent years, three new signposts have appeared. They mark a process that has transformed demand and supply conditions across the globe: the integration of China, India and other emerging market economies into the world trading system.

The first signpost shows that prices of labour-intensive manufactured goods have fallen. China, India and the former Soviet Union between them have massively increased the supply of labour available to industry around the world. As labour-intensive goods have become more abundant, they have also become cheaper. The signpost points us in a familiar direction: the need to change what we produce. Were we still producing the same labour-intensive goods as before, with output concentrated in industries like agriculture (including hops), textiles, coalmining and shipbuilding, we too would have seen the price of our own output fall, just as it did for hop growers a century ago. Instead we allowed output and employment to expand in those industries where we could exploit a comparative advantage. In Kent, the expanding sectors include financial services, transport (with 18 million tonnes of freight passing through the Channel Tunnel each year) the exploitation of life sciences, and higher education (with five universities in the county).

As consumers, we have benefited from falling prices of goods made in China and elsewhere in Asia. Between 1995 and 2005, the prices of imported manufactured goods fell by a sixth and, relative to the price of domestically produced output, by no less than a third. So over the past decade we have been able to increase consumption by more than the increase in production. Openness to the world economy has resulted in a higher standard of living.

The second signpost marks the rise in oil and other commodity prices. Rapid growth of production in China, India and other newly integrated economies has led to a substantial rise in the demand for oil and other raw materials. Between 1995 and 2004, net imports of oil to China rose by a factor of seven. Unlike earlier episodes of high oil prices, which were driven largely by

(1) Speech at a dinner for Kent Business Contacts in conjunction with the Kent Messenger Group/Kent Business, delivered on 16 January 2006. This speech can be found on the Bank's website at www.bankofengland.co.uk/publications/speeches/2006/speech263.pdf.

temporary supply constraints, the recent increase in the demand for oil has been reflected in higher prices for future delivery as well as higher spot prices. Similar rises are apparent in the market for gas. The signpost marked higher energy prices points us towards ways of using less energy, to alternative energy sources and to new sources of oil production such as the Canadian tar sands.

The first two signposts point us in the right direction. But the path has not been easy to follow. We have seen movements — in both directions — in inflation, consumer spending and output growth. Interest rates too have moved both up and down in order to maintain overall stability of the economy by keeping consumer price inflation close to the 2% target. The reasons for those changes have been explained in the minutes of the Monetary Policy Committee meetings and in our *Inflation Report*. Tonight, I want to look a little further ahead, to the challenges for monetary policy posed by a third signpost — the recent fall in long-term interest rates. The development of an integrated world capital market means that these now depend on savings and investment decisions elsewhere in the world as well as here at home.

Investors seem to be willing to lend to governments at much lower interest rates than for many a year. In some cases they have lent money for 50 years at around 4%, and the interest rate on long-term UK government bonds is at its lowest level for over 50 years. Low and stable inflation clearly explains much of the fall in long-term interest rates which fell sharply when the Bank of England was made independent in 1997. But over the past three to four years long-term interest rates around the world have fallen further to remarkably low levels. In the United Kingdom, the annual interest rate on 20-year index-linked government bonds, after allowing for anticipated future inflation, is now around 1%. For most of the past 25 years, that so-called 'real' rate of interest has varied between 2% and 4%. Long-term real interest rates of no more than 1% would normally be a signal to spend more, save less, and to invest in physical as well as financial assets. But it is not at all clear that rates will persist at such low levels. So is this particular signpost reliable?

There are broadly two types of explanation for the fall in long-term real rates around the world. The first explains low interest rates as the outcome of an increased propensity to save and lower willingness to invest in the world as a whole. The second explains them as the result of rapid growth in money and credit which, in a 'search for yield', drives asset prices up and interest rates down.

There is no doubt that in the past few years saving has been particularly high in the Asian economies. In part, this reflects their wish to build up large balances in US dollars to protect themselves from financial crises that several of them experienced in the 1990s, and also to maintain competitive exchange rates to allow export industries to absorb surplus labour. For example, although China invests an extraordinary 45% of its national income each year, it saves even more than this — 49% of national income in 2004. The resulting current account surpluses have been saved overseas, much of them in US government bonds. So, rather surprisingly, capital is flowing from some of the poorest countries of the world to some of the richest. Moreover, the rise in oil prices has raised the incomes of oil-producing countries, which have also chosen to save much of their additional revenues in overseas financial assets. Those surplus savings have depressed long-term real interest rates. In the industrialised world, consumers have realised that this is a good time to borrow and spend, resulting in the 'imbalances' evident in the current account deficits of both the United States and the United Kingdom.

Whether long-term real rates around 1% are sustainable is an interesting question, and that uncertainty poses serious questions for monetary policy. On the one hand, the increased propensity to save across the world could start to unwind. As their people become more prosperous, domestic demand in China and elsewhere in Asia will become the primary driver of those countries' growth, so they may want to save less. And business investment in the developed economies, which has been weak in recent years for reasons we do not fully understand, may pick up as in previous recoveries. The resulting rise in real interest rates and implied fall in asset prices would encourage the industrialised world to save more. That would mean a shift of resources in those countries away from domestic demand to net trade accompanied by a change in real exchange rates. The 'imbalances' in the world economy would start to unwind. Where that would leave sterling and the outlook for inflation in the United Kingdom is impossible to know in advance.

On the other hand, it is quite possible that real interest rates could remain low for some time. Although there are signs of a pickup in business investment in the United States and the euro area, investment remains weak in the United Kingdom and a recovery of world investment spending is not assured. The growing recognition that increasing longevity will mean we need

to save more for retirement may sustain or even lift world saving rates. And pension funds are now matching the risks of their assets with the risks of their future liabilities, thus raising the demand for safer long-term financial assets such as index-linked government bonds. Economists have long found it difficult to explain why, given the risks of equity investments, governments should need to offer high real rates of return on their bonds in a world of low and stable inflation. So perhaps the world capital market is returning to an era of low real rates more akin to the 19th and early 20th centuries. If annual market rates on index-linked securities in the United Kingdom were to remain around 1%, then, with a 2% inflation target, the level of official interest rates required to balance overall demand and supply would, in the long run, be lower than was thought necessary in the past few decades.

Even if we knew that long-term interest rates were low because of a change in the balance of saving and investment in the world, judging the appropriate level of interest rates would be a challenge. But monetary policy is made more difficult by the fact that there is another, very different, explanation of recent low long-term interest rates. Rapid growth of money — as central banks have kept official interest rates very low — has helped to push up asset prices as investors 'search for yield'. Data from the IMF suggest that world broad money in 2003 and 2004 was growing at its fastest rate since the late 1980s. Across the world, the prices of all kinds of assets have risen — not just of government bonds, but also of equities, houses and other real estate, commodities and gold and other precious metals.

Moreover, risk premia have become unusually compressed and the expansion of money and credit may have encouraged investors to take on more risk than hitherto without demanding a higher return. It is questionable whether such behaviour can persist. At some point the ratio of asset prices to the prices of goods and services will revert to more normal levels. That could come about in one of two ways: either the prices of goods and services rise to 'catch up' with asset prices as the increased money leads to higher inflation, or asset prices fall back as markets reassess the appropriate levels of risk premia. In neither case would it be easy to keep inflation close to the 2% target.

I do not pretend to know whether the signpost of low levels of long-term interest rates is primarily related to underlying preferences for saving and investment, or to the global growth of money and a possible underpricing of risk, or, in all probability, to some combination of the two. Nor, since we do not know the causes of low long-term rates, can we be sure for how long they will persist. Monetary policy will, therefore, need to be alert to the information contained in a wide range of asset prices, to be forward looking in its aim of maintaining low and stable inflation, and to be ready to respond to changes in the signposts.

The remarkable degree of stability that the UK economy has enjoyed over the past decade has been less evident over the past twelve months. Growth slowed and inflation rose above target. But after a period driving along a smooth new highway, a change to a more challenging road surface does not, as I said recently to the House of Lords Economic Affairs Committee, mean that the wheels are coming off the economy; rather, it tells us that there are somewhat more and somewhat larger bumps on the road. Monetary policy can try to avoid some of the worst bumps, but it cannot ensure a flat road surface. Nevertheless, growth has picked up and inflation has fallen back close to its 2% target. Our central view remains one of steady growth and low inflation. But there are risks to that central view emanating from the rest of the world and we shall watch developments in world capital markets carefully. By keeping inflation close to the target, and so doing what it can to maintain economic stability, the Monetary Policy Committee aims to allow you and other businesses to follow the signposts which guide a market economy.

I cannot finish without reminding you that tomorrow is the 300th anniversary of the birth of Benjamin Franklin, arguably the greatest of the American founding fathers. During his lengthy stays in England, Benjamin Franklin visited Kent many times. To celebrate his tercentenary the American Brewing Association has produced a new recipe for Franklin's favourite beer. The hops recommended for the recipe are Kent Goldings. Despite the fears of the demonstrators on Hop Saturday in 1908, the Kent hop industry has not disappeared altogether. The area under planting is certainly much smaller, but research in centres such as Wye College has produced the new hedgerow hops which are recognised worldwide. Employment in Kent, though, has moved into new and more productive sectors. Adapting to changes in the external environment is not easy for any of us — whether running a business or setting monetary policy — but if we do adjust the benefits will accrue, if not to everyone immediately then to the great majority over the years to come.

Reform of the International Monetary Fund[1]

It is a very great pleasure to be back in Delhi, this time to see more of India over the next two weeks. Sixty years ago delegates from around the world were gathering on Wilmington Island in Savannah, Georgia, to celebrate the baptism of the Bretton Woods twins, the International Monetary Fund, or, simply, 'the Fund' and the World Bank, 'the Bank'. India was represented by Sir Chintaman Deshmukh, Governor of the Reserve Bank of India, and Britain by John Maynard Keynes, Lord Keynes as he had become. The two men got on well. As Sir Chintaman wrote later:

'this meeting remains memorable mainly as the occasion when the Indian delegation worked in effortless accord with the British delegation under Lord Keynes and there were many occasions when there happened to be agreement between us on the need to take some step which would increase the utility, independence and creativity of the international bodies'.[2]

In his speech at this first meeting of the Fund, Keynes drew an analogy with the christening-party in *The Sleeping Beauty*, which he had seen danced only two weeks earlier. He hoped that the Bretton Woods twins, Master Fund and Miss Bank, would receive three gifts from their fairy-godmothers: first, a many-coloured coat 'as a perpetual reminder that they belong to the whole world'; second, a box of vitamins to encourage 'energy and a fearless spirit, which does not shelve and avoid difficult issues, but welcomes them and is determined to solve them'; third, 'a spirit of wisdom … so that their approach to every problem is absolutely objective'. Keynes warned the delegates that this was asking a great deal: 'there is scarcely any enduringly successful experience yet of an international body which has fulfilled the hopes of its progenitors'. So he hoped that the malicious fairy would not bring its curse upon the twins: 'you two brats shall grow up politicians; your every thought and act shall have an *arriere-pensee*; everything you determine shall not be for its own sake or on its own merits but because of something else'. And if the IMF were to become politicised then, Keynes said, it would be best for the twins 'to fall into an eternal slumber, never to waken or be heard of again in the courts and markets of Mankind'.[3]

Sixty years on, the wisdom of Keynes's remarks at Savannah is clear. In recent years, the critics have charged that all three of the virtues of universalism, energy and wisdom have been lacking in the IMF. It is an institution, it is said, which has lost its way. What is the truth of these allegations? Certainly, the Fund's remit is unclear. Its lending activities have waned, and its role in the international monetary system is obscure. The tasks given to it by the conferences at Bretton Woods in 1944 and Savannah in 1946 need to be adapted to the financial circumstances of the 21st century. That was attempted in 1976 with the Second Amendment to the Fund Articles but 30 years later it is evident that there is still more to do.

We have an opportunity to return to first principles and ask some basic questions. Do we need an IMF? Is there a role for a multilateral institution in the management of the international monetary system? If so, what is it? Not before time are those questions now being asked in the corridors, if not the main floor, of the international meetings which rotate endlessly around the world from one windowless room to another. Last October, the ministers and governors of the G20 countries said that 'more work is needed to develop a 'roadmap' for the future strategic reform of the Bretton Woods institutions'. And speeches by several G7 ministers and governors, and as recently as ten days ago from the Managing Director himself, show that the debate on the role of the IMF is live. Too often in the past, as on the 50th and 60th anniversaries of the Bretton Woods conference, the debate has simply faded away. But if the mission of the Fund is not examined and the institution revitalised, it could slip into obscurity. Just as in Savannah, the responsibility for the ideas and impetus

(1) This is an edited version of the speech delivered by the Governor at the Indian Council for Research on International Economic Relations (ICRIER) in New Delhi, India on 20 February 2006.
(2) 'Economic developments in India — 1946–1956', the Dadabhai Naoroji Memorial Prize Fund Lectures, delivered at Bombay, February 1957.
(3) *The collected writings of John Maynard Keynes*, Volume XXVI, 'Activities 1941–1946: shaping the post-war world', page 216.

for radical change lies firmly with all the shareholders around the world.

Unless we consider the fundamental question of what the Fund is for, then any proposals for reform risk being piecemeal and ineffective. That is the issue I want to discuss with you this afternoon, and I shall try to answer three questions. First, in what way is the world of today different from that of Bretton Woods? Second, what role, if any, do we want an international monetary institution to play in today's world? Third, what changes are needed to enable the IMF to play that role?

What has changed since Bretton Woods?

Following the collapse of the Bretton Woods system in the early 1970s, the IMF came increasingly to be seen not as the guardian of the international monetary system but as the international lender of last resort. It hit the headlines as the initiator of large support packages to emerging market economies — so much so, that until the recent repayment of their loans by Argentina and Brazil, 70% of the Fund's outstanding lending was accounted for by loans to three countries. In turn, the growth of private capital flows and the build-up of massive foreign exchange reserves by many Asian economies have made redundant the idea that the primary function of the Fund is to be an international lender of last resort. The Asian economies, including Japan, have increased their foreign exchange reserves over the past 15 years so rapidly that they are now nearly ten times as large as the combined reserves of the rest of the G7. So the Fund urgently needs to ask what its main purpose is.

In 1944, when the Bretton Woods system was created, it was understood that sharp changes in capital flows were costly. Changes in capital flows can induce changes in trade flows. And to bring about large changes in trade flows often requires not only a reallocation of resources, but also in some cases sharp falls in national output. So the international monetary system was built around fixed exchange rates and controls on capital movements. Each country met its international responsibilities by running a balanced current account. When 'imbalances' arose and countries were depleting or building their official reserves, a key feature of this system was supposed to be that both the creditor and debtor countries were obliged to adjust their imbalances. In practice, the obligations on creditor and debtor countries were asymmetric, and in part that explains why the system proved unsustainable.

One drawback of the system was that it did not allow countries to smooth their expenditure in the face of fluctuations in their income. The role of the IMF was to facilitate some smoothing, by lending pooled reserves. Alternatively, changes in exchange rates would be sanctioned by the IMF for those countries judged to be in 'fundamental disequilibrium'. In doing this, the IMF fulfilled its purpose to help achieve orderly world growth. The history of the United Kingdom illustrates these features of the Bretton Woods system. Britain faced repeated challenges in achieving external balance during the Bretton Woods era. Sterling was devalued twice and four IMF lending programmes were necessary. Yet in 11 of the 17 years between 1955 and 1971, the United Kingdom ran a current account surplus, and its current account deficit peaked at around a mere 1% of GDP in 1964.

The openness of capital accounts means that the world today is very different from that of the Bretton Woods era. Capital flows — both public and private — are very large. And, for many countries, private capital flows now dwarf official flows. Because domestic demand is no longer constrained by current national output, a current account deficit does not necessarily indicate any 'fundamental disequilibrium' nor require any official help to finance.(1)

Many of the 'imbalances' that reflect private decisions to save and invest are desirable because they improve the efficiency with which capital is allocated throughout the world. Since it is difficult to measure 'equilibrium' flows of capital from one country to another, it is equally difficult to define, let alone calculate, 'fundamental equilibrium' exchange rates. As Alan Greenspan has pointed out, current account deficits and surpluses are now the norm rather than the exception.(2)

Moreover, even if a country is not today running a current account deficit or surplus, past flows of capital mean that domestic residents have assets and liabilities in a wide range of overseas countries. Countries now have asset positions quite distinct from their official reserves. The single most important difference between the old world and today's world is that in the former the

(1) This principle is also illustrated by the United Kingdom. Between 1946 and 1971, the United Kingdom had four IMF programmes. The maximum current account deficit at the start of those programs was 1% of GDP. Since 1998, the UK current account deficit has not been less than 1.5% of GDP but has been financed fully through private markets.
(2) Greenspan, A (2005), 'International imbalances', remarks before the Advancing Enterprise Conference, London.

financial position of a country was captured by the size of its current account surplus or deficit; now the financial position is best measured by the size and composition of its national balance sheet. The ratio of the sum of overseas assets and liabilities to GDP for major industrialised countries rose from around 70% in 1983 to around 250% in 2003.(1)

National balance sheets tell us three things. First, they tell us about the claims of one country on another. That will help to reveal how international capital flows respond to news. For example, in the hey-day of the 'productivity miracle' in the United States in 2000, equity inflows into the United States were twice as large as debt inflows. But, by 2004, when views of US productivity growth were more modest and overseas investors were keener to acquire short-term dollar-denominated assets, debt flows were nearly four times as large as equity inflows.

Second, balance sheets contain information about the potential speed of any likely adjustment. That speed is crucial in determining the intensity of the resulting changes in capital flows and hence, the costs associated with reallocating resources. For example, currency and maturity mismatches in the banking sector created the scope for a liquidity run on Korea in 1997.

Third, balance sheets contain information about how changes in relative prices will affect the values of both assets and liabilities. For example, Australia and the Philippines were both affected by the Asian crisis in the late 1990s. Their exchange rates fell by 20% and 35% respectively. But while both had high ratios of external liabilities to GDP, a significant proportion of Australia's obligations were denominated in domestic currency, whereas the Philippines' were largely in the form of debt denominated in foreign currency. Australia was able to cut official interest rates, run a larger current account deficit and so was able to grow faster in 1998 than 1997. The Philippines, on the other hand — because they could not afford to encourage a larger foreign currency depreciation — raised interest rates in 1997, albeit temporarily, and went into recession. Its current account moved by no less than 7.5% of GDP from deficit in 1997 to surplus in 1998.

These balance sheet linkages have increased the risks we face but they are an inevitable consequence of the free movement of capital in the post-Bretton Woods world.

Is there a need for an international monetary institution?

In that world, do we need an international financial institution, and, if so, what should its role be?

National economic policies are — or should be — trying to create stable monetary and fiscal frameworks to condition expectations of future economic policy. Policy surprises should not add noise to the news about economic fundamentals. It is in each of our national interests to avoid sudden or large changes in capital flows induced by volatile or unpredictable changes in economic policy. We want the monetary and fiscal decisions not only at home, but also in other countries, to be boring.

Although domestic economic policies seem to have become increasingly boring over the past decade or two, their interaction has not. Consider two, related, examples. First, the rise in the US current account deficit to more than 6% of national income has raised fears of how the (inevitable) correction will eventually be achieved. Second, for much of the past 20 years, as evidenced by the Asian crisis of the late 1990s, we have worried about emerging market countries accumulating excessive dollar liabilities. Now we seem to be worried about their accumulating excessive dollar assets. Capital has flowed 'uphill' from poor to rich countries.

Many countries are no longer the atomistic entities of textbooks whose policy choices have no effect on global prices: whether an exchange rate, a real interest rate, or the prices of particularly sensitive commodities such as energy. Rather, the actions of all major countries have sufficient spillover effects on other countries that they will then react in turn. This has important implications. A world of atomistic countries requires no assumptions to be made about the objectives of others. The impersonal prices that we face contain all the information relevant to our own decisions. But when there are spillover effects of one country's policies on another, it is important to know about the objectives, strategies — 'policy reaction functions' — and policy decisions of other countries.

An international financial institution might, therefore, help in two ways. First, even if countries are not willing to co-operate in the sense that they jointly determine macroeconomic policies, a forum which improves

(1) Lane, P and Milesi-Ferretti, G (2005), 'Financial globalisation and exchange rates', *IMF Working paper 05/3*.

knowledge and understanding of other countries' objectives and policy reaction functions may lead to more compatible policies. Second, such an institution might provide the public good of a dispassionate and independent analysis of the spillover effects of one country's policies on others. Some of the more idealistic aspirations for Bretton Woods — such as the creation of an international central bank and new currency — were never likely to be adopted and look impossible absent a world government. But an arbiter of the international monetary system can play a more limited role — not so much the referee brandishing the yellow and red cards of the football pitch, more the cricket umpire warning the players publicly when they believe the players are not abiding with the spirit of the game. Invoking the MCC's 'spirit of cricket', when a country knows that a policy, such as an exchange rate regime, requires modification, it should walk. Indeed, the players might in time come to realise that most games benefit when played according to a clear and agreed set of rules.

So the IMF still has a role to play. Given that most systemically important countries allow their exchange rates to float, the Fund cannot have an independent remit for global monetary stability. The Fund's role should be to support national policy makers by providing expert analysis about external risks to their domestic monetary policy objectives. National policies which appear sustainable in terms of countries' own objectives may interact and, through the resulting balance sheet effects, create risks to those same countries further ahead. The Fund should be a forum in which countries can discuss these risks. It should also hold countries to account. In these ways, it can indirectly support global monetary stability. With countries naturally reluctant to cede any control over their own monetary and fiscal policies, it is likely that the IMF will have as instruments only the powers of analysis, persuasion, and, in Keynes' own favourite words, 'ruthless truth-telling'. That phrase does not conjure up many memories of any of the many international meetings I have attended. But unless the IMF has the self-confidence to play that role, its deliberations and statements will carry little weight. The Fund requires an independent, respected and clear voice.

The Fund should focus its work on the international monetary system around three tasks. First, it should provide and share information about the balance sheets of all major countries, their composition and size, and the links between them. The Fund has been in the forefront of the analysis of balance sheets for emerging market economies, and it needs to extend this approach to its surveillance of the industrialised world. Balance sheets should be at the heart of the surveillance process. That analysis should lead to an assessment of the risks to the world economy as a whole.

The second task is to encourage countries to abide by their commitments to each other, by promoting greater transparency about national policies. In agreeing the Second Amendment of the Articles, all member countries made a general commitment to each other to pursue policies consistent with the objectives of stable global growth and low inflation under Article IV. Only in relation to exchange rate arrangements were members asked to specify what framework they would follow to be consistent with this commitment. As Tim Adams, Under Secretary for International Affairs at the US Treasury, has noted recently, the nature of those commitments was left unhelpfully vague and should be clarified. Any commitments should refer not just to exchange rates, but to monetary and fiscal policies as a whole. By making their national policy frameworks sufficiently transparent, countries will be making it possible for the IMF to hold them to account and fulfil its role as umpire.

The third task is the provision of a forum for national authorities to discuss risks to the world economy and to facilitate that discussion by providing an independent, trusted and expert secretariat. Only if countries are willing to share confidences with each other — discuss their 'policy reaction functions' — will international meetings justify their cost.

Those three tasks do not exhaust the responsibilities of an international financial institution. From time to time, there may well be financial crises when it would be appropriate for the international community to provide temporary financial assistance to mitigate the costs of sharp adjustment in trade flows and output. But such a role should not be the principal focus of international monetary co-operation. As I argued in my K B Lall Lecture in 2001, following the Asian crisis of the late 1990s it was likely that countries might choose to build up large foreign exchange reserves in order to be able to act as a 'do it yourself' lender of last resort in US dollars. It is now clear that this is exactly what many Asian countries have done. Nevertheless, it is sensible to provide the Fund with the capability to act when necessary.

How should the IMF be reformed?

The treaty creating the Fund made clear that its founding purpose was 'to promote international monetary co-operation through a permanent institution which provides the machinery for consultation and collaboration on international monetary problems'. In reality, though, the Fund is not playing that role at present. Its surveillance lacks focus. Its lack of day-to-day independence hampers its ability to comment effectively on divergences between stated objectives and actual policies at the national level. And it lacks the legitimacy to be an effective secretariat. Despite strenuous efforts by its Chairman, Chancellor of the Exchequer Gordon Brown, to promote discussion, there is little genuine interaction between members of the IMFC (or the Interim Committee as it was) about the international monetary system.

One symptom of the Fund's decreasing effectiveness has been the proliferation of 'G' groups — the G5 that became the G7, the G22 that became the G33 and then the G20; the G10; the G24 and the G77. All of these were attempts to create opportunities for serious discussions among countries in the international monetary system. But as the world economy, and hence the relevant issues, have changed so it has been necessary to set up new 'G' groups. But such groups are perceived as exclusive and lack legitimacy, and their meetings have increasingly become communiqué-driven events. In February 2004, the G7 met in Boca Raton in Florida. A key issue for discussion was the challenges posed by large current account imbalances and the role of exchange rate adjustment in any unwinding of the imbalances. As we looked around the table it was obvious that some of the key players, such as China and India, were not present. Since then a rather informal and *ad hoc* arrangement has ensured that the G7 engages in discussion with a broader group. We need to take a multilateral approach to the key issues but that does not mean that every country needs a seat at the table to discuss every issue.

If the Fund is to make this possible, reform is necessary. Realistically, only meetings with a small number of participants can encourage the level of frankness needed to resolve the challenges in the international monetary system. All member countries will need to accept that the big players in the international monetary game must be able to meet at a relatively small table. But the membership of the top table must change with circumstances — the group of big players is no longer an exclusive group of rich countries. Low and middle income countries can now affect the global economy. India and China have to be at the table.

Reducing the size of the IMF Board itself to achieve this aim is likely to be problematic. An enlarged Board has been one way of providing a platform for smaller and poorer members. One solution could be to create more flexible groupings within the Fund to discuss particular topics. For example, the Managing Director's powers to initiate bilateral consultations about the policy choices of individual members could be expanded to cover multilateral issues discussed by the relevant group of members.

The institution itself, though, also needs to change. The IMF has the great merit of being a universal institution. But it needs greater focus, independence and legitimacy. In terms of focus the members of the Fund, through the IMFC, could usefully restate the Fund's mandate in terms of global economic and monetary stability. If it is to be able to meet its remit then surveillance should focus at least as much on balance sheets as on exchange rates. The mandate should make clear both what the IMF is responsible for and what it is not responsible for.

I welcome the Managing Director's recent statement that he intends to examine Fund surveillance. But producing more focused surveillance cannot be achieved in isolation from more fundamental reforms of the Fund. In terms of independence the responsibility for the delivery of a new mandate should be placed more firmly in the hands of the management of the IMF. At present, the Board involves itself in every aspect of the Fund's activities. In 2004, for example, the Board met for about 500 hours, an average of over three hours for each of the three days a week on which the Board normally meets. Board members were given about 70,000 pages of material by IMF staff and produced another 10,000 or so of their own in written statements and other documents — equivalent to 300 pages of reading for each and every working day. The direct costs of supporting the Board account for around 10% of the Fund's net administrative budget. And the indirect costs, in terms of staff time spent writing and reviewing papers, attending and following up meetings and so on, are much higher.

The Board should step back from much of this expensive micro-management, for example by ceasing its involvement in the day-to-day reviews of Article IV reports, and concentrating instead on holding

management accountable for the delivery of the mandate. The Independent Evaluation Office, reporting on the Fund's lending to Argentina, pointed to the difficulty of knowing who was responsible for those decisions: management, the Board, or the national shareholders. The Fund is an institution with exceptionally high quality staff which is not best served by its current governance arrangements.

At Savannah, the main issue that divided the Americans and the British was the role of Executive Directors. Keynes argued that the Fund should be under the control of the Managing Director with oversight carried out by part-time Executive Directors. The latter should comprise people who help to formulate the policies of their countries in national capitals, and so could not be full-time in Washington. The main function of the Executive Directors was not to manage the Fund, but to act as an essential link between the Managing Director and the national treasuries and central banks from which they were drawn. In retrospect, Keynes's position seems sound. Given the ease of modern travel — at least in comparison with 1946 — serious consideration should be given to a non-resident Board, meeting some six to eight times a year with directors comprising senior finance ministry or central bank officials.

The process of shifting to a non-resident Board would bring the issue of the division of responsibilities to the fore. Member countries might conclude, for example, that they wanted to retain control of decisions to lend under the exceptional access framework. But in other areas, such as surveillance, it would make sense to delegate responsibility to the Managing Director in the context of a clearly defined remit. Moves in this direction would need to be accompanied by reforms to strengthen the accountability of the Managing Director. A first step in this direction would be to instigate regular IEO assessments on the effectiveness with which the Managing Director and staff had discharged their surveillance responsibilities.

Finally, in terms of legitimacy, its members must feel that the ownership of the Fund is shared and that all have a voice. In practical terms, that means reaching a deal on quota shares and seats at the Board with all regions of the world appropriately represented. Such a deal will be extremely difficult to reach. Nevertheless shareholders should recognise that the collective benefits of reaching a deal would justify compromise on each of their parts. But even if an agreement is reached what would be the purpose if the Fund remained unreformed and the larger questions I have posed today were unanswered?

Conclusions

The extraordinary changes in global patterns of trade and production, in which India is playing a major part, have the potential to raise living standards around the world by exploiting the division of labour which, as Adam Smith told us many years ago, is the foundation of our prosperity. As those real economic changes unfold, it would be quite extraordinary if the institutions required to sustain and support that new open trading and financial system were not to adapt. After a decade of discussions on the 'international financial architecture', it might be sensible to pause and ask what we are trying to build.

The world needs a strong and effective IMF to make us conscious of our responsibilities as members of the international economic system, and to provide a clear and cogent analysis of the challenges ahead. In the end, it is ideas that change the way people think and then act.

Those who founded the Bretton Woods institutions did so after a time of crisis, war and economic disaster. They had the vision to put in place international institutions that might help prevent the disintegration of the open trading system that they saw as necessary to a revival of economic prosperity. We have not had to go through a time of economic disaster. We have had the opportunity to experience an extraordinary flowering of the international trading system, and the entry into that of the world's two largest countries. The expansion of trade, the rise in the number of qualified people entering the world's labour force, and the growing realisation that we can all benefit from trade has raised living standards and provided us with opportunities to reduce poverty around the world. That should make it easier not more difficult to design international institutions to sustain those developments. We will have only ourselves to blame if we fail to live up to that challenge and simply allow the IMF to evolve through a series of ever more bland communiqués and meaningless statements.

Today, I have tried to challenge the thinking behind the slow progress in reforming the IMF. But that should not be interpreted as any criticism of the extraordinarily talented and committed people who work for the Fund. On the contrary, the responsibility for reform lies fairly

and squarely with the shareholders — the member countries.

Nor are the issues an arcane exercise in international finance. Agreements on the international monetary system and on trade go hand in hand. To eliminate poverty and improve living standards around the world will require progress both on the Doha trade round and on international monetary arrangements.

In 1946 Sir Chintaman Deshmukh lent his shoulder to the wheel of creating a new international monetary order. In 2006 the world needs the new generation of Indian policymakers to contribute to the debate with a loud, clear and thoughtful voice. To borrow Amartya Sen's phrase, we need to hear from the 'Argumentative Indian'.

Global financial imbalances

In this speech,[1] Rachel Lomax,[2] Deputy Governor responsible for monetary policy, discusses the implications of the global financial imbalances for the current international monetary system. Given their already substantial reserve holdings, Asian central banks are unlikely to continue financing an increasing US current account deficit indefinitely. While the risk of disruptive adjustment may still be low, the sheer scale of current imbalances increases the potential costs of policy mistakes and misperceptions. To minimise this risk, there is a need for clear policy communication and policies that are robust to the possibility of market expectations being inconsistent with economic fundamentals. The increased international interdependency in today's world also underlies the need to greatly improve the standard of dialogue on international economic issues.

One spin-off from the debate about global imbalances has been renewed interest in the international monetary system. It is a benign aspect of a potentially acrimonious debate about whether the scale and persistence of global imbalances — and specifically the US current account deficit — was made in the United States or made in Asia — or conceivably Europe (and maybe even the Middle East).

A better approach is to view global imbalances as the outcome of decentralised savings-investment decisions within an interdependent global system. And it's worth emphasising straight away that substantial imbalances may be the natural product of a healthy global monetary and financial system: they do not necessarily represent a problem.

But is the current pattern of large and persistent global imbalances healthy in this sense? Or does it reflect unsustainable behaviour on the part of policymakers, companies or private individuals around the world, rooted in unrealistic expectations, suboptimal economic policies or tensions between national policy objectives? Are global imbalances now on such a scale that their reduction inevitably poses a threat of some kind, whether to global activity, trade or financial stability? And does the current international monetary system embody sufficient incentives to deliver an orderly correction of imbalances?

At the risk of going over ground which was already covered yesterday, let me start by briefly reviewing the changing pattern of global imbalances. In doing so, the main point I want to make is that this is quite a complex story, which is consistent with several different — but not mutually exclusive — interpretations. And, hard as it is to understand, the past may not be much help in predicting the future.

The steady increase in the US current account deficit since the 1990s and its present unprecedented level — at over 6% GDP — has made it particularly tempting to look for home-grown factors which can consistently explain this trend. But the pattern of US saving and investment underlying its current account deficit look very different in the pre and post-2000 periods.

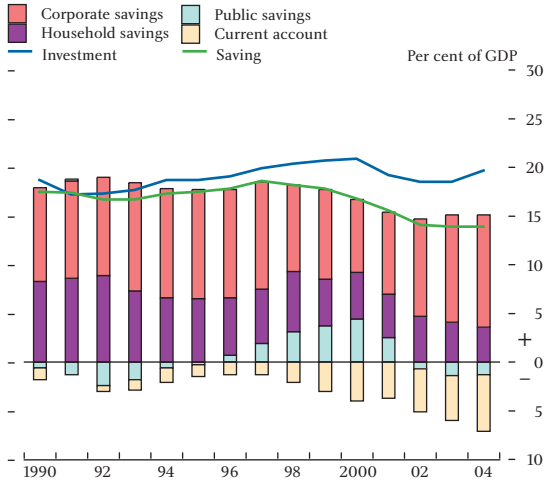
The former period was characterised by sustained fiscal consolidation, leading to fiscal surpluses, together with a fast growth in private investment in response to high expected productivity in the United States; the latter by an emerging fiscal deficit, in response to tax cuts, and a fall off in business investment (Chart 1). Only the steady downward trend in the household saving ratio — now into negative territory — is common to both periods.

This shift in the composition of the pattern of US savings and investment has coincided with a change in

(1) Delivered at the Chatham House conference on Global Financial Imbalances, Chatham House, London on 24 January 2006. This speech can be found on the Bank's website at www.bankofengland.co.uk/publications/speeches/2006/speech265.pdf.

(2) I am grateful to Andrew Foster, Jens Larsen, Adrian Penalver, Chris Salmon, Misa Tanaka and Anne Whitley for help in preparing these remarks and the charts.

Chart 1
US (gross) saving and investment

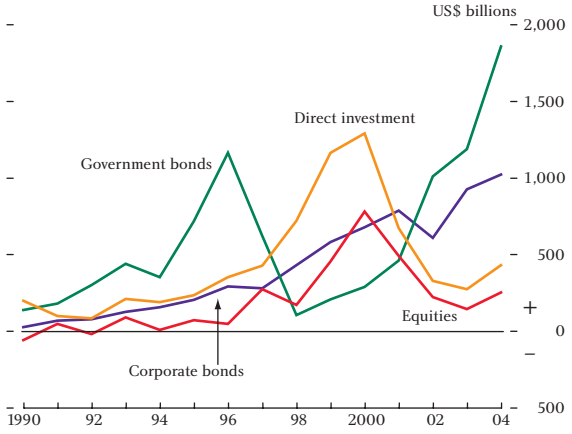


Source: IMF *World Economic Outlook*.

the composition of external financing flows into the United States.

The private equity inflows which dominated in the earlier period fell sharply after the stock market crash, and were replaced by inflows into corporate and especially government bonds (Chart 2).

Chart 2
Foreigners' net acquisition of US assets

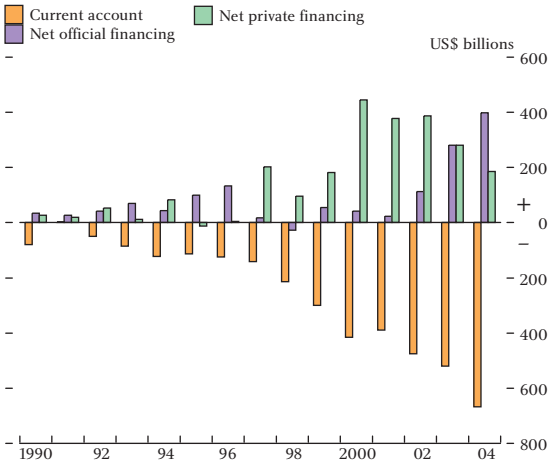


Source: Board of Governors of the Federal Reserve System.

A significant proportion of the demand for US government securities came from the official sector, notably Asian central banks, whose foreign exchange reserves have more than doubled since 2001 (Chart 3).

The fact that the US current account deficit has been funded at historically low and falling real interest rates suggests that the fall in US net savings may not have been the only — or even the main — driver of global imbalances. And while there are other possible explanations for the current low levels of global interest rates, it is certainly true that high saving relative to

Chart 3
US current account deficit financing

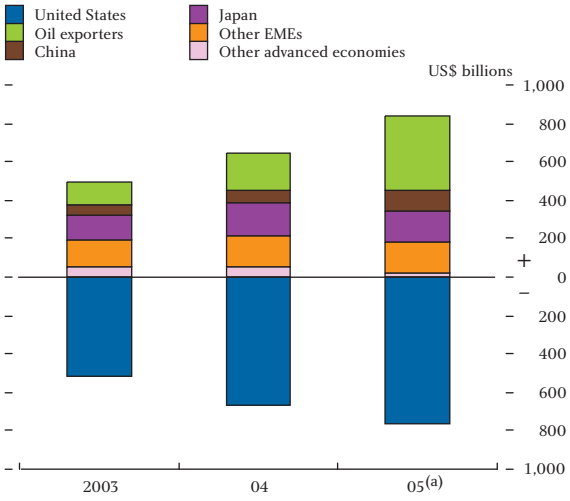


Source: US Bureau of Economic Analysis.

investment in East Asia has been an important counterpart of the US current account deficit. To be more specific, the rise in saving has outpaced the growth in investment in China, while domestic investment in the rest of East Asia remained stagnant after the Asian crises.

Finally, last year's doubling of oil prices in response to buoyant world demand has led to a further change in the pattern of imbalances, with the combined surpluses of oil-producing countries now likely to equal half the US current account deficit, on the same scale as the combined Asian surplus (Chart 4).

Chart 4
Global current accounts



Source: IMF.

(a) 2005 figures are IMF forecasts. Oil exporters include the ten largest oil exporters in 2004 (Algeria, Iran, Kuwait, Mexico, Nigeria, Norway, Russia, Saudi Arabia, United Arab Emirates and Venezuela).

How much of a threat might persistent imbalances on this scale pose to the world economy?

It is, of course, conceivable that these imbalances will prove to be relatively short-lived. They might be driven by underlying influences that prove to be largely temporary — for example an investment overhang in East Asia, which is eventually worked off, or a purely cyclical divergence in growth rates between major regions, or a short-lived spike in world oil prices. But at the moment there is little sign of this — rather the reverse.

It is therefore worth reflecting whether today's international monetary system (IMS) is sufficiently robust to ensure that global imbalances can be financed, contained or corrected through the normal mechanism of market forces, without crisis; or failing that, whether institutional arrangements exist to resolve collective action problems and conflicting priorities without damage to the wider world economy.

There are three key features of today's IMS which are particularly relevant in thinking about this question.

The first is financial globalisation which has totally transformed the landscape over the past two decades. Total financial wealth has risen sharply relative to GDP; and investors are now able and willing to hold a higher proportion of their portfolios in external assets. The trend to larger external asset and liabilities has been particularly significant in industrial countries, whose external assets and liabilities relative to output roughly tripled between 1990 and 2003, reaching average levels of more than 200% of GDP (Chart 5).

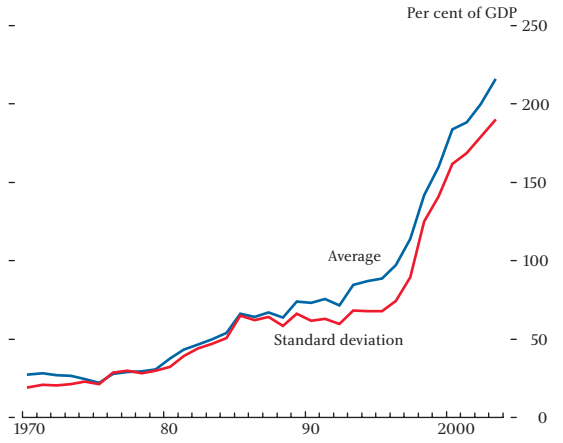
This has two effects. First, the expansion in external balance sheets has relaxed the constraints on the financing of countries' savings and investment imbalances. And second, balance sheet effects can have material impacts — affecting the link between current account deficits and external debt burdens, as well as the external adjustment process itself.

A corollary of financial globalisation has been the increased importance of market forces, rather than institutionalised inter-government agreements, in providing incentives for policymakers within systemically important countries or regions to follow policies that are mutually consistent — notwithstanding the longevity of the Bretton Woods sisters (the IMF and the World Bank).

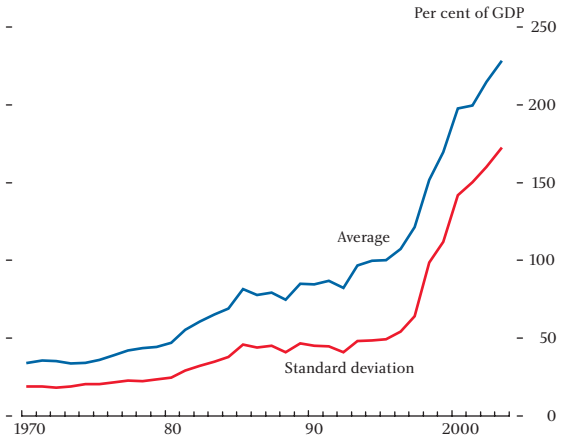
The second important feature of today's world is the rising economic importance of a group of Asian

Chart 5
Financial globalisation trends — industrial countries, 1970–2003

Foreign assets



Foreign liabilities



Source: IMF *World Economic Outlook* (April 2005, Chapter 3).

emerging market economies who heavily manage their exchange rates. As a result, the international monetary system has mutated into a 'hybrid' system in which some systemic countries float their exchange rates while others fix or manage them. One implication is that the pressure for adjustment to any given shock can be very asymmetric relative to a floating rate world. Thus, market driven exchange rate changes are likely to be concentrated on particular blocs rather than diffused across the system as a whole. As Obstfeld and Rogoff and others have pointed out, this is a situation which could create some difficult policy frictions. These have the potential to undermine free trade, and weaken world growth.

The third feature is the continued dominance of the US dollar as both a reserve currency as well as an anchor for those countries that choose to fix or manage their exchange rates. But nowadays countries have choices.

They might fix against the dollar but choose to hold at least a portion of their reserves in other major currencies. Since the advent of the euro, the dollar is no longer the only credible reserve currency.

How do these features of the international monetary system affect the risks associated with today's imbalances?

Financial globalisation has relaxed the constraints on countries in financing their savings investment imbalances, thus allowing larger imbalances to be sustained for longer. This is in principle welcome in so far as it permits more efficient adjustment over time, and smoothes the impact of economic shocks on real activity and consumption. But it also poses major new challenges for creditors and debtors, both public and private sector.

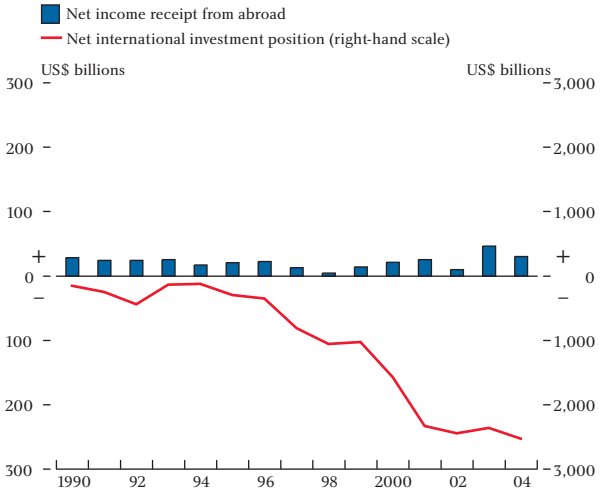
The reason is that the price at which the market is willing to finance imbalances depends on investors' expectations about the future. This means that debtors in today's world face much greater uncertainty about when credit constraints will begin to tighten. So there is always a risk that a reassessment of the economic prospects of a debtor country might lead to a rise in external financing costs. But there is considerable uncertainty about whether — and when — such a reassessment might occur.

This uncertainty is particularly acute in the case of the United States. Its dominant position in the world economy, its huge balance sheet and its reserve currency status make it special in a number of ways.

At present the United States still earns positive net income from abroad despite a steady deterioration in the current account since 1991, and a slower rise in its net external indebtedness (Chart 6). This is not to imply that the United States is immune to the basic arithmetic of debt sustainability — sooner or later persistent deficits will lead to levels of external indebtedness that represent a significant economic burden even on the United States; but it is more than usually hard to predict how long this might take.

The dollar's central role in the foreign exchange policies of Asian emerging markets adds to the uncertainty about the deficit levels at which the United States will face tighter credit constraints. Since the foreign official sector — mostly Asian central banks — have been

Chart 6
US net international investment position and net income receipt

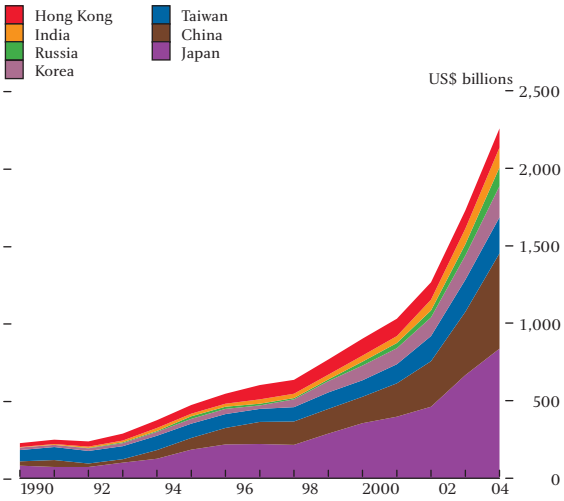


Source: US Bureau of Economic Analysis.

financing a substantial part of the US current account deficit (in net terms) and now hold a substantial amount of the outstanding stock of US Treasuries, private investors' willingness to hold dollar assets depends to some extent on their expectations of what these Asian central banks will be doing.

Since many Asian EMEs already have far more reserves than they need for self-insurance against financial crisis (Chart 7), their appetite for continued accumulation of US dollar assets will at some stage abate: indeed there has been some anecdotal evidence of this over the past year. They can already choose to diversify their reserve holdings, and the options available may become more attractive to them with the development of Asian bond markets.

Chart 7
Top reserve holders of the world(a)



Source: IMF *World Economic Outlook*.

(a) These are the largest reserve holders as of September 2005.

Their development strategies will also evolve. One-way intervention has potentially significant costs as well as benefits — costs which go well beyond the risk of substantial capital loss in the event of future exchange rate realignment. These include growing implementation problems, which are likely to be particularly acute in very open economies, and a potentially serious misallocation of domestic resources. It will not be in the interests of the Asian countries concerned to ignore these issues.

That is why I find the so-called Bretton Woods II hypothesis — or at least the proposition that Asian central banks will have a more or less open-ended commitment to financing ever increasing US deficits — rather implausible, at least as a prediction of what is likely to happen in the medium term, rather than as a description of the past few years. It assumes the continuation of unsustainable policies, which are not in the interests of the countries concerned. I concede however, that it is hard to make a precise forecast about the timing of a policy shift in Asia. And it is worth bearing in mind that this may depend on global and regional political considerations as much as on economic and financial pressures.

So given these uncertainties over the evolution of global imbalances, what should we do about them?

There is clearly no case for turning the clock back and re-introducing the constraints that characterised the genuine Bretton Woods system. The challenge is for policymakers to find ways of operating more effectively within the current system, to maximise the opportunities it affords and to manage the risks associated with open capital markets.

As a monetary policy maker, I am acutely conscious that a world of large imbalances carries some risk of disruptive market adjustments, even if the probability of them occurring is low. These could have a significant impact on economic activity, especially if they included a sharp reversion of long-term interest rates to something closer to their long-run average. We have been trying to factor this risk in to our thinking about interest rates as long as I have been on the MPC. But it is not a risk that maps easily on to any particular interest rate decision.

While the risk of a disruptive adjustment may still be low, the sheer scale of current imbalances increases the potential costs of policy mistakes and misperceptions. Any disconnect between what the markets expect and what policymakers intend to do becomes increasingly hazardous. That puts a premium on excellent policy communication, to reduce uncertainty and minimise the risk of sharp market corrections. And policymakers need to ensure that their policies are robust to the possibility that market expectations may not be consistent with economic fundamentals.

Policymakers in systemically important countries also need to be better at factoring wider political risks into their decision taking. They need to have an informed view of how markets and policymakers in other countries are likely to react, before they decide which domestic policies are likely to prove sustainable — and they need to ensure that their policies are robust to possible shifts in other countries' policies. The key political risk at present is of course protectionism — not just the possibility of bilateral restrictions, but of a fatal lack of momentum on the Doha round. This could be a material consideration in almost any scenario created by financial market pressures.

All these risks underline the need to greatly improve the standard of dialogue on international economic issues. The quality of analysis needs to improve, the right countries need to participate in the debate, discussions need to be franker, and their outcome needs to be communicated clearly.

Getting these things right will be tricky but the need for reform is growing. So I am sure we will need to address these issues soon. As to how we do it? That's for another day.

Monetary policy, demand and inflation

In this speech, Stephen Nickell,(1) member of the Bank's Monetary Policy Committee, explains the factors underlying his decision to vote for a rate cut in December and January. After 18 months of below-trend growth, there is now a modest degree of spare capacity in the UK economy. Looking forward, growth will probably approach trend levels in the near future. However, it is less probable that growth will move far enough above trend to eliminate the spare capacity in the medium term. As a consequence, there is unlikely to be any serious inflationary pressure generated by excess demand in the economy. So long as energy prices stabilise and there are no surprise second-round effects, CPI inflation will probably undershoot the target further out if rates are left on hold.

Summary

To understand inflation prospects, first consider where demand is relative to potential supply. Second, analyse growth prospects relative to trend. Then combine these to gain some idea of underlying inflationary pressures going forward. In addition, consider whether recent relative price changes, notably the rise in oil prices and the rise in import price inflation, are generating second-round effects via wage bargaining. So what is the situation?

After 18 months of below-trend growth, there is a modest degree of spare capacity in the UK economy.

Looking forward, it seems probable that the growth of demand will approach trend levels in early 2006. However, it is less probable that demand growth further out will move above trend, which it must do if the spare capacity is to be eliminated. In summary, there is unlikely to be enough excess demand in the economy going forward to generate any serious underlying inflationary pressure.

What of the oil price effect? Because oil prices stopped trending upwards in August 2005 and are not expected to trend up next year, the impact of the recent doubling of oil prices on CPI inflation is now fading. And in the absence of second-round effects, which have not appeared so far, the oil price effect will continue to fade.

The combination of the fading oil price effect and the absence of underlying inflationary pressure leads to CPI inflation undershooting the target further out if rates had been left on hold. Hence my votes for a rate cut in December and January.

There are some upside risks to inflation. Oil prices may continue to trend up in 2006, perhaps because of some supply disturbance interacting with the inexorable demand increase. Second-round wage effects may appear in the 2006 wage round. Finally, a continuing increase in wholesale gas prices may have a big enough impact further out to prevent the inflation undershoot. These risks were not, in my view, important enough to postpone a rate cut.

Introduction

In the December and January meetings of the Monetary Policy Committee I voted for a 25 basis points reduction in the interest rate. In what follows are my views on inflation prospects. Before getting down to the details, it is worth remarking on the relationship between inflation and prospects for demand in the economy.

After an interview I gave to the *Financial Times* (23 September), I was ticked off on the letters page for focusing on growth when the MPC is supposed to be targeting inflation. Then, at a meeting of the House of Lords Select Committee on Economic Affairs

(1) I would like to thank Kate Barker, Martin Brooke, Mark Cornelius, Mervyn King and David Walton for helpful comments on an earlier draft. This speech can be found on the Bank's website at www.bankofengland.co.uk/publications/speeches/2006/speech266.pdf.

(25 October 2005), Lord Lawson of Blaby remarked that he was very glad to hear the Governor reaffirm once again that the MPC was emphatically targeting inflation and not targeting activity (House of Lords, 2005, Question 15). Lord Lawson went on to add '…, few things could do more harm to inflationary expectations than a feeling that you did not have your eye very firmly on one ball and that maybe your attention had wandered equally between activity and inflation' (House of Lords, 2005, Question 16).

The factor driving changes in inflation over the longer term is the level of demand in the economy relative to the potential supply. If the former exceeds the latter, then we may expect inflation to be rising, and *vice versa*. In the light of this fact, what is one to make of the previous remarks? It is plain that if you are trying to hit an inflation target, you have to form a judgement about the level of demand in the economy relative to potential supply and how it is likely to move. This must, among other things, involve making judgements about growth prospects, not for their own sake but because they are vital when it comes to understanding the prospects for inflation. It is absolutely necessary to keep your eye on all the factors which affect future inflation, including growth prospects, if you wish to hit the inflation target. And, of course, keeping your eye on something is not the same as targeting it.

The level of demand relative to potential output is not the only factor determining inflation. Over the short run, measured inflation is strongly influenced by relative price shocks. And these may be substantial, like the recent doubling of the price of oil, or the fall in the prices of imported goods following the huge appreciation of sterling in 1996–97, or the significant rise in the prices of goods subject to VAT after the 1979 Budget. To hit the inflation target, the MPC has to take these things on board as well as the underlying inflationary forces generated by the position of demand relative to potential supply.

The extent to which the MPC will take account of these relative price effects when setting interest rates will depend on how long their impact on consumer price inflation is expected to last. If the impact of a particular relative price change fades rapidly it will be ignored, because any change in monetary policy would not have any significant effect on inflation before the impact of the relative price change disappears. So what sort of factors will make relative price effects last? A first point which is sometimes important is that a relative price effect will have an impact over a number of years if people are uncertain about whether the relative price change will be permanent. For example, sterling appreciated by around 25% in 1996–97. For foreign producers selling in the UK market, this was like a 25% reduction in the sterling costs of production. The decision they had to make was how much to cut prices as a consequence and over what period. Because they were uncertain how long this shift in sterling was going to be sustained, they only cut prices gradually and import price inflation was still negative in 1999, continuing to push down on consumer price inflation well after the shift in the exchange rate.

The second mechanism which is important in prolonging the impact of relative price changes is when wage settlements respond rapidly to changes in consumer price inflation. So if a rise in the relative price of a set of goods raises consumer price inflation and this feeds through rapidly in wage inflation, then the resulting rise in cost inflation will feed back into further price inflation ultimately generating a wage-price spiral. These second-round effects of a rise in relative prices will thus generate further increases in price inflation which will ultimately necessitate a monetary policy response.

So when are these second-round effects likely to occur? The answer is in situations where the monetary policy regime has no credibility and inflation expectations are not well anchored. A classic example happened after the large rise in VAT in the Budget of June 1979. Partly as a consequence of this, RPI inflation to rise from around 10% to over 15% by September with the consequences illustrated in Chart 1. Wage inflation responded almost immediately, fed back into price inflation and by June 1980, RPI inflation had reached 21.5%. A dramatic tightening of monetary policy and a huge rise in unemployment was required to get inflation down again and even so it did not fall below 10% until June 1982. By contrast, if inflation expectations are anchored on an inflation target, a rise in consumer price inflation generated by some relative price increase is less likely to feed through into pay settlements because of the general belief that inflation will return to target. I argue in what follows that, so far, wage inflation has not responded significantly to the recent rise in oil prices so there have been no second-round effects and, consequently, the implications for monetary policy of the oil price increase are few.

Chart 1
Inflation from 1978–82

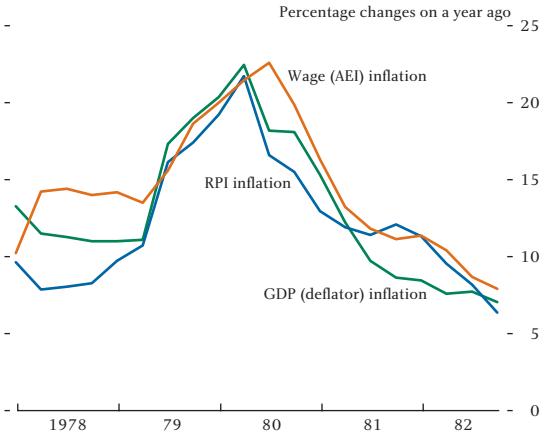
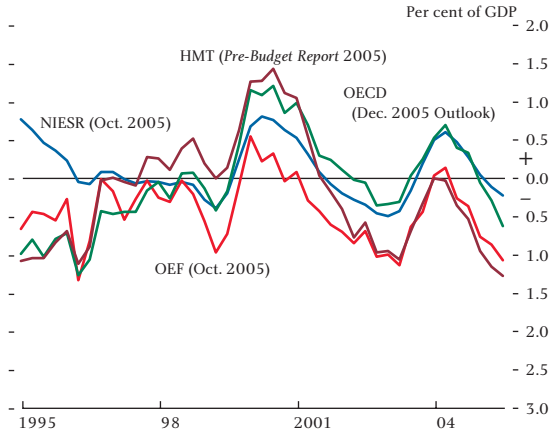


Chart 2
Output gaps



Sources: HM Treasury, National Institute of Economic and Social Research, Organisation for Economic Co-operation and Development and Oxford Economic Forecasting.

To summarise, in order to understand inflation prospects today, I must consider first, where demand is today relative to potential supply. Then I see what can be said about growth prospects relative to trend. These two combined will give some idea of underlying inflationary pressures. On top of this, I must consider the extent to which the recent rise in oil prices and, more generally, recent increases in import price inflation, having fed through into consumer price inflation are generating second-round effects via wage bargaining. This more or less describes the remainder of this paper. I conclude with my overall judgement on the prospects for inflation and its implications for monetary policy.

The UK economy, where are we today?

As I have already noted, prospects for inflation will depend crucially on demand in the economy relative to potential supply (the output gap), both today and going forward. So where are we today? In Chart 2, various measures of the output gap are presented and the overall impression is that there is some spare capacity available in the economy at present. Looking a little more deeply at this notion of spare capacity, there are two important aspects. First, there is spare capacity within companies, which basically refers to the ability of the company to supply more output without having to buy more machines in the case of a manufacturer or purchase more selling space in the case of a retailer or hire more professionals in the case of business services provider. Second, there is spare capacity in the labour market which implies that there are individuals not currently employed who are willing and able to assist in the expansion of existing capacity by, for example, manning an extra shift or increasing the number of professionals in a business services company.

To capture the first of these two aspects, in Chart 3, it appears that capacity utilisation rates, in both manufacturing and services, have fallen away since 2004 and now stand close to their average levels over the past decade. So companies have a degree of spare capacity at least relative to 2004. In the labour market, the claimant count measure of unemployment has risen steadily over the past year and the LFS measure has turned up rather sharply in recent months (Chart 4). So there is also some spare capacity in the labour market.

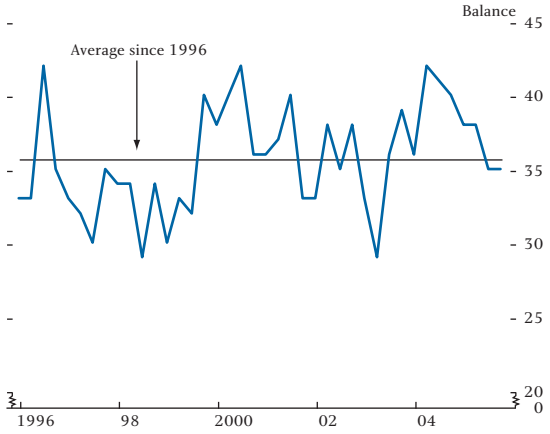
Overall, therefore, the picture is fairly clear. There is a degree of spare capacity available in the UK economy as of today. So what does this imply for inflation prospects? First, the existence of some spare capacity ensures that underlying inflationary pressures are modest. Second, some period of above-trend growth, which will reduce the extent of spare capacity, is consistent with hitting the inflation target in the longer term. Third, the precise outcome for inflation will also depend on the various relative price factors mentioned in the previous section as well as the presence or absence of second-round effects. So in what follows, I shall first consider current and future demand prospects, to see where demand is expected to go relative to trend. Then I shall look at the other factors which have to be added to the basic supply/demand effects to derive the overall prospects for inflation.

Prospects for demand relative to potential supply

If I am going to pursue the question of demand prospects relative to potential supply, it is worth starting

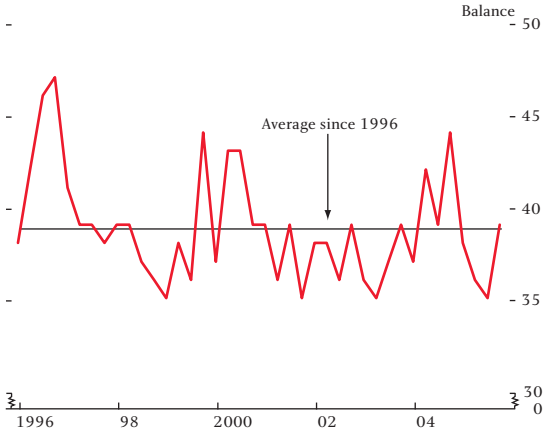
Chart 3
Capacity utilisation

Chart 3a
Manufacturing



Source: British Chambers of Commerce.

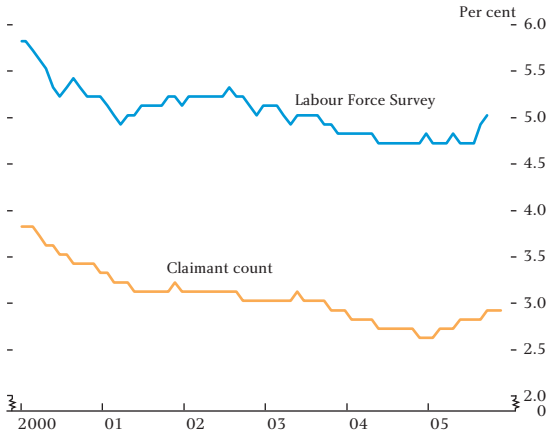
Chart 3b
Service sector



Source: British Chambers of Commerce.

by considering how rapidly potential supply is expanding. The general view is that the trend growth of GDP in the United Kingdom is currently around 2.7%. There are some uncertainties here relating to the extent of immigration of potential employees, the prospects for productivity growth in the light of the recent decline in productivity growth rates and the implications for supply potential of recent rises in fuel prices. Overall, however, treating the trend growth of potential output as 2.7% per annum is a reasonable assumption so long as we recognise the uncertainty here. Turning now to demand prospects, I start with the world economy.

Chart 4
Unemployment rate



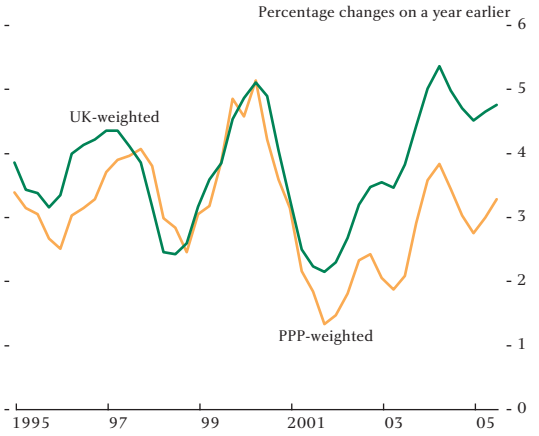
The world economy

Because the UK exports over one quarter of what it produces, it is important to have some idea of world demand. In Chart 5, it appears that economic growth in the world economy is relatively buoyant, although somewhat less so if the countries are weighted by their importance to UK exporters. The problem here, as can be seen in Chart 6, is that the euro area, which takes a disproportionate share of UK exports (over 50%), has been performing less well than the other major economies. However, the euro area is on the road to recovery and so world demand prospects look reasonably strong. Equity markets certainly think so (Chart 7) and oil prices have flattened off in the past few months (Chart 8). Of course, there are risks to this relatively benign outcome. Will the excess of savings over investment in Asia and the Middle East continue to finance the US current account deficit, as well as helping to sustain long-term real interest rates at historically low levels? Will oil and other commodity prices continue to remain relatively stable despite strong growth in the world economy? Despite these risks, my best guess would be that the world demand for UK products will probably grow reasonably strongly over the next few years. Certainly more strongly than the average of the past few years.

The UK economy

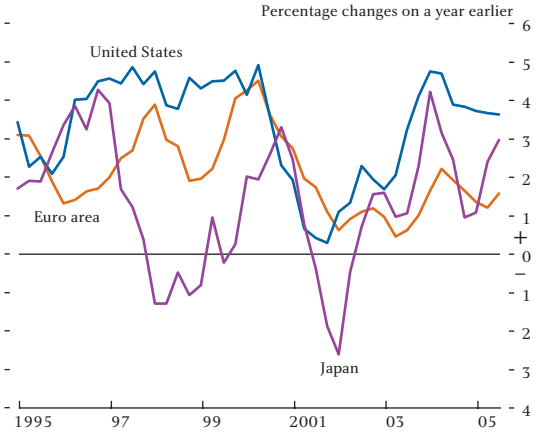
In Chart 9, the path of UK GDP is presented. Even were the recent data to be revised up, the broad overall picture is unlikely to change dramatically. Since the middle of 2004, UK GDP growth has been somewhat below trend. This is consistent with the finding in the previous section that the extent of spare capacity in the United Kingdom was rising over exactly the same period. So what happened in the middle of 2004? Let us look first at household consumption, which makes up more than 60% of GDP.

Chart 5
World GDP growth



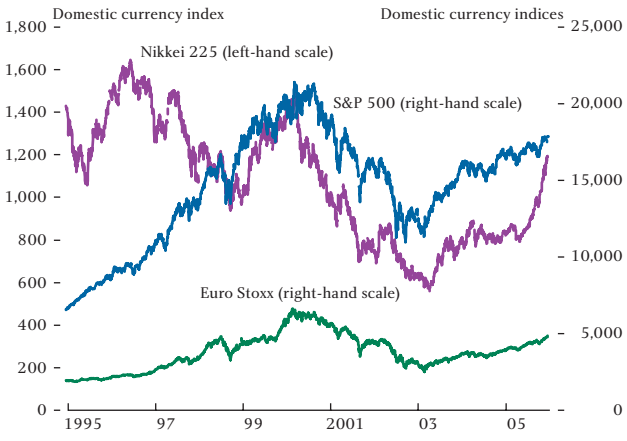
Sources: ONS and Thomson Financial Datastream.

Chart 6
International GDP growth



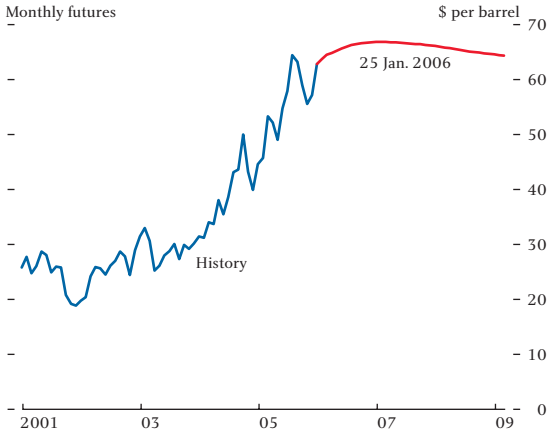
Source: Thomson Financial Datastream.

Chart 7
World equity prices



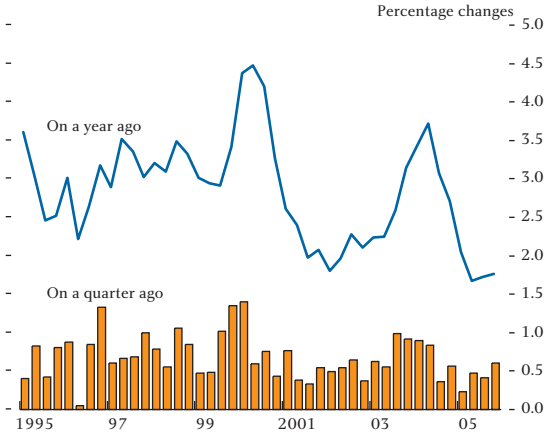
Sources: Thomson Financial Datastream and www.stoxx.com.

Chart 8
Oil price and futures curve



Sources: Bloomberg, Thomson Financial Datastream and Bank calculations.

Chart 9
UK GDP growth



Consumption

Not surprisingly, in the light of what has just been discussed, household consumption growth started to fall in the middle of 2004 (Chart 10) although there is some evidence of a recovery later in 2005, confirmed by the retail sales data (Chart 11). So why was there a significant shift in mid-2004? Perhaps the most important factor was the significant slowdown in real post-tax labour income growth over the same period. As can be seen in Chart 12, since 2000, household consumption growth has tended to track post-tax labour income growth with a bit of delay. So why did real post-tax labour income growth slow down, particularly as there was no significant slowdown in either earnings growth or employment growth? The answer is first, the sharp rise in consumer price inflation driven by oil prices and second, the fact that the effective tax on personal incomes rose particularly rapidly over this period (Chart 13) mostly without any increases in official tax rates (other than Council Tax). The factors

underlying this rise in effective tax rates were composition effects (eg incomes among those in the high tax band rose faster than average) and the fact that the tax bands in the income tax system are indexed to price inflation, not wage inflation.

Chart 10
UK consumption growth

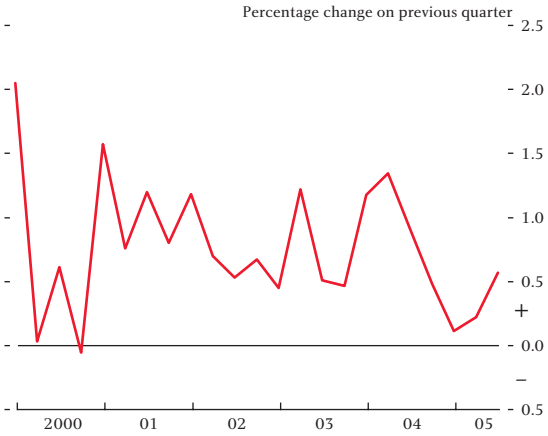


Chart 11
Retail sales

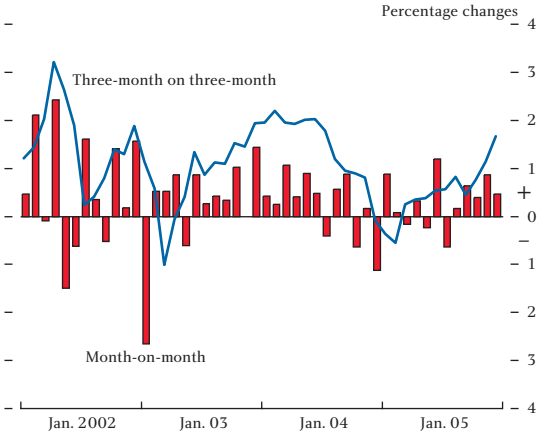
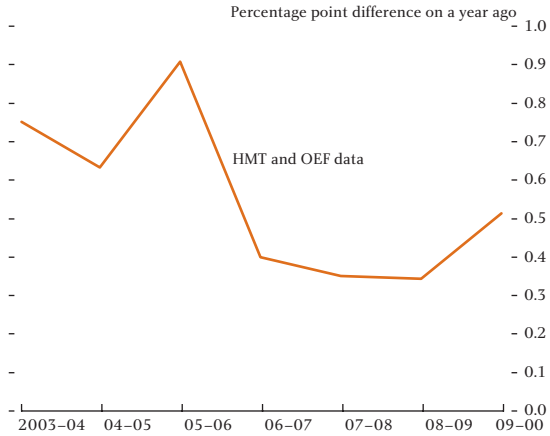


Chart 12
Income and consumption

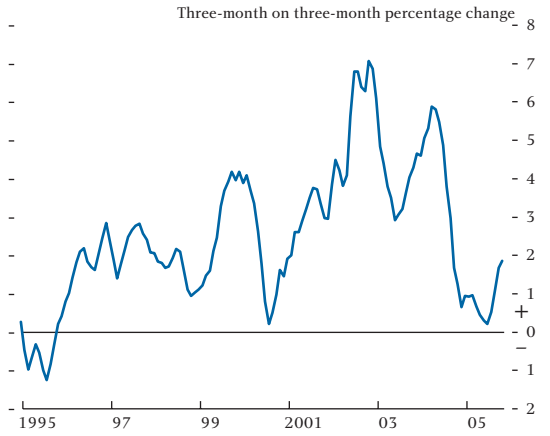
Chart 13
Change in effective tax rates



Source: Past and projected revenue from income tax and National Insurance contributions (HM Treasury) normalised on past and forecast pre-tax labour income (Oxford Economic Forecasting).

Other factors associated with the slowdown of household consumption growth since the middle of 2004 have been the sharp decline in house price inflation (Chart 14) and the rise in short-term interest rates from late 2003 to August 2004. The latter effect was probably bigger than in the past because of the historically high levels of household debt in the United Kingdom.(1)

Chart 14
House price inflation



Source: Average of the Halifax and Nationwide indices.

So what are the prospects for consumption going forward? So long as employment and earnings growth continue at existing rates, then real post-tax labour income growth will revert to normal levels because average tax rates are not expected to rise in the future as rapidly as in the immediate past (Chart 13). In the light of this and barring serious adverse shocks,

(1) Of course, when interest rates go up, while debtors must pay more, creditors have higher incomes so they can spend more. The net effect of higher rates on UK consumption is negative because debtors typically have a higher propensity to spend than creditors and not all creditors live in the United Kingdom.

consumption growth should increase towards more normal levels. Indeed, the latest data on retail sales and from the British Retail Consortium suggest this is starting to happen.

Investment

Aside from government investment, fixed capital investment growth in the United Kingdom has been weak over the past year, consistent with the overall slowdown in domestic demand (Chart 15). So what are the prospects for investment growth going forward? Since both business optimism and investment intentions have been declining since 2004 (Chart 16), the prognosis for investment growth is relatively modest.

Government consumption

Luckily for the MPC, the Treasury reveals its plans for nominal government spending for some years to come. The numbers suggest that nominal spending on goods and services as well as on government employees will grow steadily at around 6% per annum until April 2008 after which it will slow down. Public sector employment growth has, however, been slowing over the past two years and is expected to settle at a lower level going forward.

Imports and exports

The general picture over the past 18 months has been a slowdown in the growth of imports and a slight increase

Chart 15
Investment growth

Chart 15a
Whole-economy investment

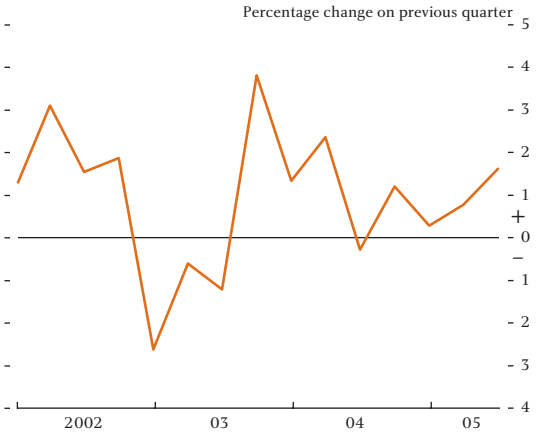


Chart 15b
Business investment

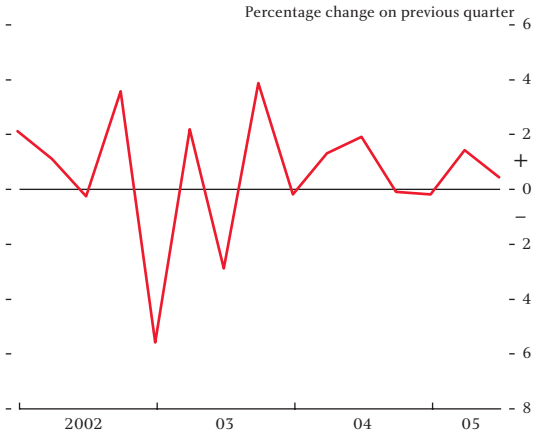
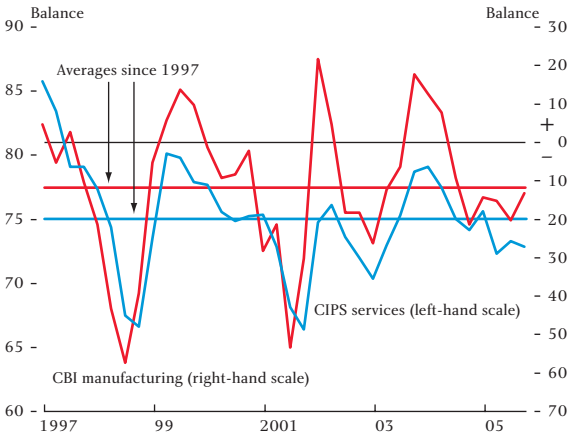


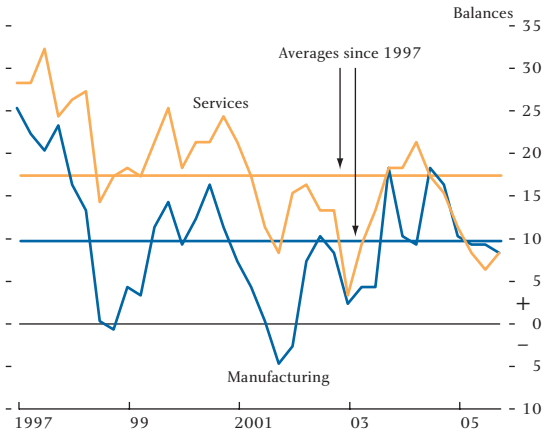
Chart 16
Survey evidence on business optimism and investment intentions

Chart 16a
Business optimism



Sources: Chartered Institute of Purchasing and Supply and Confederation of British Industry.

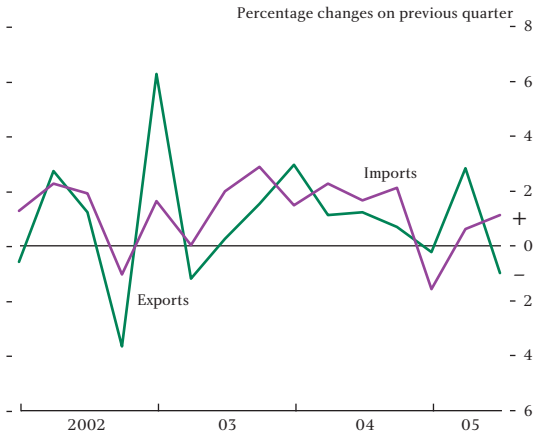
Chart 16b
Investment intentions



Source: British Chambers of Commerce.

in the growth of exports (Chart 17). Given a relatively stable exchange rate, the force underlying the slowdown of import growth is probably the recent weakness of domestic demand, particularly the demand for consumer durables and investment goods which have a very high import content (in excess of 60%). Export growth has probably been assisted by the rise in UK-weighted world GDP growth since 2003 (Chart 5). Looking forward, we may expect export growth to remain relatively strong as UK-weighted world GDP growth will probably remain buoyant. On the other hand, import growth can be expected to recover as consumption growth moves towards more normal levels. Indeed, in 2005 Q3, there is already some sign of this happening as both import growth and the growth of expenditure on consumer durables increased significantly.

Chart 17
Trade volumes



Future prospects for net trade are highly uncertain. In so far as the recovery in net trade in the past year has depended on the weakness of expenditure on consumer durables and capital goods, this recovery may be expected partially to reverse as consumption growth goes back to normal. However, since growth in the UK-weighted world will probably remain strong, stronger than over the past three years, on average, the prognosis for net trade is perhaps a little stronger than it has been over the past few years. But given a stable exchange rate, it will probably still act as a drag on overall GDP growth. Perhaps a bit less of a drag than has been the case in the past few years.

Overall demand

The overall picture is one where demand in the United Kingdom will move back towards trend rates driven by some recovery in household consumption growth and strong government expenditure growth. Weaker investment growth may hold things back a little but given the strength of UK-weighted world growth prospects, net trade may be a little less of a drag on GDP growth than it has been in recent years. The key issue for underlying UK inflation is whether or not growth prospects are strong enough relative to trend to reduce the existing level of spare capacity and generate rising inflationary pressure. Given the relatively weak prospects for investment and the fact that consumption growth is unlikely to move significantly above normal levels, it seems unlikely that government spending and net trade will make a strong enough contribution to get UK demand growth significantly above trend. Overall, therefore, the probability that the balance of supply and demand will generate significant additional inflationary pressure over the next three years seems relatively low.

Pipeline pressures, relative price effects and the overall inflationary picture

The most important recent change in relative prices has been the rise in the price of oil (Chart 8). After increasing continuously from early 2004, the oil price has flattened off since August 2005 and is expected to remain relatively stable over the next couple of years according to the forward curve. There is, however, a lot of uncertainty about this. The oil price feeds more or less directly into consumer prices via the price of petrol and indirectly via the prices of goods which require oil in their production. Taking lags into account, the impact of these shifts in the oil price was to generate upward pressure on CPI inflation from late 2004 until late 2005. Subsequently, because oil prices were no longer trending upwards after August 2004, the upward pressure on inflation switched to downward pressure after September 2005. This kind of switch happens because if, for example, the price of petrol was rising this time last year but is stable or falling today, this will exert downward pressure on the current annual inflation rate. This downward pressure on inflation will probably continue for some time and explains why the MPC's inflation forecast in the November *Inflation Report* has inflation tending to fall in 2006.

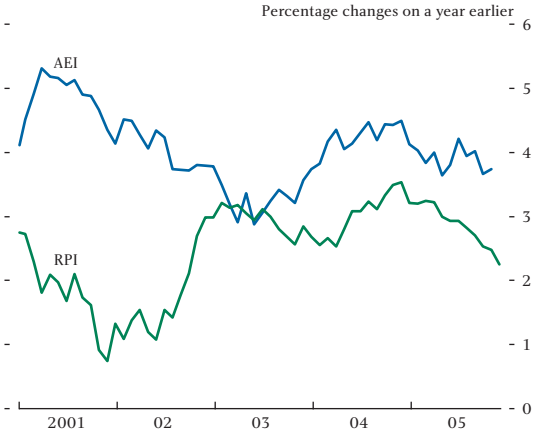
The fact that a significant and permanent rise in the price of oil only leads to a temporary jump in measured inflation is a consequence of the absence of second-round effects. As noted in the first section, second-round effects arise typically when wage settlements and earnings respond rapidly to movements

in consumer price inflation.(1) If this happens, a rise in consumer price inflation will raise wage inflation. This will impact on cost inflation, generating a second-round rise in price inflation. A wage-price spiral then gets underway and consumer price inflation moves steadily upwards despite the fact that the oil price is no longer rising.

So far, we have not seen second-round effects in response to the rises in consumer price inflation from mid-2004, as we can see from the relative stability of earnings growth and settlements in response to fluctuations in price inflation,(2) or indeed in response to the recent sharp rise in effective tax rates (Chart 18).

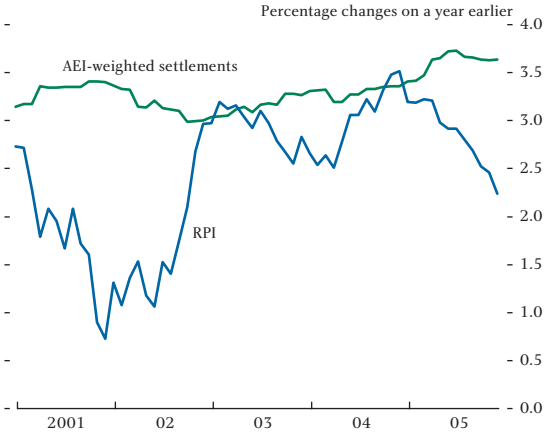
Chart 18
The response of earnings and settlements to changes in RPI

Chart 18a
Private sector regular pay growth



Sources: Bank Agents, Incomes Data Services, Industrial Relations Services and ONS.

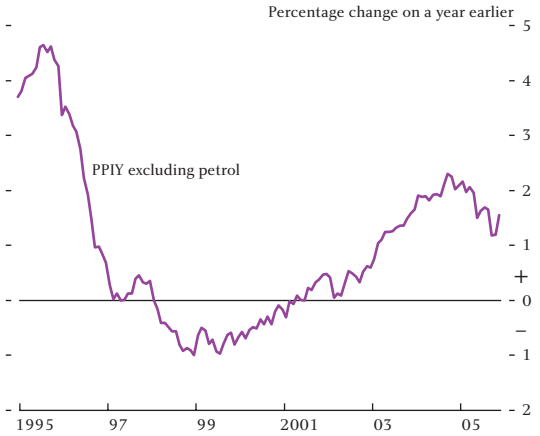
Chart 18b
Twelve-month, AEI-weighted settlements



Sources: Bank Agents, Incomes Data Services, Industrial Relations Services and ONS.

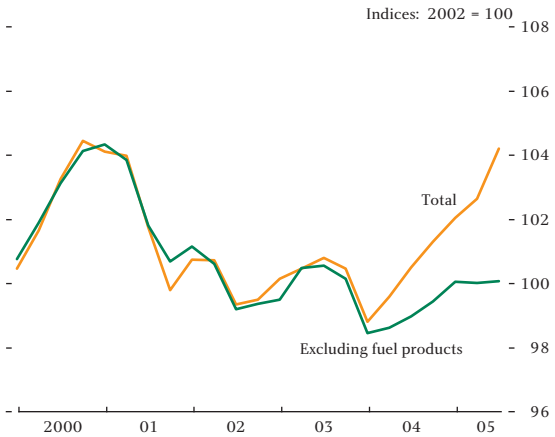
Given that the other main source of relative price movements, the sterling exchange rate, has remained pretty stable in recent years, are there are any inflationary pressures in the pipeline? Domestic goods price inflation, excluding petroleum products, has been moving steadily down since 2004 (Chart 19). Import price inflation, excluding fuel products, has been relatively stable (Chart 20). CIPS service price balance has risen a little recently, although it is still down on its level in the first half of 2004 (Chart 21). Overall, there does not seem to be any strong inflationary pressure in the supply pipeline.

Chart 19
Domestic goods price inflation



Sources: ONS and Bank calculations.

Chart 20
Import prices



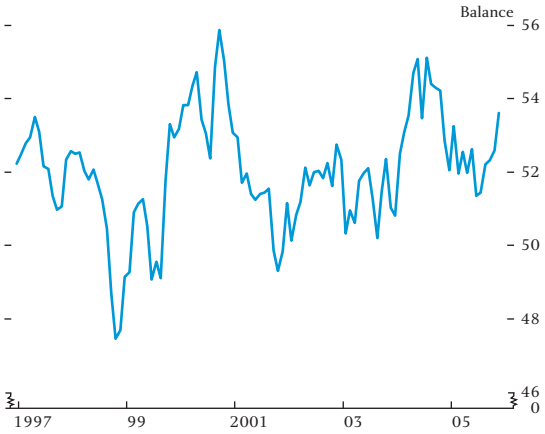
Sources: ONS and Bank calculations.

The overall picture on inflation prospects

After about 18 months of below-trend growth, there is some modest degree of spare capacity in the UK

(1) This is a special case of what is generally termed 'real wage resistance'. This happens when employees resist falls in real wages by raising wage demands in response to any changes that tend to cut real pay. These changes include not only rises in consumer price inflation but rises in effective income tax rates.
(2) We use the retail prices index (RPI) in this context because surveys of wage bargaining indicate that wage bargainers overwhelmingly use RPI as their measure of rises in the cost of living rather than CPI.

Chart 21
CIPS services prices



Source: The Chartered Institute of Purchasing and Supply.

economy. Looking forward, it seems probable that the growth of demand will approach trend levels early in 2006. However, it is less probable that demand growth further out will move above trend, which it must do if the spare capacity is to be eliminated. In the light of this, there is unlikely to be enough excess demand in the economy going forward to generate any serious upward move in underlying inflation. The other major contribution to inflation prospects is provided by the recent doubling of the price of oil. Because oil prices stopped trending upwards in August 2005 and are not expected to trend upwards next year, the impact of this event on CPI inflation is now fading. And, in the absence of second-round effects, which have not appeared so far, the oil price effect will continue to fade. The combination of this with the low probability that excess demand in the economy going forward will generate any serious upward move in underlying inflation, implies that inflation is more likely than not to come in below target for some time, once the oil price effect washes out. In order to get inflation up towards target further out, a cut in interest rates was required.

One final point is worth noting. A further significant prospective relative price change has appeared on the horizon, namely the rise in UK wholesale gas prices from 2005–06 which is implicit in the forward market. This shift would raise CPI inflation in 2006. However, again if there are no second-round effects, CPI inflation would then tend to fall back further out, once gas prices stop rising.

References

House of Lords (2005), 'Monetary policy: report with evidence, Select Committee on Economic Affairs', *4th Report of Session 2005–06* (London: The Stationery Office Limited).

Has oil lost the capacity to shock?

Despite a doubling in oil prices since the end of 2003, the UK economy appears to have emerged relatively unscathed. In this speech,(1) David Walton,(2) member of the Monetary Policy Committee, examines the reasons for this fairly benign outcome relative to previous episodes of rising oil prices. First, the size and nature of the shock have been different. Oil prices have risen as a consequence of strong global demand rather than as a result of supply disruptions associated with wars. Second, the UK economy has been better placed to absorb the current oil price shock. Unlike some previous episodes, there were few inflationary pressures in the economy when oil prices first began to rise sharply and there has been little sign of second-round effects on inflation from higher wage demands. Third, the monetary policy framework has played an important role. Inflation targeting has helped to anchor inflation expectations, yet it has allowed the MPC to respond flexibly to the oil price shock.

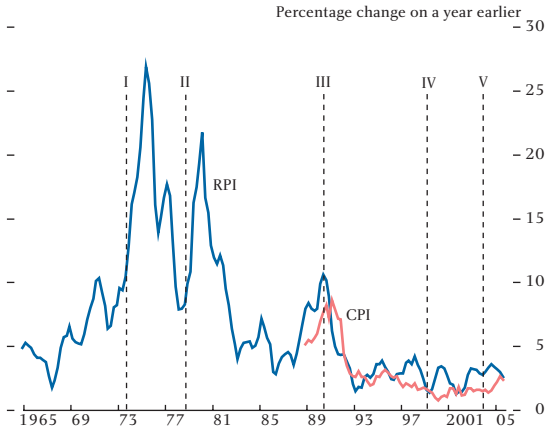
Despite a doubling in oil prices between the end of 2003 and the summer of 2005, the UK economy appears, so far at least, to have emerged relatively unscathed. GDP growth fell below its long-run average of 0.6% a quarter (2½% annualised) during the second half of 2004 but it reached a trough in early 2005 and recovered gradually back to around trend at the end of last year. Consumer price inflation rose above the Government's 2% target during the second half of 2005, reaching a peak of 2.5% in September, but it has since fallen back to 1.9% in January.

These developments are in marked contrast to the economy's performance after several previous oil price shocks; periods that were often characterised by both rising inflation (Chart 1) and recession (Chart 2). In the following, I investigate the reasons for this much more benign outcome and consider what we have learned from oil shocks, past and present, for the conduct of monetary policy.

The size and nature of the oil shock

Part of the reason for the difference in economic performance may relate to the size and nature of the shock.

Chart 1
Retail price and consumer price inflation



Note: The five oil shocks identified in the text begin: I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: Bank calculations and ONS.

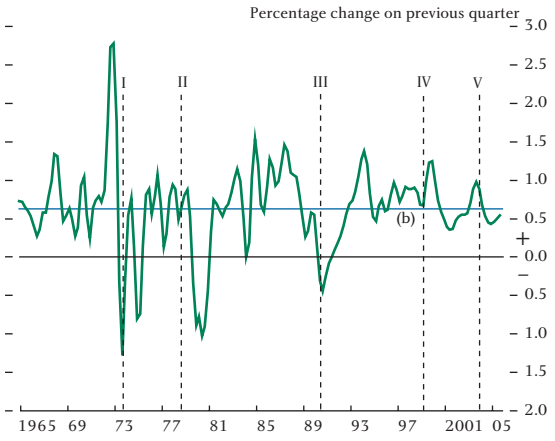
- Including the most recent episode, there have been five significant periods of rising oil prices since 1970 (Chart 3): 1973–74, 1978–80, 1990, 1999–2000 and 2004–05.(3) The cumulative increase in real sterling oil prices during these episodes is shown in Chart 4. The doubling in real oil prices on this occasion, though comparable in size to other oil shocks, has taken much longer than usual to unfold.

(1) Given to the University of Warwick Graduates' Association Senior Directors' Forum on 23 February 2006. This speech can be found on the Bank's website at www.bankofengland.co.uk/publications/speeches/2006/speech268.pdf.

(2) I would like to thank Jennifer Deaville-Powner, Lavan Mahadeva and Alex Muscatelli for their invaluable research assistance in the preparation of this speech. I am also grateful to Peter Andrews, Martin Brooke, Colin Ellis, Charlotta Groth, Richard Harrison, Neal Hatch, Bob Hills, Mervyn King, Stephen Nickell, Adam Posen, Jumana Saleheen, Chris Shadforth, Ryland Thomas and Tony Yates for helpful discussions and comments. The views expressed are my own and do not necessarily reflect those of either the Monetary Policy Committee or the Bank of England.

(3) The measure of oil prices used here is the Brent crude price series in US dollars taken from the International Monetary Fund's International Financial Statistics database. This has been taken back to the 1960s by linking it to the prices of similar types of crude oil. See International Monetary Fund (2005), *Country Notes*, page 6. The dollar price has been converted to sterling. When expressed in real terms, the oil price has been compared relative to the level of UK retail prices.

Chart 2
Real GDP growth(a)

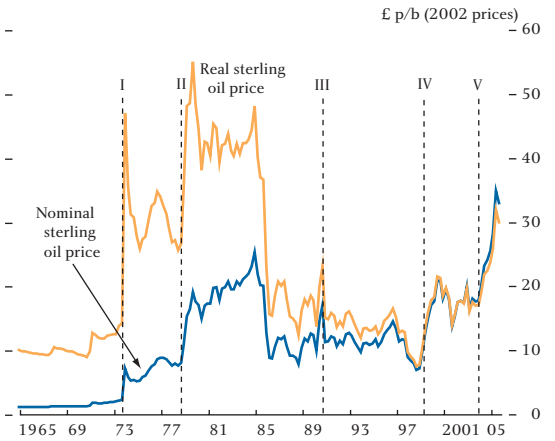


Note: The five oil shocks identified in the text begin: I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: Bank calculations and ONS.

(a) GDP at basic prices growth, smoothed by a five-term Henderson trend until 2005.
(b) Average (1965–2005) 0.6%.

Chart 3
Sterling oil price



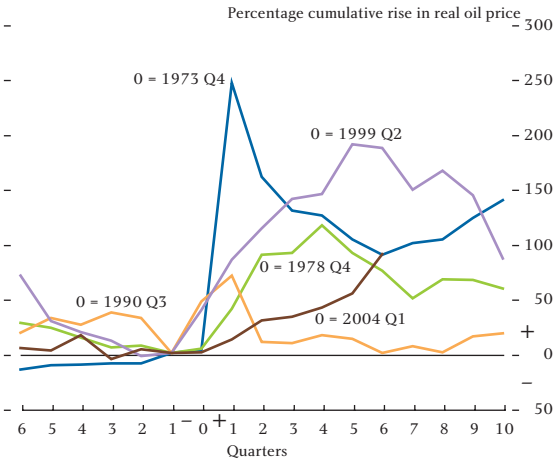
Note: I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: IMF IFS (Brent crude oil prices),ONS (UK RPI level) and Thomson Financial Datastream (US dollar exchange rate). All quarterly averages.

- The economy is less dependent on oil than during the 1970s, reducing the impact of any given oil price rise on the economy.(1) Energy use was a little less than 1.5% of non-oil gross final expenditure in 2003, down from a peak of 3.5% in the early 1980s (Chart 5). The share of household spending on fuels has also declined steadily over the past 20 years (Chart 6).

- Oil price hikes in 1973–74, 1979–80 and 1990 were all associated with armed conflicts in the Middle East. As well as disrupting oil supplies, wars might have an adverse psychological impact on the behaviour of households and companies. By contrast, the driving force behind the upturn in oil prices in 1999–2000 and 2004–05 was strong global demand for oil, particularly from the rapidly growing Chinese economy.

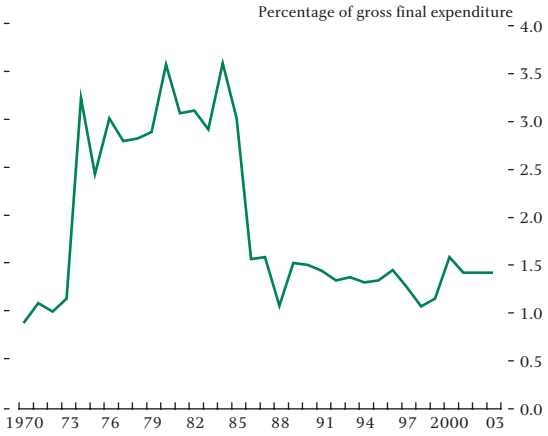
Chart 4
Oil price episodes (real sterling price level)



Note: I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: IMF IFS (Brent crude oil prices), ONS (UK RPI level) and Thomson Financial Datastream (US dollar exchange rate). All quarterly averages.

Chart 5
Nominal energy intensity (1970–2003)(a)



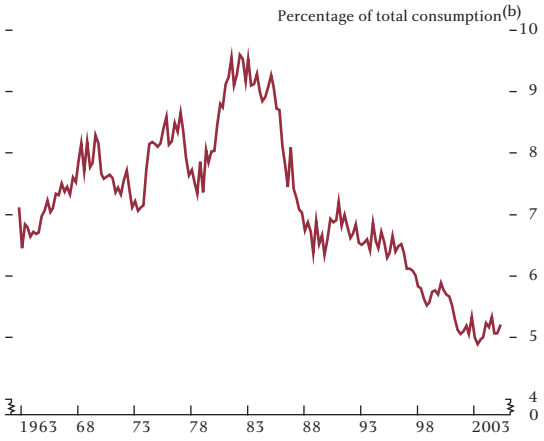
Sources: Bank calculations and ONS.

(a) Intermediate consumption of oil and gas as a share of gross final expenditure (excluding UK oil and gas production). This is not a measure of the share of energy in production, which would be better captured by intermediate consumption of oil and gas as a share of GDP value-added plus intermediate imports together, but no data for this are available back until the early 1970s.

The size and nature of the oil price shock are clearly important considerations. But so too are the mechanisms by which the shock gets propagated through the economy. Among other things, this depends on the state of the economy at the time the shock hits, the extent of rigidities in the economy, the monetary policy framework and the monetary policy response. It is to each of these that I now want to turn.

(1) Throughout this speech, I am referring mainly to the non-oil economy. The impact of higher oil prices on the overall economy is attenuated to some extent by virtue of the United Kingdom being a net exporter of oil until recently.

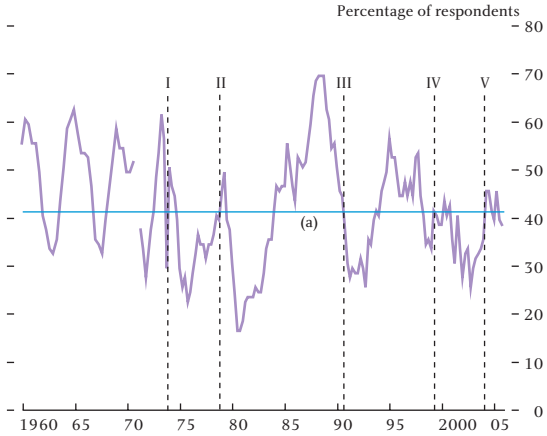
Chart 6
Household spending on fuel(a)



Sources: Bank calculations and ONS.

(a) Motor fuels plus household energy bills.
(b) Excludes non-profit institutions serving households (NPISH).

Chart 7
CBI data on capacity utilisation

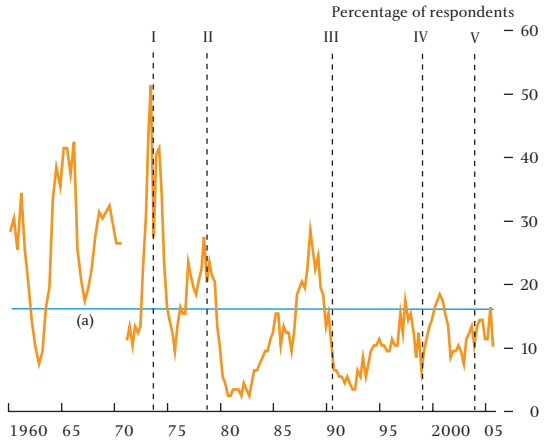


Note: Chart 7 presents the survey data in the form of one hundred minus the proportion of firms working below capacity, so that a higher percentage indicates a higher level of capacity utilisation. I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Source: *CBI Industrial Trends Survey*.

(a) Average values since 1960.

Chart 8
CBI data on skilled labour shortages



Note: Chart 8 shows the percentage of respondents indicating that the availability of skilled labour is a factor that may limit output over the following three months. I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Source: *CBI Industrial Trends Survey*.

(a) Average values since 1960.

The state of the economy at the time each oil shock hit

A closer look at Charts 1 and 2 suggests that, for some episodes, while the oil shock might have exacerbated the economic downturn and helped to boost inflation, it is hard to argue that it was the fundamental cause of either. In 1973, for example, the UK economy had peaked in the first half of the year, several months before the first oil shock hit. And although the economy went into recession around the time of the August 1990 shock, GDP growth had peaked 18 months earlier. The same is true of inflation. Retail price inflation began to rise in earnest during the second half of 1970, three years before the first oil shock hit. And it was on a rising trend from mid-1988, two years before the 1990 shock.

For the 1973–74 and 1990 episodes, there is plenty of evidence of excess demand in the economy prior to the oil shock that monetary policy was initially slow to respond to. Taking the *CBI Industrial Trends Survey* (Charts 7 and 8), for instance:

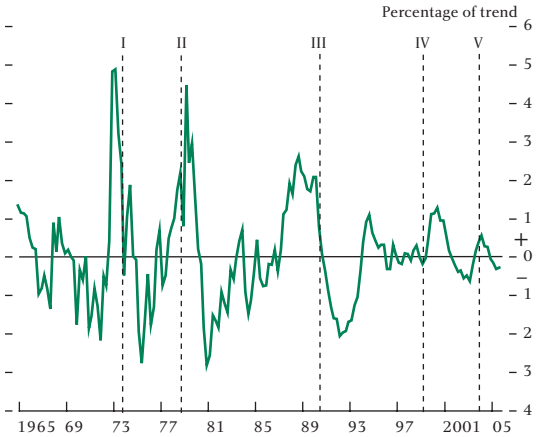
- Business optimism was running at unusually high levels from mid-1971 onwards. Employment intentions jumped sharply in early 1973 and remained extremely high throughout the year. Skilled labour shortages went through the roof during 1973 as did shortages of other labour. Meanwhile, official short-term interest rates hit a low of 5% in September 1971 and only began rising in June 1972, reaching 9% at the end of the year. They were then cut several times during the first half of 1973 to 7.5%, at a time when RPI inflation was running at about 9%. Subsequently, interest rates rose to 13% during the second half of 1973 but were then cut steadily during 1974 and early 1975 to a low of 9¾% in April 1975. Retail price inflation peaked at 27% in August 1975.

- Business optimism was running at a high level during 1987. Employment intentions were positive during 1988 (highly unusual for this series). Capacity utilisation was extremely high during 1988. Interest rates were cut on several occasions after the October 1987 stock market crash, hitting

a low of 7.5% in May 1988. They were raised progressively thereafter, reaching a high of 15% in November 1989, the level at which they stood when the August 1990 oil price shock hit.

Though the evidence of excess demand is clearest in these two episodes, the economy also seems to have been operating above potential at the time the 1978–79 oil shock hit. Chart 9 shows a time series for the output gap derived using the familiar Hodrick-Prescott filter to detrend real GDP. It suggests that output was well above trend prior to each of the first three oil shocks.(1)

Chart 9
Hodrick-Prescott filter estimate of the output gap



Note: Estimated using GDP at basic prices (1960–2005) and smoothing parameter = 1600. I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: Bank calculations and ONS.

By contrast, statistical estimates of the output gap and survey measures of capacity utilisation and labour shortages suggest that the economy has been operating fairly close to potential in recent years. Inflation expectations are less likely to be destabilised if an oil shock hits when the economy is operating close to normal capacity than if there were already considerable inflationary pressure in the system.

Real wage rigidity hinders the economy's adjustment to an oil shock

In the face of higher oil prices which raise firms' costs, the real consumption wage (ie the post-tax wage paid to workers deflated by consumer prices) must fall if firms are to maintain their profit share, and maintain employment. If workers resist the fall in the real consumption wage by bidding for higher nominal wages, thereby raising the real product wage in value added terms (ie the full cost of labour to firms divided by the price firms get for their product), the end result will be lower employment. The decline in employment will be reinforced if monetary policy is tightened in response to these so-called second-round effects on wages.

The extent to which the real consumption wage must fall depends on the size of the oil price change, the shares of oil and labour in gross output and the degree of complementarity between factors of production. Estimates of the required fall in the real consumption wage to maintain employment range from 1% to 2½%.(2)

There is evidence of real wage rigidity in the 1970s, partly because of the unfortunate timing of two wage accords.

- At precisely the time that the impact of the first oil shock was working through, Edward Heath's Conservative government introduced an incomes policy under which wages would be permitted to rise in strict proportion to increases in the cost of living above a specified threshold.(3) This was the first time that an incomes policy had contained a formal link between increases in pay and prices.

(1) Any statistical estimate for detrending GDP, such as the HP filter, can give misleading estimates of the output gap in real time if either the data are revised significantly or the subsequent evolution of the economy is significantly different from the recent past. For the first two oil shocks, the conclusion that real GDP was above trend holds even on the basis of the data available at the time. However, using the HP filter, policymakers could have been misled into believing that the economy was below trend when the 1990 oil shock hit. This is because the subsequent recession was so deep that it led to a significant re-estimation of the statistical trend in GDP in the run-up to the oil shock. Nelson and Nikolov (2003) provide evidence from policymakers' statements at the time that suggest they were routinely too optimistic about the extent of spare capacity during the 1970s and 1980s. Recent statistical estimates of the output gap should be treated with great caution.

(2) The range given for the required fall in the real consumption wage depends on how easily producers can compensate for higher energy prices by substituting away from energy. The smallest fall in the real wage would be generated if energy use could be flexibly adjusted so as to keep the energy share of gross revenue unchanged. A rough approximation in this case, see Rotemberg and Woodford (1996), would be that the fall in the real consumption wage is equal to the share of energy in gross revenue (say 1.5%) divided by one minus that share (98.5%) multiplied by the log change in the real energy price (69%). The largest fall in the real wage would be implied if instead the quantity of energy inputs had to be used in a fixed proportion to the output produced. Then, a rough approximation would be the share of energy (1.5%) divided by the share of labour (60%) in gross revenue multiplied by the percentage change in the energy price (100%). These calculations depend on estimates of the share of capital and imported non-energy intermediates in gross revenue.

(3) In the second stage of an incomes policy, effective from November 1973, pay increases of up to 7% were allowed, with various 'flexibility margins', plus flat rate increases of 40p per week for every 1% by which the rise in the cost of living exceeded 7%.

- In August 1979, the newly elected Conservative government accepted the Clegg Commission recommendation for staged pay increases for public sector employees of up to 26%. A further wedge was driven between the real product wage and the real consumption wage when the government financed a significant reduction in income tax by a large increase in VAT, adding 3½ to 4 percentage points to retail price inflation. Both factors contributed to a rapid rise in whole economy average earnings growth which peaked at over 20% in 1980.(1)

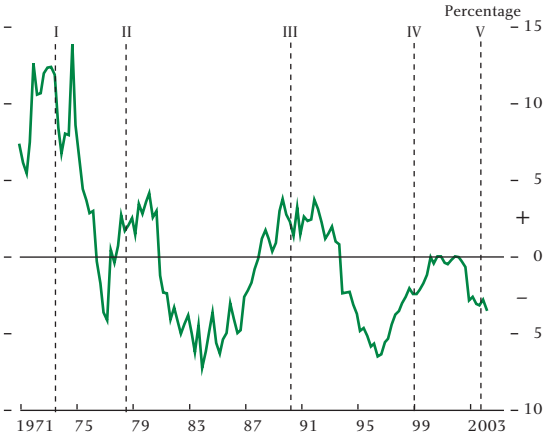
Sachs (1979) and Bruno and Sachs (1985) show that when consumer prices rise relative to the price of domestically produced goods (the GDP deflator at basic prices), the real consumption wage must grow less rapidly than labour productivity to maintain factor shares.(2)

In the first three episodes, the level of the real consumption wage was far higher than that consistent with keeping the real product wage share of employees at its market-clearing level, given trend movements in indirect taxes and benefits, terms of trade changes and productivity (Chart 10). This suggests that there was real wage resistance on these occasions. By contrast, there is no evidence of excessive real wages in the more recent episodes.

Not surprisingly, given these developments in real wages, both the actual and the equilibrium rate of unemployment rose substantially following the first three oil shocks (Chart 11). The decline in the equilibrium rate of unemployment over the past 15 years can be attributed to structural changes in the labour market as documented by Nickell (2001) — notably a decline in the power of trades unions, particularly in the private sector, and a fall in the generosity of unemployment benefits coupled with an increase in strictness of the benefit system. Judging by the broad stability of both actual unemployment and wage inflation, recent oil shocks do not seem to have disturbed the lower equilibrium unemployment rate.

Low and more stable rates of equilibrium unemployment are suggestive, though not conclusively so, of smaller real wage resistance. Stronger support for the latter is given by Faggio and Nickell (2005) who estimate, using

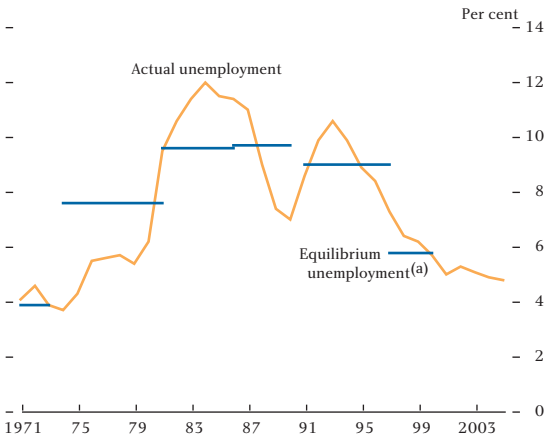
Chart 10
Real consumption wage relative to warranted level



Note: The actual real consumption wage is assumed to be a constant proportion of the warranted wage on average. The measure is centred on zero by adjusting for an estimate of that constant over the sample 1971–2005. The most recent estimates are sensitive to end-point bias (see footnote 1 on page 108) and have been omitted for this reason. I–1973 Q4; II–1978 Q4; III–1990 Q3; IV–1999 Q2 and V–2004 Q1.

Sources: Bank calculations and ONS National Accounts data on compensation.

Chart 11
Unemployment: actual and equilibrium rate



Sources: ILO and ONS.

(a) Estimates of the equilibrium rate of unemployment for 1971 to 2000 from Nickell (2001), for overlapping periods.

(1) As Chart 1 in Nickell (2006) shows, wage inflation responded almost immediately to the pickup in retail price inflation following the large rise in VAT announced in the June 1979 Budget.

(2) To see this, the labour share (S) is given by:

$$S = WL/PvV$$

where W is nominal wages, L is labour input, V is real value added (GDP) and Pv is the GDP deflator at basic prices. W/Pv is the real product wage which determines the demand for labour. Taking logs and differentiating, we have

$$\Delta S/S = \Delta W/W + \Delta L/L - \Delta Pv/Pv - \Delta V/V$$

Setting $\Delta S/S$ to zero to keep the labour share constant, adding and subtracting the consumer prices index (P_c) and rearranging:

$$\Delta P_c/P_c - \Delta Pv/Pv = (\Delta V/V - \Delta L/L) - (\Delta W/W - \Delta P_c/P_c)$$

a sample of employees from the New Earnings Survey, that the elasticity of wages with respect to unemployment has increased since the mid-1980s.

The monetary framework matters

Is it a coincidence that the inflationary effects of oil price shocks have been significantly smaller since the introduction of inflation targeting? There are several reasons to believe not.

First, and foremost, in the current monetary framework, the Monetary Policy Committee (MPC) will fight any deviation in consumer price inflation from the 2% target that threatens to be persistent. If inflation moves by more than 1 percentage point away from target, the Governor is required to write an open letter to the Chancellor explaining the reasons for this, the policy actions taken to bring inflation back to target and the period within which this is expected to occur. In a highly transparent inflation-targeting framework such as this, it is hard to see why inflation shocks should be highly persistent.

Second, and related to the first point, if the monetary framework is credible, inflation expectations are less likely to be dislodged in the event of a cost shock. Real wage resistance might be reduced if workers realise that the MPC will react to any attempt by workers to be compensated for the unavoidable loss of spending power in the event of an oil shock. Both factors lower the likelihood of second-round effects on wages, reducing the persistence of the inflation shock. There will also be a smaller hit to output if the MPC does not have to raise interest rates to rein in second-round effects.

Third, low inflation is typically less volatile. In a volatile inflation regime, unpredictable movements in costs and prices make it harder for employers to share information with their employees about the trading conditions they face. Wages might then become too closely linked to the general consumer price level. In more stable regimes, it is easier for firms and workers to distinguish the signals that matter for their own business, and to agree wages appropriately.

Fourth, because the monetary framework recognises that excess demand is the key cause of persistent inflationary pressure, it is less likely that the economy will be running a significant positive output gap when an oil shock hits. As documented by Nelson (2005), during the 1970s many politicians and economists believed that persistent, not just temporary, shifts in inflation were driven by special or 'cost push' factors, not excess demand. It was widely believed that these factors dominated the behaviour of inflation regardless of the course that monetary policy took.

Benati (2005) finds that inflation persistence is not an intrinsic structural feature of the UK economy; the behaviour of inflation seems to be related to the monetary regime in place. From an examination of the behaviour of inflation during different monetary regimes since the 17th century he concludes that inflationary shocks were only highly persistent in the period after the breakdown of the Bretton Woods system in June 1972 until sterling's departure from the exchange rate mechanism of the European Monetary System in October 1992. For much of this period, it is unclear exactly what the nominal anchor for the economy was.

How should monetary policy respond to an oil shock?

Under the Bank of England's remit, monetary policy has to stabilise consumer price inflation at 2% while trying to avoid unnecessary fluctuations in economic activity. Following any shock that moves inflation away from target and output from its normal level, the MPC's job is to work out how best — notably over what time period — to bring inflation back to target without causing undesirable volatility in output. The MPC sets interest rates accordingly and provides a justification for its actions in the published minutes of MPC meetings, and a more detailed explanation, including projections for GDP growth and inflation, in the quarterly *Inflation Report*.

Higher oil prices have posed a challenge for the MPC since, as has been evident over the past 18 months, they tend simultaneously to push up inflation and depress economic activity. Monetary policy has needed to be sufficiently 'tight' to prevent the inflationary impulse from the rise in oil prices becoming entrenched through second-round effects on wages and inflation expectations. At the same time, monetary policy has needed to be sufficiently 'easy' to avoid unnecessary negative effects on demand and output.

Higher oil prices have a fairly immediate impact on consumer price inflation working through higher petrol prices, heating bills and transport services.(1) Whether

(1) Between 2004 Q1 and 2005 Q3, consumer price inflation rose by 1.1 percentage points. Petrol, utilities and transport services accounted for around 0.8 percentage points of the rise. Thus oil-intensive elements of the CPI contributed 70% to the rise in inflation over this period.

the MPC needs to respond directly to this depends on the credibility of the monetary policy framework. If inflation expectations rise, nominal interest rates would need to rise by as much to maintain the stance of monetary policy. But if firms and households believe that the MPC will do whatever is necessary to keep inflation, on average, at 2%, there is little obvious need for the MPC to react to the first-round impact of higher oil prices since this is just a shift in relative prices.

Of course, monetary policy will only remain credible if the MPC consistently behaves in a manner that keeps inflation on target. An oil shock can have effects on supply and demand in the economy, both in the short run and the long run. It is the balance between supply and demand that matters most for inflation and, hence, interest rates.

There are several mechanisms by which demand might be reduced by higher oil prices, at least in the short term, without any help from monetary policy.

- High oil prices act like a tax, transferring money from consumers to oil producers, leaving many of us worse off. Since the price elasticity of demand for energy is fairly low, households will need to direct a greater proportion of their income to energy-related items and cut back on discretionary spending. Over time, this will be offset to some extent by higher spending by oil-producing countries on UK exports. Reflecting the United Kingdom's position as an oil producer, households will benefit from higher dividends by oil companies. The UK government is also a beneficiary of higher oil prices; higher oil-related taxes can be used to cut taxes elsewhere or boost public spending, providing support for demand.

- A large increase in oil prices may generate uncertainty both about the future outlook for oil prices and the economy as a whole. If the future is uncertain, households may decide to postpone spending on consumer durables and businesses may decide to postpone investment. Over time, though, high energy prices may act as a spur to spending on consumer durables and investment, as households and companies invest in cars and capital equipment that use energy more efficiently.

There are also several mechanisms by which potential output might be reduced by higher oil prices.

- An increase in oil prices increases companies' costs and, hence, the prices at which they are willing to supply their products. At higher prices there will be less demand, leading to lower output and employment for a time. This cyclical loss of output could become permanent if workers refused to accept a lower real consumption wage and, instead, bid for higher nominal wages to offset the rise in final goods prices.

- Higher oil prices may make some of the existing capital stock redundant or reduce the utilisation of capital. This would reduce for a time the growth of measured total factor productivity (TFP).(1)

- Higher oil prices may lead to a reallocation of resources within the economy. This may result in an underutilisation of resources and higher unemployment during the adjustment phase.

- If firms postpone investment decisions because of increased uncertainty, this will reduce temporarily the growth of the capital stock and the growth of potential output.

The magnitude and timing of these demand and supply effects are very hard to determine. Nevertheless, they are likely to be very important for the profile of the output gap and, hence, for inflation and interest rates.(2)

To illustrate this, suppose the economy is initially operating at normal capacity, ie there is a zero output gap, and is then hit by an adverse oil shock. Charts 12 to 14 show various stylised paths for demand (GDP) and supply (potential GDP) and the output gap.

- In case (i), the oil price shock is assumed to reduce potential GDP immediately. Unless aggregate demand falls in line with the reduced potential, a

(1) 'True' total factor productivity (TFP) should not be affected by a lower capital stock. But 'measured' TFP will typically be reduced because it is difficult for estimates of the capital stock or capital services to pick up the effects of scrapping.
(2) Hunt (2005), for example, reporting simulations from the International Monetary Fund's Global Economic Model, finds that energy price increases can result in significant disruptions to real economic activity and persistent inflation if the monetary authority underestimates the negative impact of an energy shock on the economy's supply capacity and there is real wage resistance.

Chart 12
Stylised output gap: case (i)

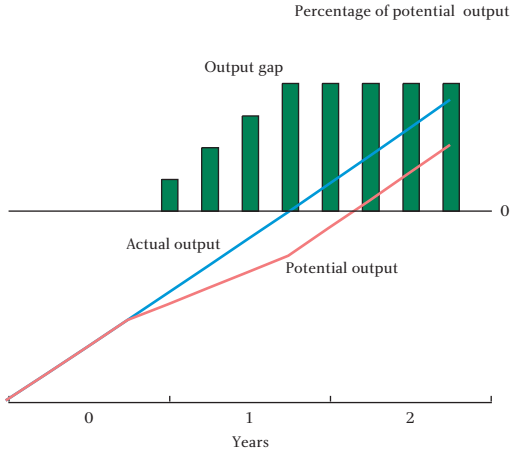


Chart 13
Stylised output gap: case (ii)

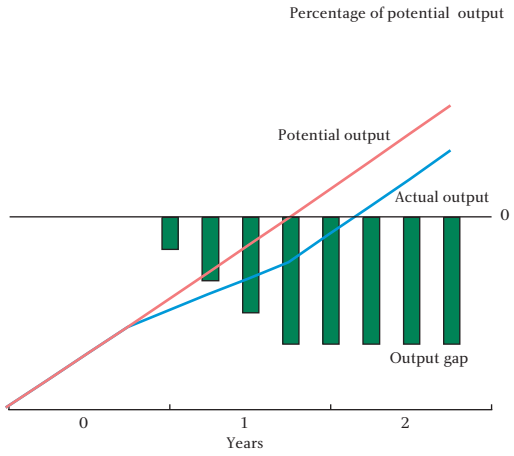
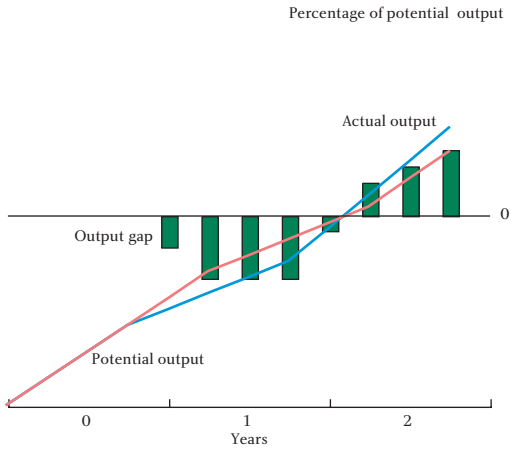


Chart 14
Stylised output gap: case (iii)



positive output gap would be generated, resulting in increased inflationary pressure. Other things equal, higher interest rates would be needed to reduce aggregate demand in line with supply.

- In case (ii), the oil price shock is assumed to reduce demand immediately. Unless potential GDP is also reduced, a negative output gap would be generated, resulting in reduced inflationary pressure. Other things being equal, lower interest rates would be needed to boost aggregate demand in line with supply.

- In case (iii), the negative demand effects are assumed to come through quickly then start to dissipate, while the negative supply effects build up gradually through time. In this case, interest rates might initially need to be lower to counteract the negative output gap but could end up higher as demand recovers and a positive output gap emerges.

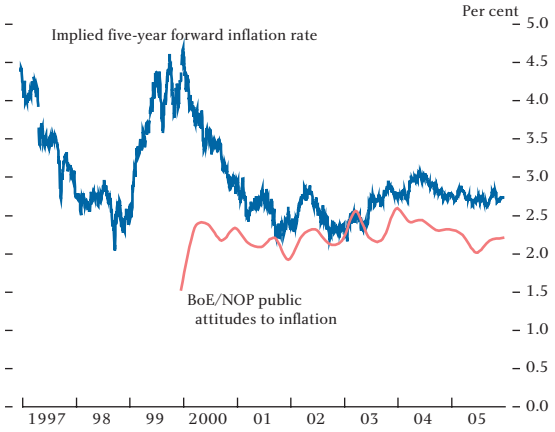
It should be clear from these stylised examples that there is no mechanical formula that can be applied to tell the MPC how to adjust interest rates to deal with higher oil prices. The appropriate monetary policy response will depend on the size and nature of the shock and how households and businesses react. There is a wide range of possible outcomes. Demand could conceivably soften too much if business and consumer confidence are damaged. Inflation expectations could become destabilised if inflation moves too far away from target. And some productive capacity could be lost permanently. Each of these will affect the chances of meeting the inflation target and, hence, the appropriate level of interest rates. As King (2005) argues, inflation targeting is the natural way to conduct policy when there is a great deal of uncertainty about the transmission of shocks to the economy; inflation targeting accommodates learning by both the private sector and policymakers.

Recent monetary policy considerations

Encouragingly, inflation expectations — whether measured from surveys, financial markets or pay settlements — have remained very stable over the past two years (Chart 15). This meant that the MPC did not need to respond directly to the first-round effects of higher oil prices on consumer price inflation.

With inflation expectations remaining stable, the MPC was able instead to pay more attention initially to the negative consequences for demand. A majority of the MPC felt that a 25 basis points repo rate cut to 4.5% was necessary in August 2005 to prevent inflation from undershooting the target in two years' time, particularly taking account of the downside risks to growth and inflation relative to the MPC's central projections. In

Chart 15
Inflation expectations remain stable



the first half of 2005, GDP growth had been more subdued than expected. The notable areas of weakness in demand were household spending on consumer durables and business investment, consistent with the idea that the uncertainty associated with higher oil prices had discouraged households and firms from committing to large items of expenditure. Since then, there have been signs of a pickup in the pace of economic activity to around its long-run average rate, though business investment remains weak.

It is also possible that the energy shock will have depressed temporarily the growth of potential output. In particular, labour productivity growth has ground to a virtual halt over the past year. While this may mostly reflect cyclical factors and a possible underrecording of output, it could also reflect a slower pace of capital accumulation and some capital scrapping. Both factors would reduce the degree of spare capacity for any given level of demand. Weaker demand growth over the past couple of years might therefore have been accompanied by weaker growth in potential supply. Consistent with this, there has not been much net change in capacity utilisation over this period according to business surveys.

And we do not yet know how large the shock will be ultimately. After dipping during the final months of last year, oil prices have been rising again in recent weeks. Wholesale gas prices have also risen sharply in recent months. In the *Inflation Report*, published on 15 February 2006, the Committee's central projection was for consumer price inflation to remain close to 2% over the next two years but there are substantial risks in both directions.

Conclusions

I have offered a number of reasons why the economy seems to have emerged relatively unscathed from a doubling in oil prices since the end of 2003. In summary:

The size and nature of the shock have been different. Relative to previous episodes, the shock has taken longer to unfold. The economy is also less dependent on oil than during the 1970s. And oil prices have risen as a consequence of strong global demand rather than as a result of supply disruptions associated with wars.

The UK economy has been better placed to absorb the current oil price shock. There were few inflationary pressures in the economy when oil prices first began to rise sharply, unlike on some previous occasions when there was clearly evidence of excess demand at the time the oil shock hit. There has also been little sign subsequently of higher wage demands. Structural changes have increased the flexibility of the labour market, reducing real wage resistance. This has been in marked contrast to the 1970s when, on occasions, real wage resistance seemed unwittingly to have become an objective of government policy.

The monetary policy framework has played an important role. Inflation targeting has helped to anchor inflation expectations, yet it has allowed the MPC to respond flexibly to the oil shock. With inflation expectations remaining stable, the MPC did not have to respond directly to the first-round effects of higher oil prices on consumer price inflation. The MPC was able instead to pay more attention initially to the negative consequences for demand. But the Committee also needs to watch carefully for any signs of an adverse impact on supply, particularly now that GDP growth appears to have returned to around its long-run average rate. At all times, the Committee's focus will be on trying to achieve the appropriate balance between demand and supply to keep consumer price inflation on track to hit the Government's target of 2%.

References

Benati, L (2005), 'UK monetary regimes and macroeconomic stylised facts', *Computing in Economics and Finance*, Vol. 107, Society for Computational Economics.

Bruno, M and Sachs, J (1985), *Economics of worldwide stagflation*, Basil Blackwell: Oxford.

Faggio, G and Nickell, S (2005), 'The responsiveness of wages to labour market conditions in the UK', *Labour Economics*, Vol. 12(5), October, pages 685–96.

Hunt, B (2005), 'Oil price shocks: can they account for the stagflation in the 1970s?', *International Monetary Fund Working Paper, WP/05/215*.

International Monetary Fund (2005), *International Financial Statistics Country Notes*.

King, M (2005), 'Monetary policy: practice ahead of theory', The Mais Lecture 2005, *Bank of England Quarterly Bulletin*, Summer, pages 226–36.

Nelson, E (2005), 'The great inflation of the 1970s: what really happened?', *Advances in Macroeconomics*, Vol. 5(1).

Nelson, E and Nikolov, K (2003), 'UK inflation in the 1970s and 1980s: the role of output gap mismeasurement', *Journal of Economics and Business*, Vol. 55(4), pages 353–70.

Nickell, S (2001), 'Has UK labour market performance changed?', speech given at the Society of Business Economists, 16 May.

Nickell, S (2006), 'Monetary policy, demand and inflation', speech given at the Bank of England's South East and East Anglia Agency, 31 January.

Rotemberg, J and Woodford, M (1996), 'Imperfect competition and the effects of energy price increases on economic activity', *Journal of Money, Credit and Banking*, Vol. 28(4), pages 550–77.

Sachs, J (1979), 'Wages, profits and macroeconomic adjustment: a comparative study', *Brookings Papers on Economic Activity*, Vol. 2, pages 269–319.

Bank of England speeches

Speeches made by Bank personnel since publication of the previous *Bulletin* are listed below.

Has oil lost the capacity to shock?
Speech by David Walton, member of the Monetary Policy Committee, at the University of Warwick Graduates' Association Senior Directors' Forum at the Commonwealth Club, London on 23 February 2006.
www.bankofengland.co.uk/publications/speeches/2006/speech268.pdf. Reproduced on pages 105–14 of this *Bulletin*.

Reform of the International Monetary Fund.
Speech by Mervyn King, Governor, at the Indian Council for Research on International Economic Relations (ICRIER) in New Delhi, India on 20 February 2006. www.bankofengland.co.uk/publications/speeches/2006/speech267.pdf. Reproduced on pages 83–89 of this *Bulletin*.

Monetary policy, demand and inflation.
Speech by Stephen Nickell, member of the Monetary Policy Committee. A shortened version of this speech was given at a private lunch in London for contacts of the Bank of England's South East and East Anglia Agency.
www.bankofengland.co.uk/publications/speeches/2006/speech266.pdf. Reproduced on pages 95–104 of this *Bulletin*.

Remarks by Rachel Lomax, Deputy Governor, at a Chatham House Conference on Global Financial Imbalances in London.
www.bankofengland.co.uk/publications/speeches/2006/speech265.pdf. Reproduced on pages 90–94 of this *Bulletin*.

Central bank communications: best practices in advanced economies.
Speech by Richard Lambert, member of the Monetary Policy Committee, at the IMF Sponsored Regional Seminar on Central Bank Communications in Mumbai, India. www.bankofengland.co.uk/publications/speeches/2006/speech264.pdf.

Speech at a Dinner for Kent business contacts in conjunction with the Kent Messenger Group/Kent Business.
Speech by Mervyn King, Governor, in Ashford, Kent on 16 January 2006.
www.bankofengland.co.uk/publications/speeches/2006/speech263.pdf. Reproduced on pages 80–82 of this *Bulletin*.

Monetary policy: significant issues of today.
Speech by Sir Andrew Large, Deputy Governor, to West London Business on 1 December 2005.
www.bankofengland.co.uk/publications/speeches/2005/speech262.pdf.

Contents of recent Quarterly Bulletins

The articles and speeches that have been published recently in the *Quarterly Bulletin* are listed below. Articles from November 1998 onwards are available on the Bank's website at www.bankofengland.co.uk/publications/quarterlybulletin/index.htm.

Articles and speeches (indicated S)

Winter 2004 (continued)
Stability and statistics (S)
Why is inflation so low? (S)
Monetary policy, data uncertainty and the supply side: living with the statistical fog (S)

Spring 2005
Dealing with data uncertainty
Indicators of short-term movements in business investment
Divisia money
Inside the MPC
The role of central banks in payment systems oversight
The Governor's speech to the CBI Dinner in Manchester (S)
The Governor's speech on the International Monetary System (S)
Why monetary stability matters to Merseyside (S)
Monetary policy in an uncertain world (S)
Why has inflation been so low since 1999? (S)
The housing market and the wider economy (S)

Summer 2005
The impact of government spending on demand pressure
How important is housing market activity for durables spending?
The inflation-targeting framework from an historical perspective
Monetary policy news and market reaction to the *Inflation Report* and MPC *Minutes*
Addendum to *Report on modelling and forecasting at the Bank of England*
Public attitudes to inflation
Chief Economist Workshop April 2005: exchange rate regimes and capital flows
Implementing monetary policy: reforms to the Bank of England's operations in the money market
A review of the work of the London Foreign Exchange Joint Standing Committee in 2004
Monetary policy: practice ahead of theory
The Mais Lecture 2005: speech by the Governor (S)
Inflation targeting in practice: models, forecasts and hunches (S)
Monetary policy, stability and structural change (S)
How much spare capacity is there in the UK economy?
Communicating monetary policy in practice (S)

Summer 2005 (continued)
Monetary policy in the United Kingdom — the framework and current issues (S)
A matter of no small interest: real short-term interest rates and inflation since the 1990s (S)

Autumn 2005
Assessing the MPC's fan charts
Long-run evidence on money growth and inflation
The determination of UK corporate capital gearing
Publication of narrow money data: the implications of money market reform
The Governor's speech at Salts Mill, Bradford (S)
The Governor's speech at the Mansion House (S)
Monetary policy making: fact and fiction (S)

Winter 2005
Introducing the Agents' scores
Do financial markets react to Bank of England communication?
Financial stability, monetary stability and public policy
Share prices and the value of workers
Stabilising short-term interest rates
The Governor's speech to the CBI North East annual dinner (S)
UK monetary policy: the international context (S)
Economic stability and the business climate (S)
Challenging times for monetary policy (S)
Monetary policy challenges facing a new MPC member (S)

Spring 2006
New information from inflation swaps and index-linked bonds
The distribution of assets, income and liabilities across UK households: results from the 2005 NMG Research survey
Understanding the term structure of swap spreads
The information content of aggregate data on financial futures positions
The forward market for oil
The Governor's speech in Ashford, Kent (S)
Reform of the International Monetary Fund (S)
Global financial imbalances (S)
Monetary policy, demand and inflation (S)
Has oil lost the capacity to shock? (S)

Bank of England publications

The Bank of England publishes information on all aspects of its work in many formats. Listed below are some of the main Bank of England publications. For a full list, please refer to our website www.bankofengland.co.uk/publications/index.htm.

Working papers

An up-to-date list of working papers is maintained on the Bank of England's website at www.bankofengland.co.uk/publications/workingpapers/index.htm, where abstracts of all papers may be found. Papers published since January 1997 are available in full, in portable document format (PDF).

No.	Title	Author
260	Financial constraints and capacity adjustment in the United Kingdom: evidence from a large panel of survey data *(May 2005)*	Ulf von Kalckreuth Emma Murphy
261	Default probabilities and expected recovery: an analysis of emerging market sovereign bonds *(May 2005)*	Liz Dixon-Smith Roman Goossens Simon Hayes
262	The impact of unsecured debt on financial distress among British households *(May 2005)*	Ana Del-Río Garry Young
263	The determinants of unsecured borrowing: evidence from the British Household Panel Survey *(May 2005)*	Ana Del-Río Garry Young
264	Liquidity risk and contagion *(May 2005)*	Rodrigo Cifuentes Gianluigi Ferrucci Hyun Song Shin
265	Asset pricing, asymmetric information and rating announcements: does benchmarking on ratings matter? *(June 2005)*	Spyros Pagratis
266	The determinants of household debt and balance sheets in the United Kingdom *(July 2005)*	Merxe Tudela Garry Young
267	Bank loans versus bond finance: implications for sovereign debtors *(July 2005)*	Misa Tanaka
268	Forecasting using Bayesian and information theoretic model averaging: an application to UK inflation *(July 2005)*	George Kapetanios Vincent Labhard Simon Price
269	Accounting for the source of exchange rate movements: new evidence *(August 2005)*	Katie Farrant Gert Peersman
270	A model of bank capital, lending and the macroeconomy: Basel I versus Basel II *(August 2005)*	Lea Zicchino
271	Consumption, house prices and expectations *(September 2005)*	Orazio Attanasio Laura Blow Robert Hamilton Andrew Leicester
272	What caused the early millennium slowdown? Evidence based on vector autoregressions *(September 2005)*	Gert Peersman
273	'Real-world' mortgages, consumption volatility and the low inflation environment *(September 2005)*	Sebastian Barnes Gregory Thwaites
274	The substitution of bank for non-bank corporate finance: evidence for the United Kingdom *(September 2005)*	Ursel Baumann Glenn Hoggarth Darren Pain
275	Wealth and consumption: an assessment of the international evidence *(October 2005)*	Vincent Labhard Gabriel Sterne Chris Young
276	Corporate expenditures and pension contributions: evidence from UK company accounts *(October 2005)*	Philip Bunn Kamakshya Trivedi
277	When is mortgage indebtedness a financial burden to British households? A dynamic probit approach *(October 2005)*	Orla May Merxe Tudela

278	Misperceptions and monetary policy in a New Keynesian model *(October 2005)*	Jarkko Jääskelä Jack McKeown
279	Monetary policy and private sector misperceptions about the natural level of output *(October 2005)*	Jarkko Jääskelä Jack McKeown
280	A quality-adjusted labour input series for the United Kingdom (1975–2002) *(October 2005)*	Venetia Bell Pablo Burriel-Llombart Jerry Jones
281	Monetary policy and data uncertainty *(November 2005)*	Jarkko Jääskelä Tony Yates
282	Stress tests of UK banks using a VAR approach *(November 2005)*	Glenn Hoggarth Steffen Sorensen Lea Zicchino
283	Measuring investors' risk appetite *(November 2005)*	Prasanna Gai Nicholas Vause
284	Modelling manufacturing inventories *(December 2005)*	John D Tsoukalas
285	The New Keynesian Phillips Curve in the United States and the euro area: aggregation bias, stability and robustness *(December 2005)*	Bergljot Barkbu Vincenzo Cassino Aileen Gosselin-Lotz Laura Piscitelli
286	Modelling the cross-border use of collateral in payment systems *(January 2006)*	Mark J Manning Matthew Willison
287	Assessing central counterparty margin coverage on futures contracts using GARCH models *(January 2006)*	Raymond Knott Marco Polenghi
288	The price puzzle: fact or artefact? *(January 2006)*	Efrem Castelnuovo Paolo Surico

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 website at www.bankofengland.co.uk/publications/other/externalmpcpapers/index.htm. The following papers have been published recently.

No.	Title	Author
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
12	Measuring the UK short-run NAIRU *(April 2003)*	Nicoletta Batini Jennifer Greenslade
13	UK consumers' habits *(May 2003)*	Ryan Banerjee Nicoletta Batini
14	National Accounts revisions and output gap estimates in a model of monetary policy with data uncertainty *(May 2005)*	Lavan Mahadeva Alex Muscatelli
15	Do financial markets react to Bank of England communication? *(December 2005)*	Rachel Reeves Michael Sawicki

Monetary and Financial Statistics

Monetary and Financial Statistics (*Bankstats*) contains detailed information on money and lending, monetary and financial institutions' balance sheets, banks' income and expenditure, analyses of bank deposits and lending, external business of banks, public sector debt, money markets, issues of securities, financial derivatives, interest and exchange rates, explanatory notes to tables and occasional related articles.

Bankstats is published monthly on the internet but paper copies are available on a twice-yearly basis. Paper copies are published for the January and July editions in hard copy on Wednesday 1 February 2006 and Tuesday 1 August 2006 respectively. The price per annum in the United Kingdom is £40, or £20 per copy. *Bankstats* is available on a monthly basis free of charge from the Bank's website at www.bankofengland.co.uk/statistics/ms/current/index.htm.

Further details are available from: Mark Thompson, Monetary and Financial Statistics Division, Bank of England: telephone 020 7601 4014; fax 020 7601 3208; email mark.thompson@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's website at www.bankofengland.co.uk/statistics/ms/articles.htm.

Title	Author	Month of issue	Page numbers
The statistical code of practice — a review of progress	Mick Bollan Nick Davey	January 2006	4–7
Cost benefit analysis workshop, 14–15 July 2005	Andrew Holder	January 2006	1–3
A method for examining revisions to published statistics	Alison Franklin	July 2005	20–21
Understanding the Bank of England's statistical requirements under International Financial Reporting Standards	Robert Westwood	June 2005	16–19
Consolidated external claims of UK-owned banks: a new dataset	Kerry Baker	June 2005	14–15

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 policymakers 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 and on the Bank's website at www.bankofengland.co.uk/publications/fsr/index.htm.

Payment Systems Oversight Report

The *Payment Systems Oversight Report* provides an account of how the Bank is discharging its responsibility for oversight of UK payment systems. Published annually, the *Oversight Report* sets out the Bank's assessment of key systems against the benchmark standards for payment system risk management provided by the internationally adopted Core Principles for Systemically Important Payment Systems, as well as current issues and priorities in reducing systemic risk in payment systems. Copies are available on the Bank's website at www.bankofengland.co.uk/publications/psor/index.htm.

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 Information and Enquiries Group, Bank of England, Threadneedle Street, London, EC2R 8AH and on the Bank's website at www.bankofengland.co.uk/publications/practicalissues/index.htm.

Handbooks in central banking

The series of *Handbooks in central banking* provide concise, balanced and accessible overviews of key central banking topics. The *Handbooks* have been developed from study materials, research and training carried out by the Bank's Centre for Central Banking Studies (CCBS). The *Handbooks* are therefore targeted primarily at central bankers, but are likely to be of interest to all those interested in the various technical and analytical aspects of central banking. The series also includes *Lecture* and *Research* publications, which are aimed at the more specialist reader. All the *Handbooks* are available via the Bank's website at www.bankofengland.co.uk/education/ccbs/handbooks/index.htm.

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. An update was published in September 2000 and is available free of charge.

The Bank of England Quarterly Model

The Bank of England Quarterly Model, published in January 2005, contains details of the new macroeconomic model developed for use in preparing the Monetary Policy Committee's quarterly economic projections, together with a commentary on the motivation for the new model and the economic modelling approaches underlying it. The price of the book is £10.

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.

Summary pages of the *Bulletin* from February 1994, giving a brief description of each of the articles, are available on the Bank's website at www.bankofengland.co.uk/publications/quarterlybulletin/index.htm.

The *Bulletin* is also available from National Archive Publishing Company: 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. It is also available at www.bankofengland.co.uk/publications/quarterlybulletin/contentsandindex.htm.

Bound volumes of the *Quarterly Bulletin* (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 *Inflation Report* is available at www.bankofengland.co.uk/publications/inflationreport/index.htm.

The *Report* starts with an overview of economic developments; this is followed by five sections:

- analysis of money and asset prices;
- analysis of demand;
- analysis of output and supply;
- analysis of costs and prices; and
- assessment of the medium-term inflation prospects and risks.

Publication dates

Copies of the *Quarterly Bulletin* and *Inflation Report* can be bought separately, or as a combined package for a discounted rate. Current prices are shown overleaf. Publication dates for 2006 are as follows:

Quarterly Bulletin		*Inflation Report*	
Spring	13 March	February	15 February
Summer	19 June	May	10 May
Autumn	25 September	August	9 August
Winter	11 December	November	15 November

Quarterly Bulletin and *Inflation Report* subscription details

Copies of the *Quarterly Bulletin* and *Inflation Report* can be bought separately, or as a **combined** package for a discounted rate. Subscriptions for a full year are also available at a discount. The prices are set out below:

Destination	2006					
	Quarterly Bulletin and *Inflation Report* package		*Quarterly Bulletin* only		*Inflation Report* only	
	Annual	Single	Annual	Single	Annual	Single
United Kingdom, by first-class mail (1)	£27.00	£7.50	£21.00	£6.00	£10.50	£3.00
*Academics, **UK only***	*£18.00*	*£5.00*	*£14.00*	*£4.00*	*£7.00*	*£2.00*
*Students, **UK only***	*£9.00*	*£2.50*	*£7.00*	*£2.00*	*£3.50*	*£1.00*
European countries including the Republic of Ireland, by letter service	£33.00	£9.00	£25.00	£7.00	£13.00	£4.00
Countries outside Europe: Surface mail	£33.00	£9.00	£25.00	£7.00	£13.00	£4.00
Air mail	£43.00	£12.00	£34.00	£9.00	£17.00	£5.00

(1) Subscribers who wish to collect their copy (copies) of the *Bulletin* and/or *Inflation Report* may make arrangements to do so by writing to the address given below. Copies will be available to personal callers at the Bank from 10.30 am on the day of issue and from 8.30 am on the following day.

Readers who wish to become **regular subscribers**, or who wish to purchase single copies, should send to the Bank, at the address given below, the appropriate remittance, payable to the Bank of England, together with full address details, including the name or position of recipients in companies or institutions. If you wish to pay by **Visa, MasterCard, Maestro or Delta**, please telephone 020 7601 4030. Existing subscribers will be invited to renew their subscriptions automatically. Copies can also be obtained over the counter at the Bank's front entrance.

The **concessionary rates** for the *Quarterly Bulletin* and *Inflation Report* are noted above in *italics*. **Academics at UK institutions** of further and higher education are entitled to a concessionary rate. They should apply on their institution's notepaper, giving details of their current post. **Students and secondary schools in the United Kingdom** are also entitled to a concessionary rate. Requests for concessionary copies should be accompanied by an explanatory letter; students should provide details of their course and the institution at which they are studying.

These publications are available from Publications Group, Bank of England, Threadneedle Street, London, EC2R 8AH; telephone 020 7601 4030; fax 020 7601 3298; email mapublications@bankofengland.co.uk.

General enquiries about the Bank of England should be made to 020 7601 4444.
The Bank of England's website is at www.bankofengland.co.uk.

Issued by the Bank of England Publications Group.

ISSN 0005-5166

Printed by Park Communications Limited

Printed on recycled paper