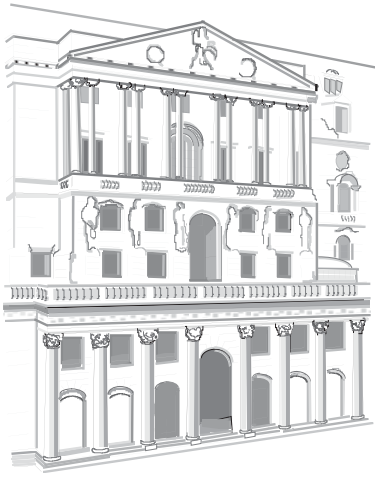
Bank of England Quarterly Bulletin



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The Quarterly Bulletin and Inflation Report

Inflation Report
(published separately)

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

Markets and operations
(pages 117–34)

This article reviews developments in international and domestic financial markets and describes Bank of England market operations in the period 30 December 1999 to 7 April 2000. It does not, however, repeat the review of developments over the century date change that was contained in the February 2000 *Quarterly Bulletin*. Official interest rates were raised by 50 basis points in the United Kingdom, the euro area and the United States during the review period. Nevertheless, market-based indicators of short-term interest rate expectations were little changed in all three areas. The US yield curve became inverted in January and early February, largely in response to news about changes in the prospective supply of US government securities. This development had relatively little impact on gilt yields, however. World equity markets became significantly more volatile during the period, with sharp falls in IT-related share prices occurring during March and early April. Exchange rate movements generally continued the patterns observed in 1999 Q4; the US dollar and sterling continued to appreciate, while the euro depreciated further.

The international environment
(pages 135–49)

This article discusses developments in the world economy since the February 2000 *Quarterly Bulletin*, as well as the outlook for output and inflation over the next two years. Forecasts of world economic activity in 1999 have been revised up repeatedly over the last twelve months, and GDP growth for the year as a whole is now estimated to have been around 3.5%. Underlying this, activity was stronger than was earlier forecast in a broad range of countries. Oil and related energy prices continued to rise up to the middle of March, when OPEC member countries agreed to increase production. Evidence of stronger inflationary pressures has been seen in producer input and output prices, and to some extent in export prices. But further along the price chain consumer prices have generally risen by considerably less, although there has been some pick-up in inflation measures in the United States and euro area. Since the February 2000 *Quarterly Bulletin*, official interest rates in the United States and the euro area have been raised by 0.25 and 0.5 percentage points respectively, and are now at 6% and 3.75%. The Bank of Japan has maintained the zero interest rate policy implemented in February 1999. According to almost all forecasters, the medium-term outlook is for continued strength in the world economy, and most projections for GDP growth have been revised up since the previous *Quarterly Bulletin*. It is now not untypical to see projections for world GDP growth to rise by somewhat less than 4.5% in 2000 and around 4% in 2001.

Research and analysis
(pages 150–67)

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

A comparison of long bond yields in the United Kingdom, the United States, and Germany
(by Martin Brooke of the Bank's Gilt-edged and Money Markets Division, and Andrew Clare and Ilias Lekkos of the Bank's Monetary Instruments and Markets Division).
Long-dated gilt yields are currently well below the comparable German and US government bond yields for the first time in many years. This article considers what factors are likely to have contributed to these changes in nominal rates of return. We conclude that much of the

decline in long gilt yields can be attributed to a decline in UK inflation expectations since the mid-1970s. However, we find evidence to suggest that gilt yields have more recently also fallen in response to a significant reduction in net gilt issuance combined with an increase in demand for gilts from UK institutional investors.

Money, lending and spending: a study of the UK non-financial corporate sector and households (by Andrew Brigden of the Bank's Structural Economic Analysis Division, Alec Chrystal of the Bank's Monetary Assessment and Strategy Division and Paul Mizen, consultant to the Bank's Monetary Assessment and Strategy Division). Many empirical studies over the past three decades or so have reported estimates of the determinants of consumption, investment and the demand for money. This article summarises recent Bank work that seeks to understand more fully the demand for bank and building society loans, and the interactions between these borrowings and the demand for money and decisions to consume and invest. This work aims to enhance our understanding of the links between the monetary sector and real spending decisions.

The contents page, with links to the articles in PDF format, is available at www.bankofengland.co.uk/qb/m00qbcon.htm
The speeches contained in the *Bulletin* can be found at www.bankofengland.co.uk/speeches

Markets and operations

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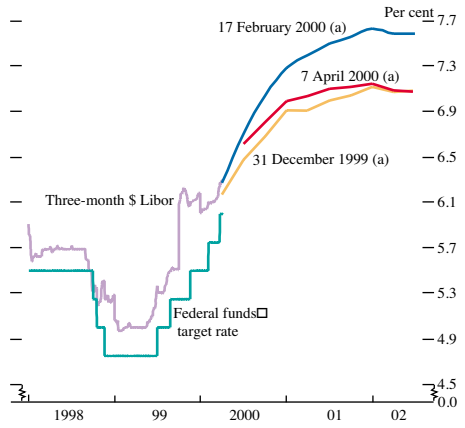
- *Official interest rates were raised by 50 basis points in the United Kingdom, the euro area and the United States during the review period. Nevertheless, market-based indicators of short-term interest rate expectations were little changed in all three areas.*

- *The US yield curve became inverted in January and early February, largely in response to news about changes in the prospective supply of US government securities. This development had relatively little impact on gilt yields, however.*

- *World equity markets became significantly more volatile during the period, with sharp falls in IT-related share prices occurring during March and early April.*

- *Exchange rate movements generally continued the patterns observed in 1999 Q4; the US dollar and sterling continued to appreciate, while the euro depreciated further.*

Chart 1
US interest rates



Source: Bloomberg.

(a) Interest rates implied by eurodollar futures contracts at the dates specified. From April 2000 onwards, the x-axis relates to contract expiry dates.

Table A
Consensus GDP forecasts for 2000

	January	March	Difference
United States	3.6	4.6	1.0
Japan	0.7	1.0	0.3
Euro area	3.0	3.2	0.2
United Kingdom	3.1	3.2	0.1

Source: Consensus Economics.

International markets

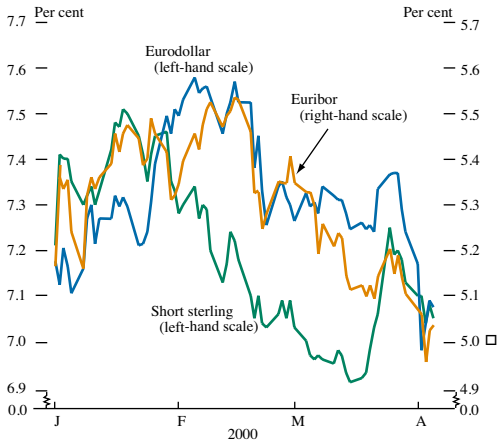
Short-term interest rates

United States

US short-term interest rates implied by eurodollar futures contracts expiring between 2000 and 2002 ended the period little changed from the end of 1999 (see Chart 1), indicating expectations of rates rising from around 6½% in spring 2000 to around 7% by the end of the year. Implied interest rates rose in the first half of the period, and declined thereafter (see Charts 1 and 2). Early in the year, market participants saw the smooth passage of the century date change as removing one possible constraint on monetary policy, making a rise in official interest rates more likely. In addition, the strength of the US economy continued to surprise markets during January; the December labour market and retail sales reports, consumer confidence, Q4 GDP and the employment cost index were all stronger than the markets had expected(1) and led interest rate expectations to rise. Outside forecasters generally revised up their forecasts for US GDP growth during the period as a whole (see Table A). By the end of January, most market participants were expecting the Federal Open Market Committee (FOMC) to raise the Federal funds target rate by 25 basis points at both its February and March meetings. Consequently, there was little reaction when it raised the Federal funds target and discount rates by 25 basis points on 2 February.

(1) Unless stated otherwise, data referred to as stronger or weaker than expected are relative to the median expectation of forecasts provided by market economists polled by the financial news information services.

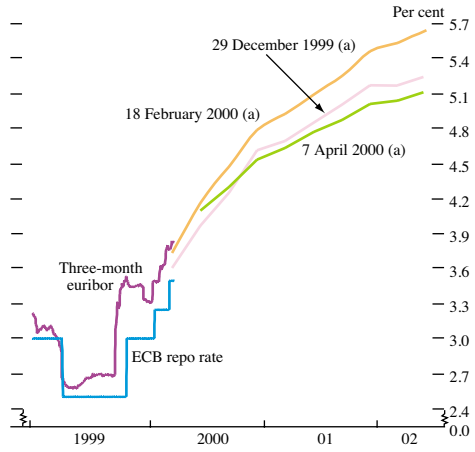
Chart 2
Futures interest rates(a)



Source: Bloomberg.

(a) Implied by March 2002 futures contracts.

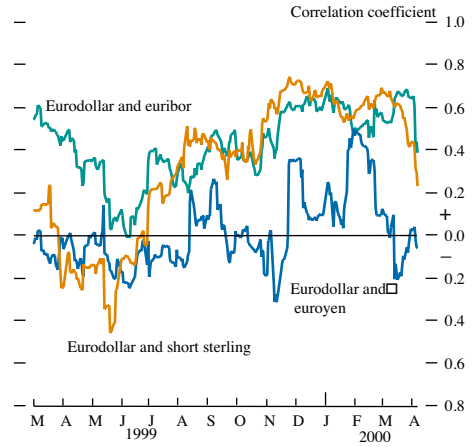
Chart 3
Euro-area interest rates



Source: Bloomberg.

(a) Interest rates implied by euribor futures contracts at the dates specified. From April 2000 onwards, the x-axis relates to contract expiry dates.

Chart 4
Correlations between futures contracts(a)



Sources: Bank of England and Bloomberg.

(a) 30-day rolling correlations between two year ahead futures contracts. Contracts expiring in June 2001, December 2001 and June 2002 were used.

The fall in longer-dated interest rates implied by eurodollar futures largely occurred in two phases: between 17 and 25 February, and around the beginning of April. The February decline reflected a number of factors. First, weaker-than-expected January PPI and CPI data were published on 17 and 18 February respectively. Second, a series of comments from Federal Reserve officials, including Chairman Greenspan's first-round Humphrey-Hawkins testimony on 17 February, were interpreted as reinforcing market expectations that official interest rates would be raised at forthcoming meetings, possibly obviating the need for larger rises in the longer term. And third, falls in equity prices encouraged some switching out of equities into fixed-income assets. There was little immediate market reaction to the 25 basis point rise in the Federal funds target and discount rates to 6.0% and 5.5% respectively at the FOMC meeting on 21 March. An abrupt upward move in implied interest rates occurred, however, following publication of the minutes of the February FOMC meeting on 23 March; market participants were surprised that some committee members had expressed a preference for an increase of 50 basis points in the Federal funds rate and had felt that further increases might be needed.

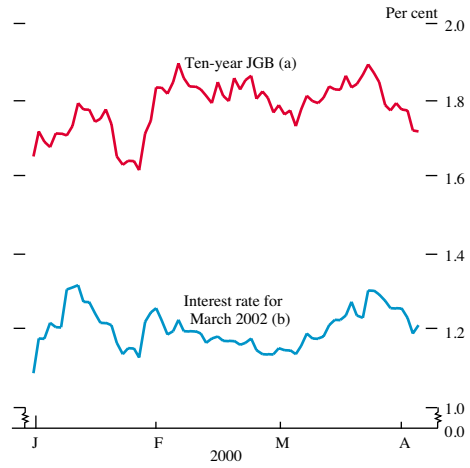
The fall in futures rates in late March and early April was again linked to equity price declines. The Nasdaq index fell by more than 9% between 31 March and 4 April, partly as a result of the antitrust court ruling against Microsoft.

Euro area

Movements in the euro-area money market yield curve were similar to those in the United States during the period (see Chart 2); implied futures interest rates rose until the middle of February and then fell through to 7 April. Overall, implied interest rates derived from euribor futures ended the period slightly lower than at the end of 1999 (see Chart 3), with the exception of very short rates. At the end of the period, the three-month rate was expected to rise by 65 basis points to around 4$^{1}/_{2}$% by December 2000. Chart 4 shows that the 30-day rolling correlation between daily changes in interest rates implied by eurodollar and euribor futures contracts was relatively high during Q1. As well as reflecting US influences, the rise in euro-area interest rate expectations in January was also related to a series of stronger-than-expected euro-area economic data releases; in particular, German manufacturing orders, French and German employment, German business sentiment, and French household consumption. These indicators led markets to anticipate higher official European Central Bank (ECB) interest rates. Market participants, however, had difficulty in correctly anticipating at which of its meetings the ECB would raise rates. For instance, prior to the ECB's 3 February increase, only a quarter of economists polled by Reuters had correctly forecast the 25 basis point rise in the refinancing rate to 3.25%.

While near-term interest rates implied by euribor futures remained stable in the second half of the review period, implied rates for September 2000 and beyond fell. This followed the publication of weaker-than-expected French and German industrial production data. Nonetheless, comments from ECB officials (including those

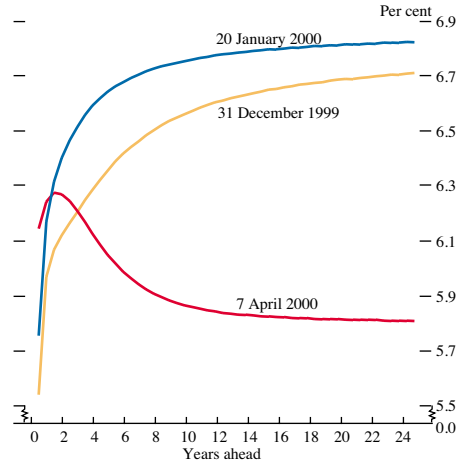
Chart 5
Japanese interest rates



Source: Bloomberg.

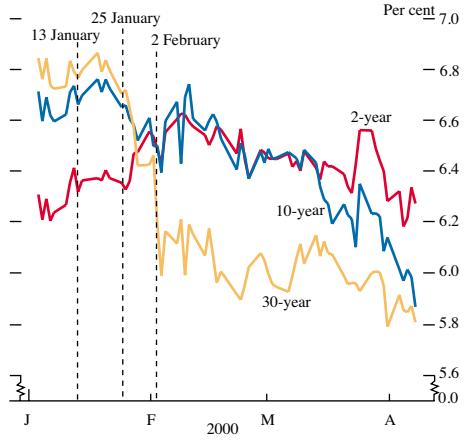
(a) Derived from Svensson par yield curve.
(b) Implied by the March 2002 euroyen futures contract.

Chart 6
US Treasury zero-coupon yield curve(a)



(a) Derived using the Svensson curve-fitting technique.

Chart 7
US Treasury yields(a)



(a) Derived using the Svensson curve-fitting technique.

made on 3 February),(1) a further decline in the value of the euro, and the steady rise in the price of crude oil to more than $30 per barrel in early March reinforced market expectations for higher official rates in the near term. On 16 March, implied interest rates from euribor contracts fell by 5–10 basis points after the refinancing, marginal lending, and deposit rates were raised a further 25 basis points to 3.5%, 4.5% and 2.5% respectively; some market participants had thought a 50 basis point rise possible.

Japan

Interest rates derived from euroyen futures contracts rose modestly during the first quarter (see Chart 5), largely in response to domestic conditions rather than international developments. The rise started in early January following a speech made by Bank of Japan (BoJ) Governor Hayami in late December, which market participants interpreted as suggesting that the zero interest rate policy might end sooner than previously thought. Later in January, however, the BoJ reaffirmed its zero interest rate policy. In the first half of March, publication of stronger-than-expected machinery orders and capital expenditure data led interest rate expectations to rise slightly.

Long-term interest rates

US Treasury yields of all maturities increased in the first few weeks of the year (see Chart 6), partly in response to the same factors that led to the rise in short-term interest rates. In addition, the unwinding of investment strategies aimed at avoiding potential Y2K market disturbances also contributed to the yield rise, as investors sold some of their holdings of 'safe-haven' Treasuries.

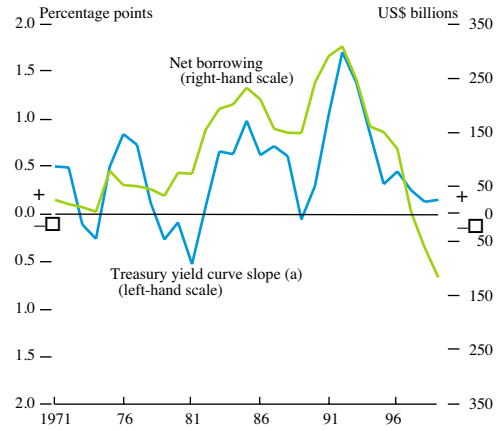
From 20 January onwards, however, medium and particularly longer-dated US Treasury yields fell sharply, producing an inversion of the yield curve from the two-year maturity onwards; 30-year yields fell by around 100 basis points between 20 January and 7 April (see Charts 6 and 7). The most likely explanation for the decline in long-duration yields was the change in the prospective supply of US government securities of that maturity.

In January and February there were a series of announcements suggesting that the supply of US government securities would be reduced. First, on 13 January, the Treasury released the details of its plans to repurchase $30 billion of Treasury notes and bonds in 2000 (approximately 1% of the total outstanding US Treasury debt stock).(2) Second, on 25 January, President Clinton announced that his 2001 budget submission would accelerate the pay-down of US Treasury debt; the US administration now plans to reduce its debt to zero by 2013, two years earlier than previously stated. And third, the Treasury's quarterly refunding announcement, made on 2 February, revealed significant cuts in the number and size of planned auctions at all maturities.

Since one of the stated objectives of the Treasury repurchase operations is to prevent an increase in the average maturity of US

(1) At a press conference, the ECB indicated that the decision to raise interest rates had been taken on the basis of the assessment of the risks to price stability arising from monetary and credit growth, and import, oil, and non-oil commodity price increases.
(2) The initial announcement suggesting the possibility of buying back Treasuries was made in August 1999.

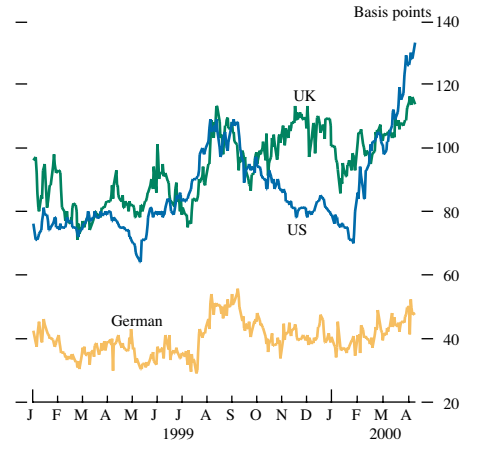
Chart 8
US Treasury yield curve slope and net government borrowing



Source: IMF.

(a) Ten-year Treasury yield minus three-year Treasury yield.

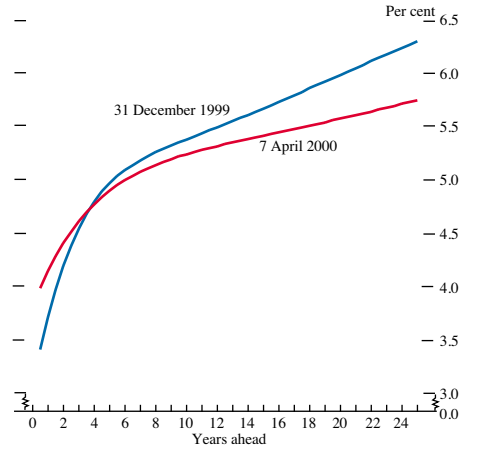
Chart 9
Ten-year swap spreads(a)



Source: Bloomberg.

(a) Calculated by subtracting the nominal par government bond yield from the same-dated swap rate.

Chart 10
German zero-coupon yield curve(a)



(a) Derived using the Svensson curve-fitting technique.

government debt,(1) the buy-back programme was expected to target securities with longer maturities. Consequently, after 20 January, yields fell by most at the longer end of the yield curve. In addition, Chart 8 suggests that there has historically been a relationship between net government borrowing and the slope of the yield curve, with the curve becoming more inverted as net borrowing declines. Two factors may help to explain this relationship. First, the government's fiscal position tends to improve, and net government debt issuance to decline, when economic growth is strong. Official short-term interest rates are often rising in such circumstances, pushing up the yields on short-maturity securities relative to those on longer-maturity bonds. And second, supply is a more powerful influence on yields at the longer end of the curve, given that there are relatively few readily available fixed-income substitutes and that very long duration bonds can only be generated through new issuance. In contrast, over the medium term, there is a ready supply of shorter-duration bonds, since the residual maturity of all bonds diminishes with the passage of time.

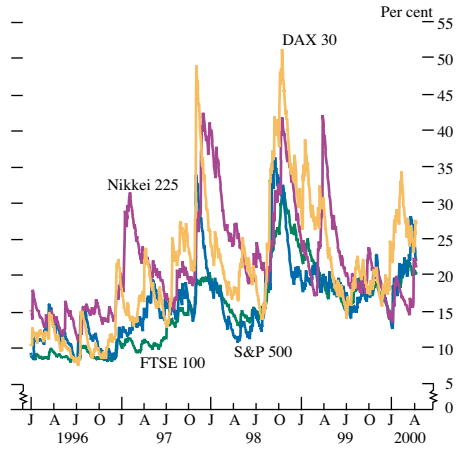
These changes in perceptions about the future supply of Treasuries have made it more difficult to derive reliable information about interest rate expectations from the Treasury market. In addition, the market now views Treasury notes and bonds as less reliable benchmarks for the pricing of other assets such as swaps and corporate bonds. Consequently, the swap curve has become the more widely used benchmark both for the pricing of other asset classes and for observing market interest rate expectations. Between 31 December and 7 April swap spreads over Treasuries increased by 10 basis points at the five-year maturity and by more than 50 basis points at the ten-year maturity (see Chart 9). A large part of this widening of spreads coincided with the fall in Treasury yields. Swap rates themselves were little changed at 10 and 30-year maturities over the period, and the five-year swap rate increased by around 10 basis points.

As in the United States, the euro-area yield curve flattened during the period (see Chart 10). Between 31 December and 7 April, the yield on two-year German government securities rose by around 10 basis points, while the 30-year yield fell by more than 50 basis points. Yields on shorter-maturity securities were influenced by similar factors to those that had moved euribor futures interest rates. At the same time, prospective falls in net issuance of euro-area government securities exerted downward pressure on yields at all maturities—government budget deficits for the euro-area economies are widely expected to continue to decline relative to GDP. Additionally, the sharp falls in the yields of longer-dated US Treasuries narrowed their spread over euro-area government securities of similar maturities, making the latter more attractive to market participants and causing the yield curve in the euro area to flatten further.

Yields on all maturities of Japanese government bonds (JGBs) rose modestly during the period, with the exception of very long-dated issues. By the end of the period, 10 and 30-year nominal yields stood at around 1.7% and 2.0% respectively. Throughout the quarter yields were influenced by supply considerations. For instance, yields rose after the sale of ten-year JGBs in early

(1) See US Treasury Secretary Summers' announcement on the introduction of debt buy-backs on 13 January 2000.

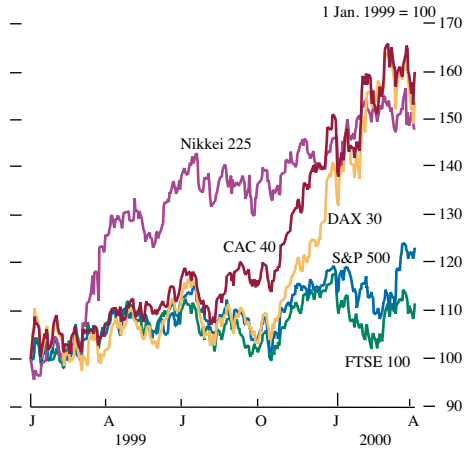
Chart 11
Volatility of international equity indices(a)



Sources: Bank of England and Primark Datastream.

(a) 252-day rolling exponentially weighted moving averages.

Chart 12
Selected world equity indices



Sources: Bank of England and Primark Datastream.

Table B
International equity market performance

Percentage changes from previous period, in local currencies

	1998	1999			2000
	Year	H1	Q3	Q4	Q1 (a)
United States					
S&P 500	26.7	11.7	-6.6	14.2	3.2
Dow Jones 30	16.1	19.5	-5.8	11.2	-3.4
Nasdaq	39.6	22.5	2.2	48.2	9.3
Europe					
CAC 40 (France)	31.5	15.1	1.2	29.8	5.9
Dax (Germany)	17.7	7.5	-4.3	35.1	8.1
Dow Jones Euro Stoxx 50	32.0	13.4	-3.1	33.6	7.2
FTSE 100	14.6	7.4	-4.6	14.9	-5.2
Japan					
Nikkei 225	-9.3	26.6	0.4	7.5	7.0

Source: Bloomberg.

(a) 31 December 1999–7 April 2000.

January; yields fell in the run-up to the sale of a five-year JGB in early February on market confidence that strong demand would emerge for the new stock, but rose afterwards on an unexpectedly low bid-to-cover ratio; and yields rose in the middle of March on news of a forthcoming ten-year JGB auction.

Equity market developments

World equity prices became more volatile in the first quarter, although they remained less volatile than in autumn 1998 (see Chart 11). The FTSE 100 index fell by more than 5% during the period. The performance of the other major market indices was mixed (see Chart 12 and Table B), with the Dow Jones falling and the S&P 500 posting a moderate increase, while the Nikkei, DAX and CAC indices all added to the strong gains they recorded in 1999 Q4. The Nasdaq index (which includes a relatively large number of IT stocks) and the smaller IT indices in Europe were particularly volatile, rising rapidly during January and February, and falling substantially during March and early April (see Chart 13).

The most recent upsurge in price volatility has been attributed to increasing investor uncertainty about the valuation of 'new economy' stocks (which are primarily in the IT, media and telecommunications sectors). Some investors have re-allocated their equity holdings towards 'old economy' stocks (ie the longer-established blue-chip firms). The volatility of technology stocks increased sharply in March and early April. On 3 April, the Nasdaq index posted its fourth-largest daily percentage price fall of the past 30 years (-7.6%), partly in reaction to the court ruling in Microsoft's anti-trust case. Daily price volatility was also high for the smaller European technology indices. Correlations between the prices of 'old economy' and 'new economy' indices fell sharply in the United States in the period to 7 April, but not in the other major markets.

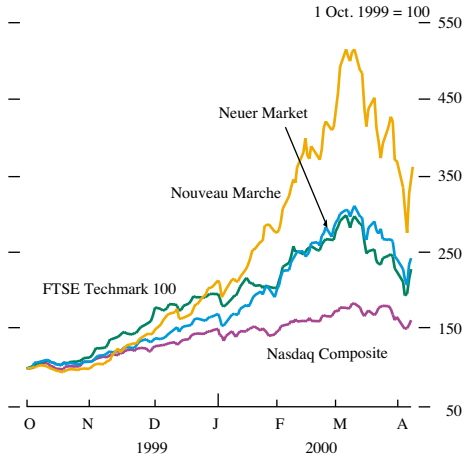
Much of the observed divergence between old and new economy indices over the past year can be attributed to strong investor appetite for Internet-related companies and a switch away from traditional value funds towards high-growth funds. However, a more detailed analysis of sub-indices reveals that the current asymmetries across industry sectors are not particularly unusual. For example, more than 20% of the FTSE All-Share index's 39 industry sectors showed positive 'excess' returns of 30% or higher during 1999.(1) But asymmetry was also prominent in the late 1980s—during 1985–89, 22% of the sectors had 'excess' returns of more than 30%, compared with 25% during 1995–99. The degree of asymmetry in 1999 was unusual, however; the average 'excess' return for the three best-performing sectors was 111% in 1999, well above the comparable returns in the 1986–89 period.

Several of the main indices changed composition during Q1, sometimes as a result of mergers (eg Vodafone-Mannesmann), in other instances following replacement of incumbent companies by new economy stocks.

On 7 April the FTSE 100 index closed at 6570, down 5.2% from its level at the end of December 1999; the All-Share index fell

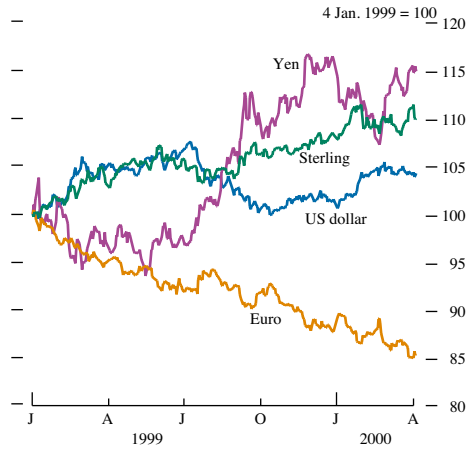
(1) Excess returns were calculated as the difference between the sectoral return and the main index return; the 30% cut-off was chosen arbitrarily.

Chart 13
Major IT indices



Sources: Bank of England and Primark Datastream.

Chart 14
Effective exchange rate indices



Sources: Bank of England and Bloomberg.

Table C
Ten-year swap rates

	Per cent		Change
	31 Dec. 1999	7 April 2000	(basis points)
United States	7.17	7.14	-3
Japan	2.04	2.01	-3
Euro area	5.79	5.66	-13
United Kingdom	6.49	6.32	-17

Sources: Bank of England and Bloomberg.

by 3.8% over the period. The heaviest losses were sustained by the forestry and steel and other metals sectors. However, small and medium-sized firms fared better—the FTSE 250 index ended the period 0.25% higher, while the SmallCap rose by 5.9%.

Foreign exchange markets

Over the period, the dollar and sterling trade-weighted exchange rate indices (ERIs) appreciated by 2.7% and 1.6% respectively; the yen ERI was volatile and ended the period 1.1% below its starting-level; and the euro ERI depreciated by 1.1% (see Chart 14). In terms of its main bilateral exchange rates, sterling continued to appreciate against the euro, moving below £0.6060 at the end of the period. At the same time, the pound depreciated slightly against the US dollar and the yen. The principal feature in sterling's appreciation over the period was thus the general depreciation experienced by the euro. Between the beginning of 1999 and 7 April 2000, the pound appreciated by 17.3% against the euro.

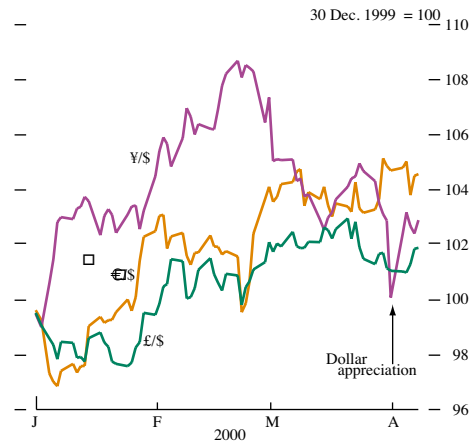
When foreign and domestic interest rate expectations are constant, and relative risk premia and equilibrium exchange rates are unchanged, nominal exchange rates might be expected to follow a path determined by existing interest rate differentials. For example, if sterling interest rates are higher than those abroad, sterling would be expected to depreciate, thereby ensuring that investors are indifferent between holding domestic and foreign currency denominated assets. In practice, however, exchange rate movements are often not consistent with the path implied by existing interest rate differentials, largely because of changing expectations of future interest rates and future equilibrium exchange rates.

As has already been mentioned, US market-determined interest rates at most maturities increased by more, or fell by less, than comparable interest rates in the United Kingdom and euro area, thereby widening interest rate differentials in favour of the United States. In addition, expectations of future UK interest rates as measured by futures contracts and swap rates generally fell by more than comparable euro-area interest rates, thereby narrowing the expected interest rate differential between UK and euro-area interest rates. Table C illustrates one measure of interest rate differentials, namely ten-year swap rates.

The widening in interest rate differentials in favour of the United States and the associated larger upward revisions to projections of US growth (see Table A) may help to explain why the dollar strengthened against all the other major currencies over the quarter (see Chart 15). Chart 16 shows that changes in the dollar-sterling exchange rate were particularly closely correlated with changes in interest rate differentials during the first quarter. By contrast, the euro's depreciation against both the dollar and sterling during the period appears to have been greater than can be explained by movements in interest rate differentials alone, suggesting that other factors were also important.

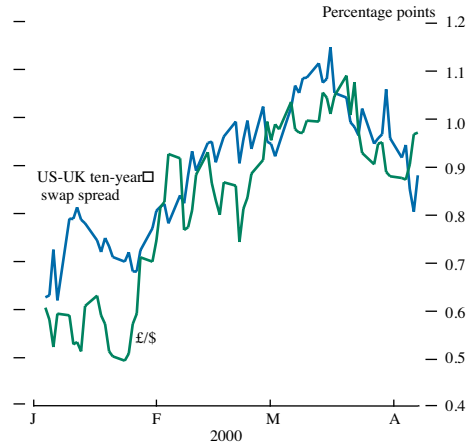
Taking a longer-term perspective, Chart 17 shows the extent to which cumulative changes in relative interest rate differentials may explain cumulative changes in the euro ERI. As can be seen, changes in interest rate differentials appear to have been only a

Chart 15
US dollar exchange rates



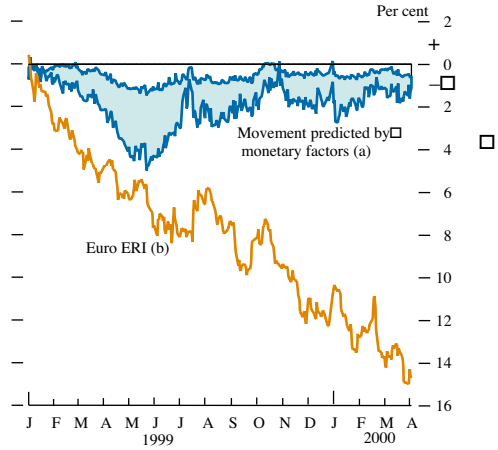
Sources: Bank of England and Bloomberg.

Chart 16
Movements in interest rate differentials and the £/$ exchange rate



Sources: Bank of England and Bloomberg.

Chart 17
Impact of monetary policy news on the euro ERI



(a) The width of the band is dependent on assumptions about the speed of the monetary transmission mechanism. For further details see the November 1997 *Quarterly Bulletin*, pages 377–89.
(b) Using an effective index including only the G7 countries.

weak explanatory factor. Considerations other than changes in interest rate differentials are therefore needed to explain the euro's depreciation. One such factor might be changes in the market's expectation of the long-run equilibrium exchange rate of the euro. Chart 18 compares the spot rate for euro-sterling against one-year Consensus forecasts for this exchange rate. Though forecasters seem to have been repeatedly surprised by the euro's depreciation, they have continued to expect the euro to appreciate. This suggests that the market expectation of the long-run equilibrium euro-sterling exchange rate remains higher than the spot rate. Nevertheless, longer-range forecasts suggest some tentative evidence of a downward revision to market expectations of the equilibrium value of the euro against the pound.

In addition, the euro's depreciation against the other major currencies may partly reflect a decrease in the relative willingness of market participants to hold euro-denominated assets. In particular, some market participants have reported a reduction over the quarter in the number of fund managers who were overweight in euro-denominated assets relative to their benchmarks (following a build-up of such 'long' positions in mid to late-1998). Many of these long positions in euro assets were adopted as part of portfolio reallocation strategies ahead of the introduction of the euro.

Market participants continue to identify foreign exchange flows from actual and anticipated cross-border mergers and acquisitions as important influences on sterling. However, the extent to which these flows were supportive of the pound in 2000 Q1 is ambiguous. In particular, the largest such transaction in the quarter was the agreed merger between Vodafone Airtouch and Mannesmann, which involved financing flows of around €170 billion. Given that Vodafone purchased Mannesmann, this deal might ordinarily have been expected to support the euro. However, the foreign exchange implications of this merger were complex and its impact consequently difficult to analyse.

Sterling markets

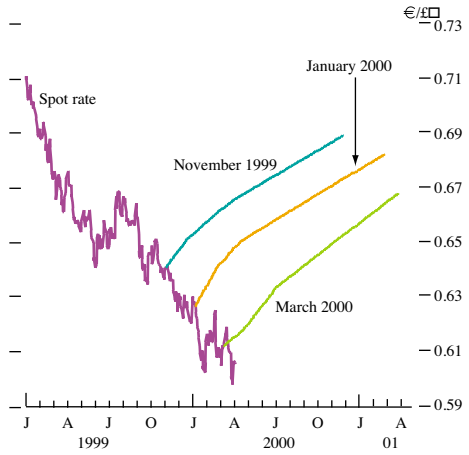
Short-term interest rates

The Monetary Policy Committee (MPC) raised the Bank's repo rate by 25 basis points on two occasions during the review period: on 13 January and on 10 February. The official rate was left unchanged after the March and April meetings.

Ahead of the January, February, and April meetings, there was some expectation, apparent in short-term interest rate futures and from survey evidence, that the Bank's repo rate would be raised. In the case of the January meeting, a fall in interest rates implied by short sterling contracts immediately after the decision suggests that some market participants were expecting a rate rise exceeding 25 basis points.

The decision by the MPC to raise the Bank's repo rate to 6% on 10 February, and the subsequent decision to leave the rate unchanged on 9 March, appear to have been largely anticipated by the markets at the time. Among the 34 private sector economists who participated in a Reuters poll ahead of the February meeting, there was a 72% mean probability attached to the prospect of a 25 basis point increase in the Bank's repo rate. Ahead of the March meeting, the equivalent probability attached to a no-change

Chart 18
Consensus forecasts for euro-sterling



Source: Consensus Economics.

Table D
Expectations ahead of MPC meetings

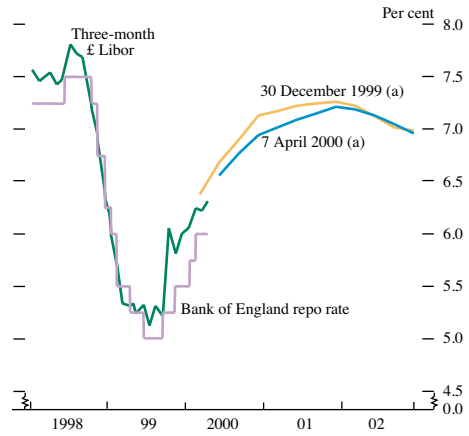
Basis points

MPC meeting	13 Jan.	10 Feb.	9 Mar.	6 April
Reuters poll mean expected rate change	+18	+18	+7	+11
Actual change in Bank repo rate	+25	+25	No change	No change
Market reaction: change in front short sterling implied rate (a)	-4	No change	No change	-4

Sources: Reuters and Bloomberg.

(a) Close of business on the day of the MPC decisions versus close of business the day before.

Chart 19
UK interest rates



Sources: Bank of England and Bloomberg.

(a) Interest rates implied by the short sterling futures contracts on the dates specified. From April 2000, the x-axis relates to contract expiry dates.

outcome was 71%. In each case, there was no price movement in the short sterling futures market immediately following the decision (see Table D).

Market participants were less certain, however, about the MPC's likely actions in April—expectations were split between no change and a 25 basis point rise, with a slight bias towards the former. A Reuters poll published ahead of the meeting attached a 58% mean expectation to no change. Reflecting this uncertainty, the decision to maintain the Bank's repo rate at 6% led to a small fall in short-term interest rates.

Despite the increases in the Bank's official rate and rising near-term interest rate expectations in the United States, yields implied by short sterling interest rate futures fell modestly during the review period (see Chart 19). A similar fall was also observed in forward yields derived from the gilt and gilt repo markets (see Chart 20).

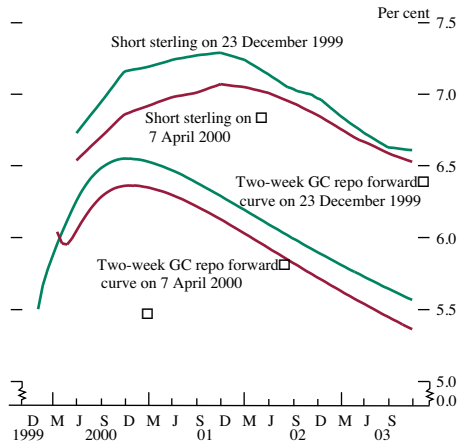
In the first two weeks of the year, sterling interest rate expectations increased, broadly in line with the United States and the euro area (see Chart 2). However, between 18 January and 20 March, there was a decline in UK rate expectations—the rate implied by the June 2000 short sterling futures contract fell by around 40 basis points, in contrast to comparable rates implied by US and euro futures contracts, which rose by 3 and 11 basis points respectively. Domestic considerations, therefore, had a strong influence on UK markets during this period. Much of the fall in sterling market interest rates related to a combination of weaker-than-expected price pressures (for example, the UK producer input price data on 14 February showed a fall of 1.0% in January against an expected rise of 0.2%); weaker-than-expected industrial and service sector output data; a sustained high level of sterling; and market interpretations of MPC minutes and the February *Inflation Report* (published on 17 February).

Money market rates fell after the publication of the minutes of the January MPC meeting when it was reported that eight members had voted for a rise of 25 basis points and one for a rise of 50 basis points. Market participants attached a somewhat stronger probability to the possibility of a 50 basis points rise. Similarly, the February *Inflation Report* was interpreted as suggesting that there were fewer rate rises in prospect than previously anticipated. Speeches by MPC members also influenced market interest rates. Furthermore, near-term interest rate expectations fell despite the stronger-than-expected January and February average earnings data.

In the second half of March, interest rates rose after the publication of the UK Budget and following a sharp rise in interest rates implied by eurodollar futures. Although the Budget was generally viewed as neutral in the short term, the market paid attention to the move towards net borrowing in 2002 and 2003. As a result of this and the rise in US interest rate expectations, rates implied by the 2001 and 2002 short sterling contracts rose by about 30 basis points in the week following the Budget (see Chart 2).

Chart 20 illustrates that gilt forward rates in maturities out to two years declined by less than implied rates from short sterling futures contracts of equivalent maturity over the review period, and also that the two markets continued to imply different levels for the peak in rates. Similarly, the fall in short sterling implied rates was

Chart 20
Short sterling futures and two-week GC repo forward curves



Sources: Bank of England and Bloomberg.

Table E
Summary of interest rate expectations (selected dates)

Per cent

	5 Jan.		29 Mar.		Change (basis points)
Dec. 2000					
Short sterling (a)	7.38		6.95		-43
Forward gilt yield (b)	6.68		6.47		-21
Poll of Economists (c)	6.32		6.43		+11
Dec. 2001					
Short sterling (a)	7.47		7.23		-24
Forward gilt yield (b)	6.54		6.28		-26
Poll of Economists (c)	6.10		6.06		-4
Peak					
Short sterling (a)	7.47	Dec. 2001	7.23	Dec. 2001	-24
Forward gilt yield (b)	6.70	2001 Q1	6.47	2001 Q1	-23
Poll of Economists (c)	6.52	2000 Q3/4	6.52	2000 Q2	0

Sources: Bloomberg and Reuters.

(a) Implied three-month Libor rate.
(b) Implied two-week forward rate.
(c) Implied official Bank of England repo rate.

not fully matched by revisions to economists' published forecasts of official interest rates (see Table E).

The differences between the movements are likely to relate to a number of factors, as short sterling futures, which are priced off three-month Libor, are prone to influences in addition to expectations of the Bank's official repo rate (which is a two-week secured rate). These include:

- credit risk (short sterling contracts use unsecured Libor rates as a benchmark);
- the amount of hedging of interest rate risk (which may vary over time);
- risk aversion and the degree of uncertainty about future interest rates; and
- futures market liquidity.(1)

Between end-January and end-March, both the published data and market anecdote suggest that the last three of these influences contributed to much of the convergence of implied interest rate expectations.

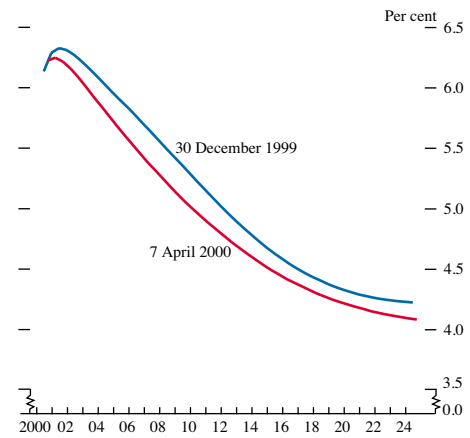
The process through which market participants use the short sterling market (or close-substitute derivatives) to hedge assets, and the associated impact on term interest rates, is complicated. Over the review period, some market contacts noted that there was a shift in household preferences away from fixed-rate mortgages to variable-rate mortgages. When there is an increase in the demand for fixed-rate mortgages, the mismatch between mortgage lenders' assets and liabilities generally increases, as these institutions are largely funded by floating-rate liabilities. Mortgage lenders may choose to offset the associated interest rate risk by either selling short sterling contracts, or by conducting an equivalent transaction in a similar derivative (for example, interest rate swaps or forward-rate agreements). Other things being equal, this process will result in upward pressure on short sterling implied rates. Over the period, contacts reported a fall in such hedging activity, which was said to have alleviated the upward pressure on implied futures rates.

Market contacts also note that the desire to hedge is greater when uncertainty about future interest rates is high and when official rates are expected to rise. Furthermore, the impact of hedging activity on interest rate futures is usually greater in the short term if the market is illiquid.

In addition to the fall in average interest rate expectations in Q1, there was also an underlying decline in interest rate uncertainty. For example, the implied volatility of the short sterling futures contract 18 months ahead (a measure of the market uncertainty derived from option prices) fell by more in Q1 than did the equivalent contract in 1999 Q4. There was also a rise in the number of short sterling futures contracts being traded, which may suggest there was some increase in liquidity. As an illustration, the total number of contracts outstanding in the short sterling market

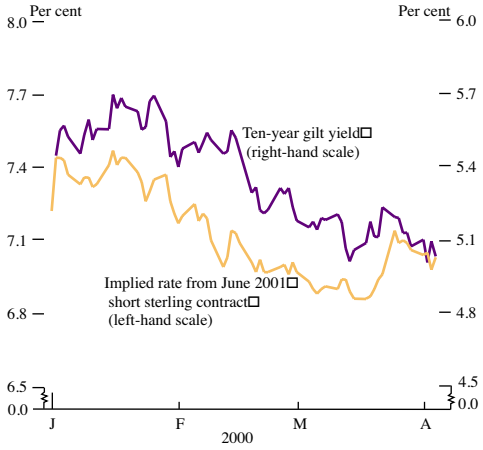
(1) The liquidity of close-substitute derivatives, such as interest rate swaps, is also important.

Chart 21
Gilt yield curve(a)



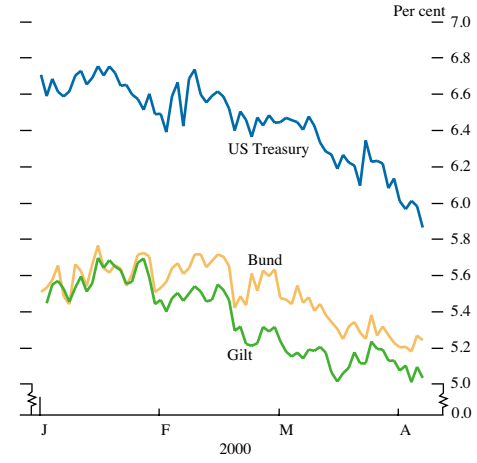
(a) Derived using the Bank's VRP curve-fitting technique.

Chart 22
UK interest rates



Sources: Bank of England and Bloomberg.

Chart 23
Ten-year bond yields(a)



(a) Derived from Svensson curve-fitting technique.

(open interest) increased by 10% over 2000 Q1, whereas it fell by 22% during 1999 Q4. Similarly, turnover in short sterling contracts was 15% higher in 2000 Q1 than in 1999 Q4. While the liquidity picture in Q4 was undoubtedly influenced by the transfer of the short sterling futures market from open outcry onto LIFFE's electronic trading platform, and by the approach of the millennium date change, it seems reasonable to conclude that liquidity in the short sterling futures market improved in Q1.

Long-term interest rates

The gilt yield curve shifted down by around 15 basis points over the review period (see Chart 21). Ahead of the Budget and the Debt Management Report (DMR), both published on 21 March, changes in bond yields were predominantly influenced by domestic news about expectations of future nominal interest rates and, on occasion, international developments. Bond yields reacted to the data and MPC-related news mentioned in the short-term interest rate section above, and were highly correlated with movements in short-term rates (see Chart 22).

Influential international events included the decline in euro-area bond yields that followed the ECB's decision to raise their official rate by 25 basis points on 16 March, and the rise in US interest rate expectations that followed the publication of the February FOMC minutes on 23 March. However, the supply-related news about the US Treasury bond market had little impact on the gilt market (see Chart 23).

There were three further items of UK-specific news relating to the supply and demand for gilts that influenced gilt yields over the review period. The first of these was the Appeal court ruling against the Equitable Life Assurance Society on 20 January, which deemed that it was unlawful for an insurer to reduce bonuses to policyholders opting for their guaranteed annuity. This led many market participants to anticipate a higher associated demand for long gilts from life assurance companies, thereby putting downward pressure on long gilt yields.

The other two supply-related influences were the Budget and the Debt Management Report. At the short end, gilt yields were influenced by two pieces of news. First, the planned move to net borrowing by the government in 2002/03 led to a rise in interest rate expectations and an associated increase in short gilt yields. This was partially offset, however, by the intention noted in the DMR not to issue short-dated gilts in financial year 2000/01 (see Table F).

Medium and long-dated gilt yields rose because the DMR included a larger-than-expected figure for gross gilt issuance in the next financial year (£12.2 billion against an average expectation prior to the Budget of about £11 billion), and was more heavily skewed to long-dated maturities than the market had anticipated. Two aspects of the government's financing plans were not fully anticipated by the market: first, the Debt Management Office (DMO) will be refinancing foreign currency borrowing that matures in the next financial year by additional gilt issuance (amounting to £3.5 billion); and second, the DMO plans to buy back some relatively less liquid stocks (£3.5 billion in value) in the three to eight-year part of the curve.

Table F
Government financing in 2000/01

£ billions

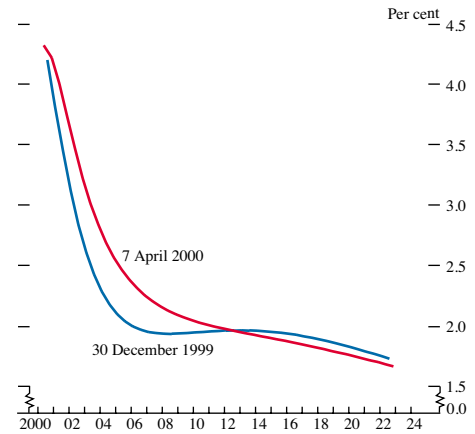
General government net cash requirement forecast	-4.9
Expected net financing of official reserves (a)	3.5
Gilt redemptions	18.6
Debt buy-backs	3.5
Gilt sales residual from 1999/2000	-9.5
Financing requirement	11.2
Less net financing from:	
National Savings	-0.8
Treasury Bills and other short-term debt (b)	-0.2
Gross gilt sales required	12.2
of which:	
Ultra-short conventionals (1–3 years)	0
Short conventionals (3–7 years)	0
Medium conventionals (7–15 years)	2.2
Long conventionals (>15 years)	6.5
Index-linked gilts	3.5

Note: Figures may not sum due to rounding.

Source: Debt Management Report, 21 March 2000.

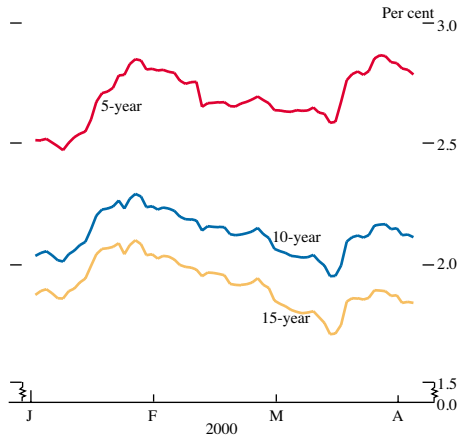
(a) The reserves require financing in 2000/01 to replace €2 billion of euro notes, €2.5 billion of eurobonds and expiring forward contracts.
(b) Financing of cash deposits at the Bank of England.

Chart 24
Index-linked gilt yield curve(a)



(a) Derived using the VRP curve-fitting technique.

Chart 25
Selected index-linked gilt yields(a)



(a) Derived using the VRP curve-fitting technique.

Gilt yields increased following the Budget and the DMR: between 20 and 22 March, the 5-year benchmark gilt yield rose by 6 basis points, the 10-year yield by 12 basis points and the 30-year yield by 9 basis points.

Index-linked gilts

Real yields on index-linked gilts(1) rose for short and medium-dated maturities (see Chart 24), in contrast to the fall in conventional gilt yields over the same period. The difference between the two is reported by market participants to have been more closely related to technical factors rather than to any change in inflation expectations. At the long end of the real yield curve, yields fell by about 5 basis points, slightly less than the fall in long-dated conventional yields.

There was one index-linked auction during the period (see below). Market contacts noted an adjustment in portfolios ahead of the issue, which, in addition to the rise in nominal interest rate expectations at that time, appeared to raise index-linked yields across the curve (see Chart 25). Contacts reported that the rise in short-dated index-linked yields probably also reflected the weakness in the 2% Index-linked Treasury Stock 2006 bond. Demand for this bond has declined ahead of next year, when it will fall out of the benchmark index for index-linked bonds of five years' maturity and above used by institutional investors.

There were two further supply-side influences on the index-linked gilt market during the review period, both of which supported real yields. First, the comparatively low real rates encouraged two companies to issue sterling index-linked bonds in late March (see below); and second, the DMR indicated a higher level of planned issuance (£3.5 billion) of index-linked bonds than the market had anticipated. Despite these supply influences, however, long-term real yields have remained low due to the sustained demand from institutional investors.

Gilt auctions

The conventional auction originally scheduled for 29 March 2000 was cancelled following confirmation of the reduced financing requirement in the November 1999 Pre-Budget Report. However, an auction of £350 million 2½% Index-linked Treasury Stock 2024 was held on 26 January and a switch auction was held on 9 February, in which £1.5 billion of (nominal) 8% Treasury Stock 2015 was exchanged for £1.6 billion of 6% Treasury Stock 2028. This helped to meet the strong institutional demand for ultra-long gilts and slightly extended the average duration of outstanding conventional gilts from 8.7 to 8.8 years.

Other sterling bond issues

Gross sterling bond issuance (other than gilts) was £14.9 billion in Q1, broadly similar to the £14.6 billion issued in Q1 last year, and nearly 40% higher than in 1999 Q4 (see Chart 26). Issuance had been quite subdued in Q4, though was still higher than expected, as some borrowers had either brought forward or delayed their funding to avoid uncertain market conditions at the year-end. Bond issuance increased steadily from late January as improved interest rate sentiment pushed corporate yields down. Within the Q1 total,

(1) As generated by the Bank's VRP curve-fitting technique.

Chart 26
Sterling non-government bond issuance

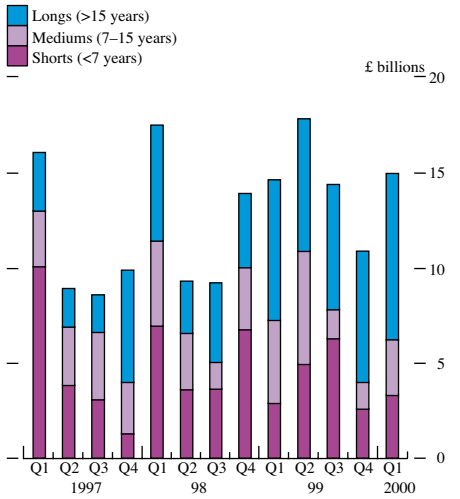
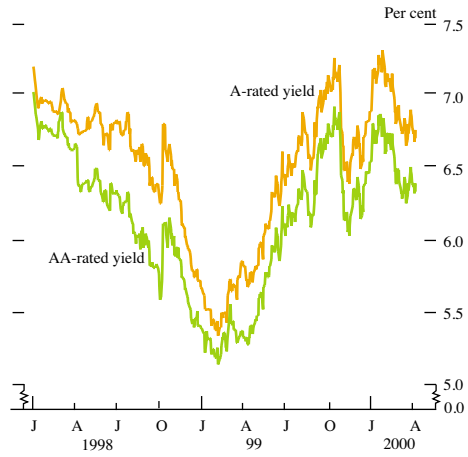


Chart 27
Ten-year corporate yields



Source: Bloomberg.

Table G
Sterling bond issuance in 2000 Q1

	Number of issuers	Amount (£ billions) Total	By credit rating: AAA	AA/A	BBB/ and below
Fixed-rate issues					
UK corporates	17	3.5	0.7	1.5	1.3
UK financials	12	2.1	0.1	1.4	0.6
Supranationals	4	2.2	2.2	0.0	0.0
Overseas borrowers	29	4.1	2.2	1.6	0.3
Total	**62**	**11.9**	**5.2**	**4.5**	**2.2**
FRNs					
UK corporates	3	0.2	0.1	0.1	0.1
UK financials	7	1.9	1.1	0.8	0.0
Overseas borrowers	4	0.9	0.0	0.9	0.0
Total	**14**	**3.0**	**1.2**	**1.8**	**0.1**

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

fixed-rate issuance was £11.9 billion and floating-rate issuance was £3 billion. Both amounts were very similar to their levels in Q1 last year.

The largest part of Q1 sterling bond issuance was of longer-dated maturities (£8.7 billion), with medium and short issuance more subdued at £2.9 billion and £3.3 billion respectively. Issuers have tended to sell more long-dated bonds over the past year (see Chart 26), as the limited supply of long-maturity gilts has encouraged demand for corporate bonds.

Fixed-rate sterling bond issuance by UK firms in Q1 totalled £5.6 billion, around three quarters of its level in 1999 Q1. Part of the reason for this decline may have been the rising cost of bond finance over the past year (see Chart 27). Furthermore, domestic borrowers did not substitute floating-rate for fixed-rate debt issues—floating issuance by domestic firms totalled £2.1 billion in Q1, £600 million less than in Q1 last year (see Table G).

Overseas issuers were more active in the sterling market in Q1. They issued £6.3 billion of bonds (see Table G), compared with £3.6 billion a year ago; about £1 billion of this was by US companies to fund UK operations (including Ford, Heinz, Procter and Gamble, and McDonalds). Swap spreads also encouraged issuance by AAA-rated supranationals that can issue in sterling and then enter the swap market to receive fixed income at a higher rate than they have to pay on their own fixed-rate sterling debt (see the box on pages 130–31 which explains how the currency swap process works).

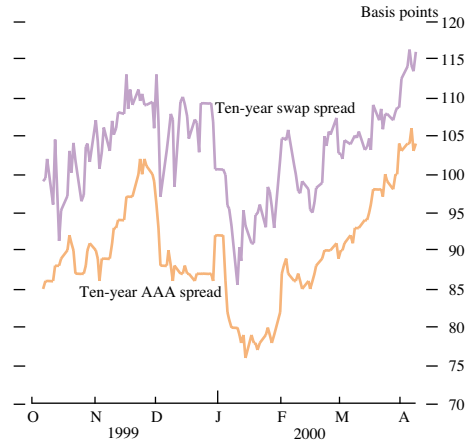
UK companies issued proportionately more in the euro and dollar bond markets. In Q1, domestic firms issued the combined equivalent of £11.4 billion in these two markets, almost 50% more than their issuance in the sterling market (see Table H). In contrast, in Q1 of last year, UK firms raised about two thirds of their bond financing in the sterling market. Some of the explanation for the increase in foreign currency issuance this year relates to Vodafone's acquisition of Mannesmann. To part-finance this deal, Vodafone issued three US dollar denominated bonds equivalent to £3.3 billion. Euro issuance was similarly boosted by the Royal Bank of Scotland raising debt (equivalent to £0.5 billion) to help finance its purchase of NatWest. Issuance in other currency markets may also be a complement, rather than a substitute, for sterling bond issuance. For example, UK companies may be seeking to hedge their euro or dollar-denominated assets or income streams. The building-up of European and US operations will tend to increase the incentive for UK firms to raise some of their financing in euros and dollars.

Chart 28 compares the ten-year yield for AAA-rated issuers with that for gilts. The spread started to fall in late December, as concerns about disruptions to financial markets over the year-end diminished. The spread then remained steady through most of January. Through the rest of Q1, gilt yields fell by more than corporate yields and the spread widened. Market participants suggested that this mainly reflected the lack of supply of UK government bonds. Swap spreads followed a very similar trend, with rising spreads attributed to conditions in the gilt market rather than perceptions about the credit quality or risk aversion of swap market participants.

Table H
Bond issuance by UK firms

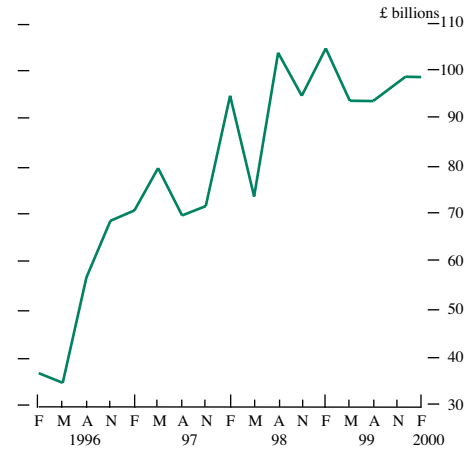
	Sterling or sterling equivalent, in billions:		
	US $ bond market	Euro bond market	Sterling bond market
1998	8.9	3.8	20.2
1999	8.9	10.9	33.5
1999 Q1	1.6	3.7	10.8
Q2	3.4	0.4	11.2
Q3	1.1	3.5	7.3
Q4	2.8	3.3	4.2
2000 Q1	7.0	4.4	7.7

Chart 28
Ten-year credit spreads versus gilts



Source: Bloomberg.

Chart 29
Gilt repo outstanding



Source: Bank RSL quarterly survey.

The relatively low level of yields on index-linked gilts (the ten-year yield, for example, has been some 190 basis points below the equivalent yield on a US Treasury inflation-linked bond) encouraged a few companies to issue inflation-linked debt in March (two companies issued £400 million in total). These bonds are especially attractive to discretionary fund managers who are able to buy a wider variety of assets than just index-linked gilts, with the corporate inflation-linked bonds yielding as much as 200 basis points more than the equivalent-maturity index-linked gilts.

Gilt repo

According to the Bank's latest survey, the size of the gilt repo market was little changed between the end of November 1999 and the end of February 2000, with the amount outstanding having fallen by £1 billion to £99 billion (see Chart 29). Within the total, however, there was a re-balancing towards shorter-maturity transactions. In particular, the amounts outstanding for one to three-month maturity gilt repo fell by £7 billion while the outstanding stock of overnight repo increased by £9 billion. Market participants said that the November data had been influenced by Y2K factors. The recent decline in the amounts outstanding of one to three-month maturities reflected a return towards historically more normal levels. Similarly, the spread between GC repo and interbank rates at three months' maturity fell to 10–20 basis points during the review period, having widened to more than 50 basis points in November as a result of Y2K-related considerations.

Market operations

Open market operations and sterling Treasury bill issuance

The stock of money market refinancing held at the Bank averaged £13 billion in January; daily money market shortages averaged £1.4 billion, up from £0.7 billion in December (see Chart 30). The shortages were generally small in the first half of the month and there were money market surpluses on two days. In February, the stock of money market refinancing was unusually high at £22 billion; consequently, the average daily money market shortage rose to £2.3 billion.

Two factors contributed to the rise in the size of the daily shortages in the second half of January and February: the seasonal rise in the government's tax receipts (see the CGNCR data in Table I) and the maturity of the Bank's longer-term repo facility. The latter had been available from mid-October in order to reinforce market confidence that liquidity provision would be sufficient over the year-end. Consequently, in 1999 Q4 the Bank had provided almost £8 billion of the stock of money market refinancing at a maturity of three months, rather than the usual two weeks. When these longer-term repos were due to mature in January and February, the Bank offered market participants the facility to roll over the refinancing into February and March to aid their liquidity management; there was, however, no demand for this facility.

In anticipation of the larger shortages in January and February, the Bank withdrew the one-month Treasury bill tender from 30 December 1999. The size of the three-month Treasury bill tender remained at £100 million a week throughout Q1 (see Table J). Following the redemption of £5 billion of 9% Conversion Stock 2000 on 3 March, the stock of money market

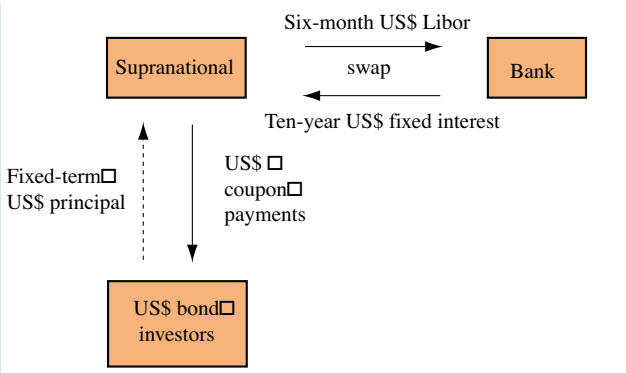
International funding arbitrage

Sovereign, supranational and large corporate bond issuers are able to issue debt in a range of different currencies and use swaps to convert the associated cash flows into other currencies. Since the Russian debt crisis of 1998, swap spreads—the spread of swap rates over government bond yields—have been highly variable and wider in some currencies—notably sterling—than in others. This led some commentators to argue that it may be cheaper to issue sterling bonds and use interest rate and cross-currency swaps to convert the liability to the currency the issuer desires than to issue directly in that currency.

This box investigates the factors that should determine the choice of currency for the bond issuer. In theory, funding arbitrage should ensure that the common-currency costs to a debt issuer of raising funds should be the same, irrespective of the currency in which it chooses to denote its bonds. In reality, however, there can sometimes be cost advantages from issuing debt in one currency and simultaneously swapping the associated cash flows into the currency of choice. This type of arbitrage can occur, for example, if an issuer is less well known to investors in one bond market than in another, or if one market becomes 'saturated' by the issuer. Funding arbitrage is therefore most likely to hold for large and well-known issuers, such as governments, supranationals and multinational firms.

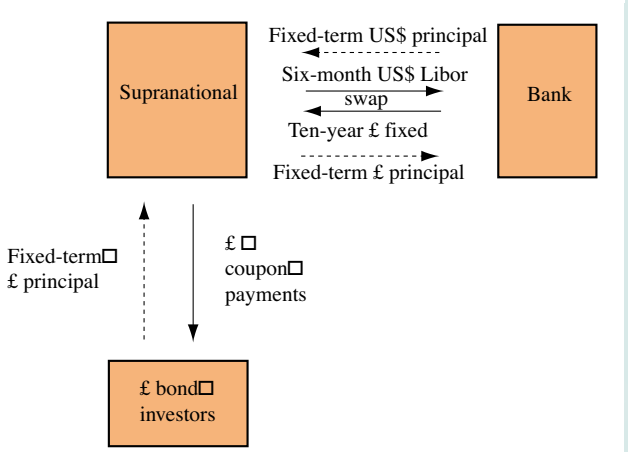
To illustrate, assume that a supranational wished to issue ten-year debt and acquire a floating-rate US dollar (US$) liability. One option would be to issue a ten-year fixed-rate dollar bond and simultaneously enter into a fixed-for-floating US$ interest rate swap, in which it would receive the fixed ten-year swap rate and pay the floating six-month US$ Libor rate. This arrangement is shown in Figure 1. The spread over US$ six-month Libor at which the institution would secure funding would be determined by the difference between the fixed (par) rates paid on the bond and received on the swap.

Figure 1
US$-denominated bond issue with fixed-for-floating US$ interest rate swap



Option 2, portrayed in Figure 2, would be to issue a fixed-rate sterling bond and simultaneously enter into a cross-currency fixed-for-floating interest rate swap in which the supranational would receive the fixed swap rate in sterling and pay floating US$ six-month Libor (in dollars).

Figure 2
Sterling debt with cross-currency fixed-for-floating interest rate swap



This arrangement is essentially equivalent to combining a standard £ fixed-for-floating interest rate swap with a cross-currency basis swap. A basis swap is a contract that exchanges six-month £ Libor (sterling) payments for six-month US$ Libor (dollar) payments, with an exchange of sterling and dollar principals at the start and end of the contract. Although, in theory, the basis swap should cost nothing as each side of the swap will have the same initial present value, in reality there may be a small cost related to market demand and supply conditions and to reflect the broker's spread.

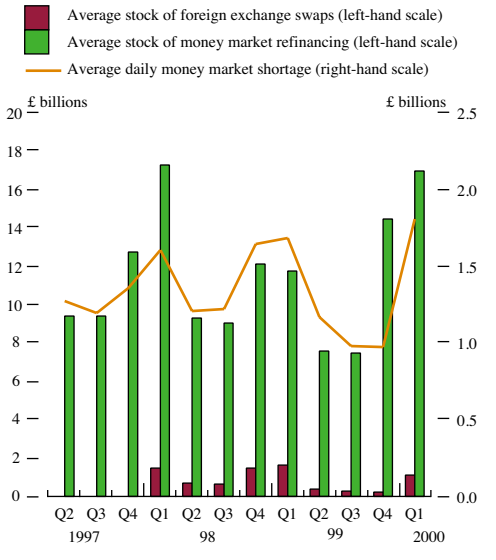
In both cases the supranational ends up paying US$ Libor. But every six months it also receives the difference between the agreed ten-year swap rate and the coupon rate on the issued bond. For a high-quality issuer this is often a positive amount meaning that the institution achieves floating-rate funding below US$ Libor, ie Libor minus X, where X is the difference between the swap rate and the par yield at issuance. The key point is that the currency of issue should be chosen on the basis of the difference between the swap rate and the coupon rate the institution would have to pay on a par bond issue in each currency. Choosing to issue in the currency with the largest X and then using swaps results in the cheapest funding. The spread of the swap rate

over the respective government bond yield is not relevant to the calculation.

To compare the relative costs of securing floating-rate US$ funding for particular supranational issuers, one can look at traded £ and US$-denominated bonds (with no embedded options) issued by supranationals. When a fixed-rate bond is trading at face value, its coupon represents, by definition, the par yield on the bond. We assume that new debt can be issued on the same terms as existing debt. Then, by comparing the par rate on the bond with the par rate received on a same-currency fixed-for-floating interest rate swap of identical maturity, one can derive the cost of arranging floating-rate funding (relative to the reference floating Libor rate) in the currency of issue. By adding the costs associated with entering a cross-currency floating-for-floating basis swap, one can in turn obtain the relative cost of achieving floating-rate funding in the other currency.

Performing this exercise for a number of £ and US$ supranationals' bonds with maturity dates between 2007 and 2010, one can calculate the costs of arranging seven to ten-year US$ six-month floating-rate finance over a number of 'snapshot' dates at which the bonds traded at (or very close to) par. Such calculations generally suggest that the capital market appears to be relatively efficient in the sense that it does not allow large funding arbitrage opportunities to exist for long. Although both swaps spreads and the spreads of high-quality issuers' bond yields over government bond yields change over time, for each currency they tend to track each other closely so that the spread between the swap rate and the par yields remain similar across currencies. Where, temporarily, they do not, an opportunity opens for securing cheaper funding by issuing in one currency and simultaneously entering into a currency swap. Such funding arbitrage opportunities, however, can be expected to disappear as bond issuers exploit them.

Chart 30
Stock of money market refinancing and daily shortages



refinancing fell to an average of £16 billion in March. Daily money market shortages averaged £1.7 billion (see Chart 30).

As in December, short-dated interest rates generally traded somewhat below the Bank's repo rate during the first half of January, largely as a result of relatively small money market shortages. But from the second half of January to mid-March, the sterling overnight index average (SONIA) and the two-week GC repo rate traded closer to the Bank's repo rate (see Chart 31). Towards the end of March, there was a further period in which short-dated market rates traded somewhat below the Bank's repo rate. The Bank responded to this development by increasing slightly the amount by which it was prepared to leave the market short after the 9.45 am round of operations, even when the available refinancing was fully bid by market participants. This led to a narrowing of the spread between short-dated market rates and the Bank's repo rate.

Foreign exchange swaps are also used by the Bank to supply liquidity to the sterling money market (mostly when the money market shortages are large). A daily average of £1.1 billion was outstanding during the quarter (see Chart 30).

The Bank's counterparties continued to make use of euro-denominated eligible securities in Q1. These accounted for an average of 10% of the collateral taken by the Bank in its open market operations during January, February and March (see Chart 32).

The one-month Treasury bill tender was reintroduced from 10 March (see Table J) in order to facilitate a higher stock of Treasury bills in market hands on 3 April, the date of the transfer of responsibility for Exchequer cash management to the DMO (see below). Demand for Treasury bills continued to be strong over the quarter—cover at the tenders averaged around seven times the amount of bills on offer. The average yields were around 13 and 21 basis points below LIBID for the one-month and three-month bills respectively.

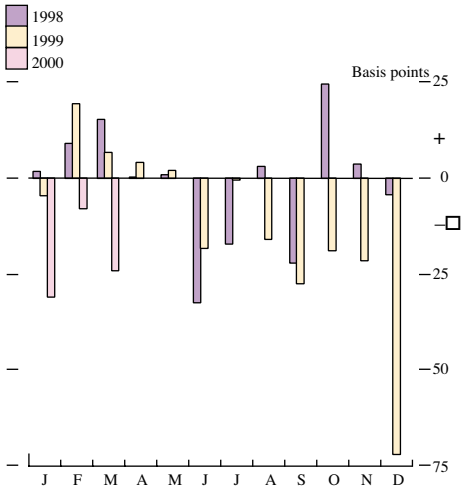
Table I
Influences on the cash position of the money market

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

	1999	2000		
	Apr.–Dec.	Jan.	Feb.	Mar.
CGNCR (+)	5.5	-17.1	-1.9	3.8
Net official sales of gilts (-) (a)	-3.8	-0.4	0.1	5.5
National Savings (-)	0.8	0.0	0.0	0.1
Currency circulation (-)	-7.8	6.5	0.2	-2.1
Other	-1.6	3.2	-1.2	1.5
Total	**-6.8**	**-7.9**	**-2.7**	**8.8**
Outright purchases of Treasury bills and Bank bills	-0.7	0.8	0.0	-0.7
Repos of Treasury bills, Bank bills, EEA bonds, and British Government stock and non-sterling debt	8.9	1.7	3.7	-4.6
Late facilities	-0.3	0.7	-0.7	0.1
Total refinancing	7.9	3.1	3.0	-5.2
Foreign exchange swaps	-1.3	2.6	-0.1	-2.5
Treasury bills: Market issues and redemptions (b)	-0.6	-1.8	0.0	1.5
Total offsetting operations	**7.2**	**7.5**	**2.9**	**-9.2**
Settlement banks' operational balances at the Bank	0.4	-0.4	0.2	-0.3

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

Chart 31
Monthly averages of SONIA minus the Bank's repo rate



Exchequer cash management

The DMO assumed full responsibility for managing the Exchequer's daily cash position from 3 April. From 14 January, the DMO had assumed responsibility from the Bank for processing the weekly sterling Treasury bill tender. And, from 14 February, the DMO undertook limited bilateral transactions (mainly in repo and reverse repo) with some of its counterparties, with the intention of smoothing part of the Exchequer component of the Bank's money market forecast.

As the DMO now offsets the Exchequer's cash position with the money market each day, it will no longer use the Ways and Means advance on the Bank's balance sheet to balance its short-term financing needs (but see also comments below). Instead, the DMO aims to achieve a small, unchanged precautionary deposit at the Bank each day. Consequently, the Bank's balance sheet (and hence the Bank's money market forecast) is now more stable and predictable and the money market's need for refinancing from the Bank is no longer influenced by the Exchequer's net cash position.

The DMO announced on 20 April that the planned level for the Ways and Means advance for 31 March 2001 is £15 billion. This was a downward revision from the £17 billion target level contained in the DMR. Because of errors in predicting Exchequer cash flows at the end of the financial year, the balance of the Ways and Means advance was below £15 billion on 31 March 2000. The target level will be achieved by a limited series of transactions between the Bank and the Exchequer in financial year 2000/01.

The Bank will co-operate with the DMO to square the market's end-of-day position when there is a late change to the Exchequer's cash position. When there is a change in the Exchequer's favour, the DMO will not be able to conduct transactions with its counterparties late in the afternoon (because of the closure of settlement systems). The Bank will therefore provide the market with any additional refinancing necessary at its 4.20 pm late repo facility (at a non-penal rate). This additional refinancing will be funded on the Bank's balance sheet by an above-target deposit from the DMO.

The cash management transfer has necessitated a change to the Bank's method of absorbing money market surpluses. The Bank no longer issues Treasury bills (as the proceeds of Treasury bill issuance are now placed back in the market by the DMO). Instead, the Bank will now absorb (or 'mop') any market surpluses by a short-maturity gilt repo, executed via a competitive rate tender.(1)

HM Treasury and Bank of England euro issues

The Bank of England continued to hold regular monthly auctions of €1 billion of bills during 2000 Q1, comprising €200 million of one-month, €500 million of three-month and €300 million of six-month Bank of England bills. The stock of euro bills outstanding was therefore maintained at €3.5 billion throughout the quarter. The auctions were oversubscribed, with issues being

(1) In addition, the Bank can ask the DMO to issue extra Treasury bills and deposit the proceeds at the Bank in order to drain the money market.

Money market instruments

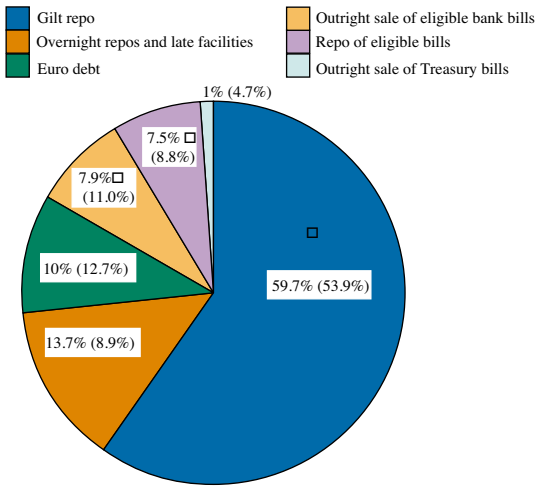
Following the Securities Settlement Priorities Review of 1998, the Bank issued a consultation paper 'The Future of Money Market Instruments' in November 1999. This paper proposed that money market instruments (MMIs), which are currently settled in the Central Moneymarkets Office, should be dematerialised and integrated into CREST, the UK system for the electronic transfer and settlement of equities, and from later this year, gilts. A single system would allow market participants to settle MMIs (which include certificates of deposit, Treasury bills, bills of exchange and commercial paper), in the same way as for gilts and equities, and take advantage of economies of scale and increased efficiency in back-office systems.

There was unanimous market support for the proposals and the Bank published a response, 'Next Steps', in March 2000, summarising the responses and the further work to be undertaken. This includes convening a new Working Group to consider further outstanding issues, such as the timetable, transition, valuation and grouping of MMIs, and issuance procedures. It will also be necessary to consider further the related legislative changes and other legal issues.

A number of the proposals related to bills of exchange. Some of these have already been implemented in advance of the other MMI reforms, as they are not connected with dematerialisation. In March, the Bank liberalised the requirements for the eligible bank bills it takes in its open market operations. Hitherto, eligible bills had to be specifically related to a short-term self-liquidating transaction (eg a sale of particular goods). This reflected a long-established belief, going back several hundred years, that an underlying transaction should underpin the repayment made to the holder of the bill on maturity. This was seen as important for the sound condition of the bill market.

The Bank, with the market's support, concluded that a relationship with a transaction is no longer necessary to enhance the credit quality of a bill. Credit quality depends rather on the general financial condition of the accepting bank and of the company drawing the bill, and of any third party which guarantees the bill. So the underlying transactions requirement, and the associated clausing requirements relating to the evidencing of the transaction, have been abolished. Eligible bills may now be drawn for any purpose. However, as previously, a bank must continue to make a general credit assessment of the drawer, and the original term of the bill must not be more than 187 days. A further liberalisation also allows banks generally to borrow from other banks by drawing bills.

Chart 32
OMOs—instrument overview(a)



(a) This chart shows the share of the various instruments in the Bank's daily open market operations in 2000 Q1. Figures in brackets relate to 1999 Q4. Figures may not sum to 100% because of rounding.

covered by an average of six times the amount on offer. During the quarter, bids were accepted at average yields of around the euribid rate for the relevant maturity.

€500 million of a new three-year euro Treasury note, the ninth in the programme of annual new issues, was auctioned on 18 January 2000. Cover at the auction for the 4.75% January 2003 issue was four times the amount of offer. The 4% 2000 euro Treasury note (€2.0 billion of which had been issued in 1997) matured at the end of January. The total of notes outstanding with the public under the UK euro note programme thus fell from €6.0 billion at the end of December, to €4.5 billion at the end of March 2000. Further reopening auctions of the 2003 euro Treasury note are expected to take place on 18 April, 18 July and 17 October 2000.

On 21 March, the Bank of England announced that it will be taking over from HM Treasury as the issuer of euro notes. This is similar to the change made last year when the Bank took over from HM Treasury as issuer of euro bills. The Bank plans to make its first issue of Bank of England euro notes in January 2001. Apart from the change in issuer, there will be no other significant changes to the features of the programme. The proceeds from these note issues will be held on the Bank's balance sheet as foreign currency assets. HM Treasury will use foreign currency swaps out of sterling to replace the part of the financing of the Government's foreign

Table J
Changes in the sizes of weekly Treasury bill tenders

Period beginning	Amount (£ millions): One-month tender	Three-month tender
30 December	0	100
10 March	250	100
17 March	500	100
24 March	750	100
31 March	150	100

exchange reserves that was previously provided by the issue of euro Treasury notes. The additional sterling financing requirement that this will create is reflected in HM Treasury's sterling financing plans for 2000/01.

UK gold auctions

On 7 May 1999, HM Treasury announced a restructuring of the United Kingdom's reserves, which involved a programme of five gold auctions in the financial year 1999/2000. The last two auctions in this programme took place on 25 January and 21 March—25 tonnes of gold were sold at each. The auction on 25 January achieved a price of $289.50 and was covered 4.3 times. The auction on 21 March achieved a price of $285.25 and was covered 3.0 times. Plans for gold sales in the financial year 2000/01 were announced by HM Treasury on 3 March 2000. There will be a programme of six auctions of around 25 tonnes each, with the first two taking place on 23 May and 12 July. It is intended that the remaining four auctions in this financial year will take place in September and November 2000, and in January and March 2001.

The international environment

- *This article discusses developments in the world economy since the February 2000* Quarterly Bulletin, *as well as the outlook for output and inflation over the next two years.*(1)

- *Forecasts of world economic activity in 1999 have been revised up repeatedly over the past twelve months, and GDP growth for the year as a whole is now estimated to have been around 3.5%. Underlying this, activity was stronger than was earlier forecast in a broad range of countries.*

- *Growth in the United States in the first quarter of 2000 has, again, been above estimates of the trend rate of most forecasters. The euro area saw a period of weaker growth in the first half of 1999 followed by a marked strengthening in the last six months of the year. The recovery has strengthened in many emerging market economies, including a broad range of countries in South East Asia and Latin America. In contrast, while Japan shows some distinctive signs of recovery, the most recent data, for the fourth quarter, indicated a fall in measured output.*

- *Oil and related energy prices continued to rise up to the middle of March, when OPEC member countries agreed to increase production. Evidence of stronger inflationary pressures has been seen in producer input and output prices, and to some extent in export prices. But further along the price chain consumer prices have generally risen by considerably less, although there has been some pick-up in inflation measures in the United States and euro area.*

- *This more muted response to date of consumer prices may have a number of causes, including the reduction in the intensity of oil usage in many of the industrialised economies over the last 20 years or so. But it has also come at the same time as continuing discussion of possible changes in potential output, especially in the United States, reflecting, at least in part, the influence of new technologies.*

- *Since the February 2000* Quarterly Bulletin, *official interest rates in the United States and the euro area have been raised by 0.25 and 0.5 percentage points respectively, and are now at 6% and 3.75%. The Bank of Japan has maintained the zero interest rate policy implemented in February 1999.*

- *According to almost all forecasters, the medium-term outlook is for continued strength in the world economy, and most projections for GDP growth have been revised up since the previous* Quarterly Bulletin. *It is now not untypical to see projections for world GDP growth to rise by somewhat less than 4.5% in 2000 and around 4% in 2001.*

- *Nevertheless it is also not untypical for forecasts to indicate that the balance of risks around the projection is on the downside, primarily for reasons linked to the possibility of asset markets falling.*

(1) Based on data available up to 27 April (the February 2000 *Quarterly Bulletin* was based on data up to 3 February 2000).

Table A
Forecasts for GDP growth

Per cent

	IMF (a)				Consensus Economics (b)			
	2000		2001		2000		2001	
United States	4.4	*+1.8*	3.0	*n.a.*	4.6	*+1.0*	3.1	*+0.1*
Japan	0.9	*-0.6*	1.8	*n.a.*	1.0	*+0.3*	1.5	*+0.2*
Euro area	3.2	*+0.4*	3.2	*n.a.*	3.2	*+0.2*	3.0	*+0.1*

n.a. = not available.

(a) IMF *World Economic Outlook*, April 2000 (differences from October 1999 in italics; percentage points).
(b) *Consensus Forecasts*, April 2000 (differences from January 2000 in italics; percentage points).

Table B
Consensus forecasts for GDP growth(a)

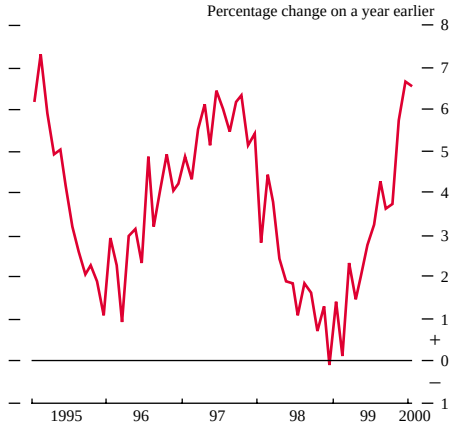
Per cent

	1999		2000		2001	
Latin America	0.0	*+0.3*	3.7	*+0.3*	4.2	*n.a.*
North East Asia (b)	7.5	*+0.4*	7.2	*+0.4*	6.6	*n.a.*
South East Asia (c)	3.1	*+0.1*	5.1	*+0.2*	5.3	*n.a.*

n.a. = not available.

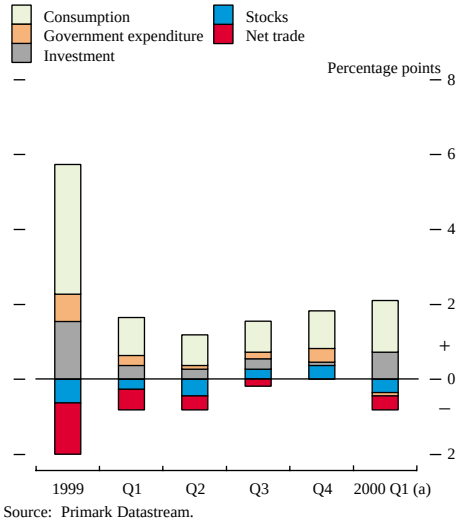
(a) April 2000. Figures in italics are differences from December 1999 (Latin America) and from January 2000 (Asia); percentage points.
(b) Peoples' Republic of China, Hong Kong SAR, South Korea and Taiwan.
(c) Indonesia, Malaysia, Singapore, Thailand and the Philippines.

Chart 1
World industrial production



Sources: Primark Datastream and Bank of England.

Chart 2
United States: contributions to GDP growth



Source: Primark Datastream.

(a) Advance estimates.

Demand and output

The picture since the February 2000 *Quarterly Bulletin* has been one of stronger growth in world activity. World GDP is estimated to have grown by around 3.5% in 1999, compared with 2.7% in 1998, and an average of 2% across the 1990s as a whole. Among the major economies, the United States grew by 4.1% last year, its third consecutive year of growth at or above 4%. Output in the euro area grew by 2.2% last year; although this was lower than the 2.8% achieved in 1998, activity picked up quite strongly during the second half of the year. Japan's growth remained sluggish, at 0.3%, but was an improvement on the contraction suffered in 1998, when activity fell by 2.5%.

Looking forwards, growth in the United States is now expected by the IMF to reach 4.4% this year, 1.8 percentage points higher than was forecast in October.(1) The overall picture of strengthening activity is broadly based, with growth forecasts for the euro area, non-Japan Asia and Latin America also revised upwards (see Tables A and B). The IMF now forecasts world activity to grow by 4.2% this year and by 3.9% in 2001, broadly in line with the Monetary Policy Committee's central projection in the May 2000 *Inflation Report*.

In the final quarter of 1999 world GDP is estimated to have grown by around 1.2%.(2) This reflects continued strong domestic demand growth in the United States and a continuing recovery in domestic demand in the euro area, but a second successive quarter of negative output growth in Japan (where all the components of output except investment made a negative contribution to growth). In the other Asian economies output is estimated to have grown by around 1.9% in 1999 Q4, continuing the picture of strong recovery, while output is estimated to have grown by around 0.7% in Latin America, as the region showed clear signs of recovering from its earlier slowdown.

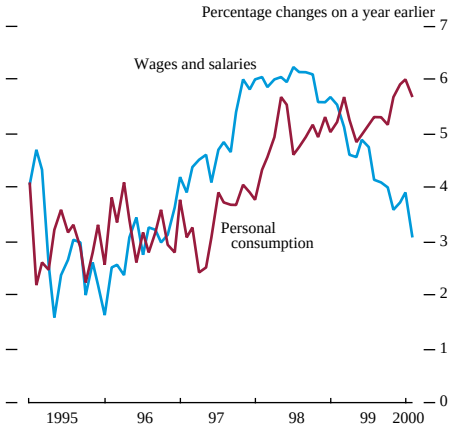
On the most recently available data, world industrial production is estimated to have grown by 6.5% in the year to January (see Chart 1). This reflects strong contributions from the United States and the emerging market economies, with growth of 5.5% and 10.6% respectively. January saw a slowdown in the rate of growth of world industrial production, but this may have reflected millennium-related influences.

The United States

Strong growth in the US economy has continued to reflect robust domestic demand. In 1999 Q4 consumption contributed 1 percentage point to overall growth of 1.8% (see Chart 2), which was possibly boosted by spending associated with the millennium. Growth was also supported by strong government spending, although the preliminary data for 2000 Q1 suggest that this was probably an erratically high outturn. Conversely, investment spending was weak in the fourth quarter, possibly reflecting a pause in investment spending following earlier outlays associated with preparations for the century date change.

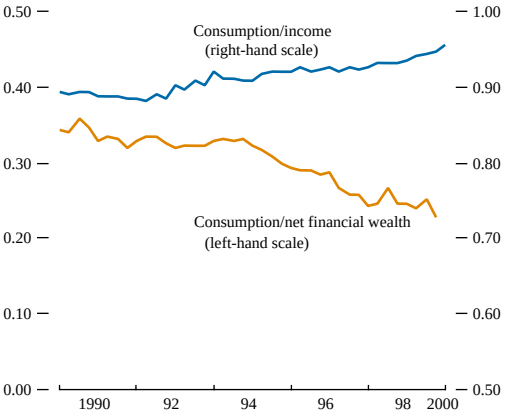
(1) IMF *World Economic Outlook*, April 2000.
(2) The quarterly numbers for world growth are estimates. Where reliable quarterly data are available from national sources, these are used. Otherwise, quarterly estimates are calculated by interpolating estimates of annual growth, taken from the April 2000 IMF *World Economic Outlook*.

Chart 3
US consumption



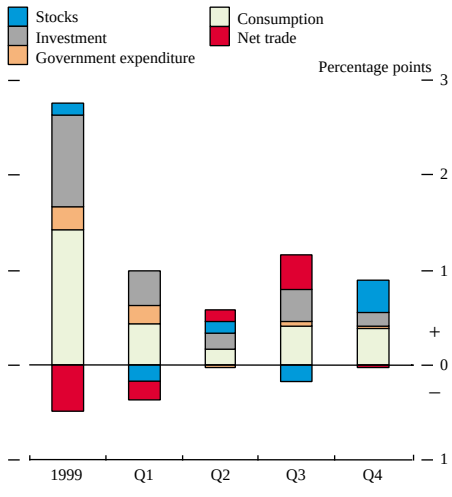
Source: Primark Datastream.

Chart 4
US consumption ratios



Source: Primark Datastream.

Chart 5
Euro area: contributions to GDP growth



Source: Eurostat.

Indicators of domestic demand remained strong in Q1. Retail sales rose by 3.7% in the three months to March. And though it fell after the record level achieved in January, consumer confidence remains very high. Capital goods orders rose in March, and the twelve-month growth rate remained strong, suggesting likely robust investment growth after the weakness in Q4. The advance estimate of GDP growth in Q1 supports this picture.(1) GDP is estimated to have grown by 1.3% compared with the final quarter of 1999, with strong positive contributions from private consumption and investment, in part offset by negative contributions from net trade, stockbuilding, and government expenditure.

Productivity growth in the United States has continued to accelerate, even though the economy has now experienced its longest period of unbroken growth in recorded history. Non-farm business labour productivity rose by 1.5% in the fourth quarter, its strongest quarterly rise since 1992 Q4. The average annual growth rate of labour productivity since 1996 has been 2.6%, compared with 1.6% during 1991–95. Although the strength of recent productivity growth has led many commentators to revise up their estimates of potential US growth, the degree to which the recent IT-driven pick-up in productivity growth reflects cyclical factors remains uncertain.(2)

Federal Reserve Board chairman Alan Greenspan has noted the link between the upturn in US productivity growth and the strength of US domestic demand, observing that 'productivity-driven supply growth has, by raising long-term profit expectations, engendered a huge gain in equity prices. Through the so-called 'wealth effect', these gains have tended to foster increases in aggregate demand beyond the increases in supply'.(3) But there is considerable uncertainty about the size and timing of the impact of these wealth effects on US consumption.

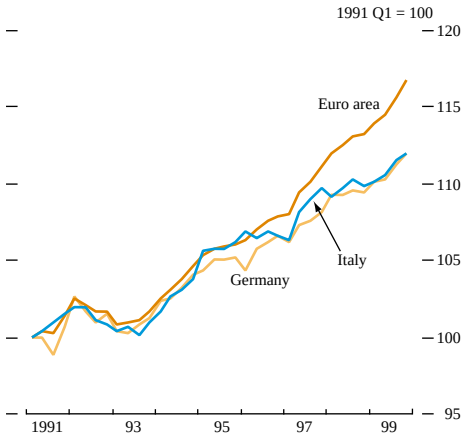
Real personal consumption continued to grow strongly last year, while the growth rate of wages and salaries eased (see Chart 3). This suggests that wealth effects boosted consumption growth above that implied by the growth of wages and salaries. Moreover, despite strong consumption growth in recent years, the consumption-wealth ratio has fallen quite markedly (see Chart 4), suggesting that—in the absence of a sharp fall in wealth—there could be further scope for consumers to spend out of accumulated wealth.

The euro area

In the euro area, GDP growth of 0.9% in the fourth quarter mainly reflected strong domestic demand (see Chart 5), with consumption

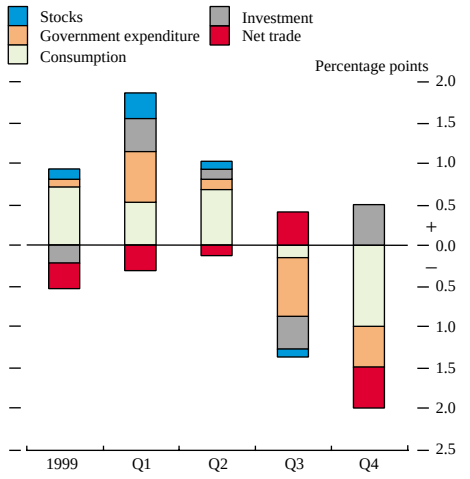
(1) 'Advance' estimates are based on source data that are incomplete or subject to further revision. They are released near the end of the first month after the end of the quarter; more detailed estimates are released near the end of the second and third months.
(2) There has been much debate about whether recent strong productivity growth reflects the effect of the use of IT within the wider economy, or the effect of rapidly increasing productivity in the computer producing sector. Recent research suggests that the IT sector has accounted for 0.7 percentage points of the increase in productivity growth from the first to the second half of the 1990s. Of this just under 0.5 percentage points is attributed to an increased use of IT and a little over 0.2 percentage points to increased total factor productivity in the computer industry. See Oliner, S and Sichel, D E, 'The Resurgence of Growth in the late 1990s: Is Information Technology the Story?', paper given at the conference on Structural Change and Monetary Policy at the Federal Reserve Bank of San Francisco, 3–4 March 2000.
(3) Greenspan, A, 'The revolution in information technology', 6 March 2000.

Chart 6
GDP since 1991



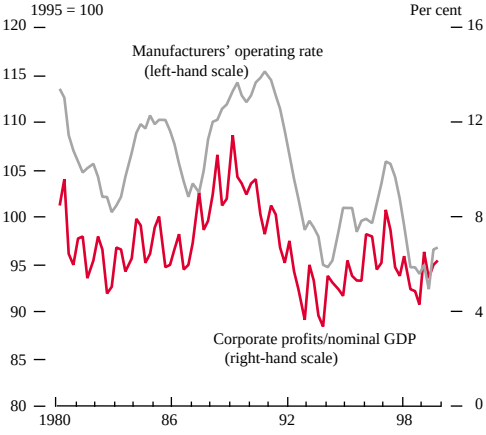
Source: Eurostat.

Chart 7
Japan: contributions to GDP growth



Source: Economic Planning Agency.

Chart 8
Corporate profits and manufacturers' operating rate



Sources: Primark Datastream and Japanese Ministry of Finance.

contributing 0.4 percentage points to growth. The picture of stronger consumption seems to have continued into the first quarter, with monthly indicators showing both consumer and retail confidence rising between December and March. Investment contributed 0.1 percentage points to GDP growth in the fourth quarter, and increased by 4.7% over 1999 as a whole, the fastest annual rate of increase since the start of this area-wide series in 1991. Moreover, the outlook for investment appears favourable, with capital goods production in the euro area increasing by 0.5% in January, and the European Commission survey of industrial confidence continuing to rise.

Net trade made a small negative contribution to growth in the fourth quarter. Export volumes increased by 1.5% after very strong growth of 3.2% in Q3, while imports grew by 1.7%. Looking over the longer term, it is notable that since 1997 Germany and Italy have grown more slowly than the euro area as a whole (see Chart 6). One reason for this appears to have been the weaker net trade performance of Germany and Italy compared with the other euro-area member countries, which may partly be due to the greater degree to which Germany and Italy were affected by the slowdown in the emerging market economies.

Japan

Activity in Japan fell in the fourth quarter, by 1.4%. Of its components, only investment made a positive contribution to growth. Consumption and government expenditure were strong in the first two quarters of 1999 before weakening in the second half of the year (see Chart 7). This indicates that much of the ¥17.8 trillion supplementary budget passed in November 1998 was spent in the early part of the year, supporting private consumption over the same period but with no substantial lasting effect.

The possibility of a recovery led by private investment is indicated by corporate profits, which were 42% higher in the fourth quarter on an all-industry basis than in the same quarter a year earlier. It has been suggested by the Bank of Japan (BoJ)(1) that a recovery in corporate profitability is a precondition for self-sustaining economic recovery in Japan. In this scenario such a recovery could lead to further growth in private non-residential investment as Japanese firms typically fund new investment from retained profits (see Chart 8). With a longer lag, corporate profitability could also lead to an increase in private consumption as employment and incomes stabilise.

While corporate profits appear to be improving in aggregate, the picture is not even across all sectors. In the fourth quarter, the growth in corporate profits was limited to large manufacturers (whose profits were 93% higher than a year ago), while those of small non-manufacturers remained broadly unchanged. The latest BoJ Tankan survey of business, released in March, gave a similar picture of uneven recovery. On an all-industry basis, the diffusion index of business conditions (a confidence indicator) improved on three months earlier, and was forecast by respondents to improve further over the next three months. Large firms continued to be more optimistic than small firms. And there remained a divergence between manufacturers and non-manufacturers, with the

(1) Minutes of the Monetary Policy Meeting, 24 February 2000.

World import proxy

The Bank tracks developments in UK export markets in order to help explain and forecast movements in UK exports. These developments are approximated by adding together total import growth across UK trading partners, using weights determined by each country's share of UK exports. Where possible, staff use national accounts data to compile the UK export market series. However, restricting the series to national accounts would exclude many trading partners for which these series are published only with a lag, if at all. Recent Bank work has looked at incorporating customs data where appropriate to construct a world trade activity proxy.

Customs data report import values, in domestic currency or in US dollars, rather than volumes information as in national accounts series. But the data can be deflated using an import price index where available, or else an appropriate producer price index, to give an approximation for import volumes. Another issue is that goods pass through customs but services do not. However, goods comprise around 75% of total world trade, so quarterly growth rates from deflated customs series can be used to approximate the growth rates required for goods and services import volumes.

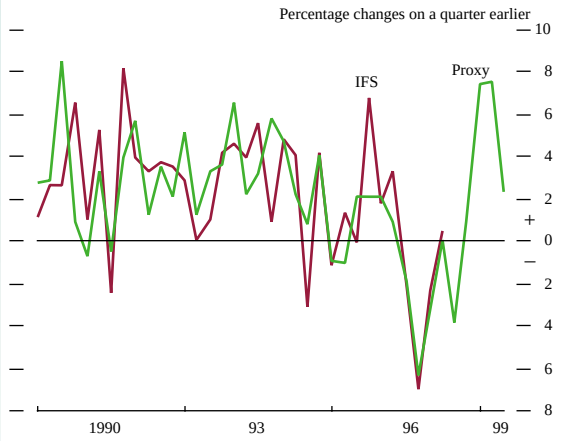
Methodology

In order to compile import proxies, the non-OECD world is divided into regions, and a sample of countries chosen from each region. Countries are chosen on the basis of their relative trading importance. For example, the proxy for Asia comprises Hong Kong SAR, Singapore, Malaysia, Thailand, India and the Philippines, representing around 60% of UK exports to the region.(1) All available national accounts imports data are collected, and where they are not available, customs data are compiled, deflated and the quarterly growth rates spliced on to available national accounts series. These data are then aggregated together to obtain an import volumes proxy for each region.

Charts A and B show the import proxies for Asia and Latin America (which excludes Mexico), compared with import volumes data computed from the IMF *International Financial Statistics* (IFS) series.(2)(3)

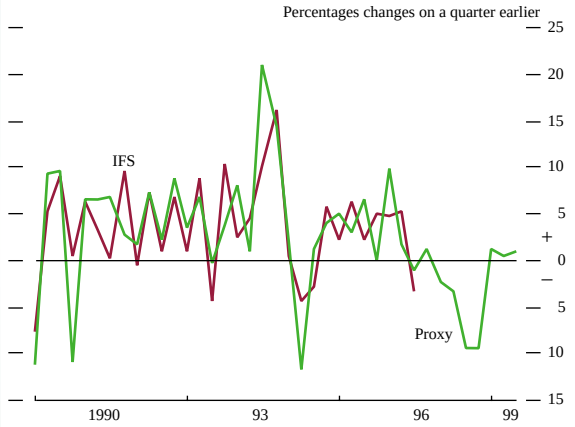
As the charts show the proxy series give a good approximation to import volumes growth for the different regions. These proxies are then weighted together with national accounts imports series for OECD countries to give a UK-weighted world imports series. Chart C shows this measure with UK export volumes growth. With the proxy data incorporated into the export markets measure, the 1999 Q4 data point includes data for countries representing approximately 87% of UK export markets.

Chart A
Asia import volume growth



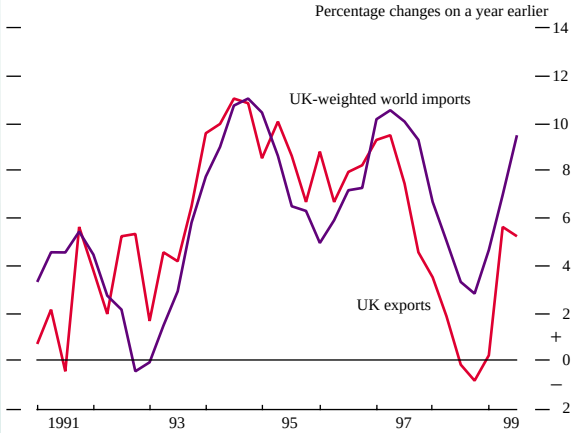
Sources: IMF and Bank of England.

Chart B
Latin America import volume growth



Sources: IMF and Bank of England.

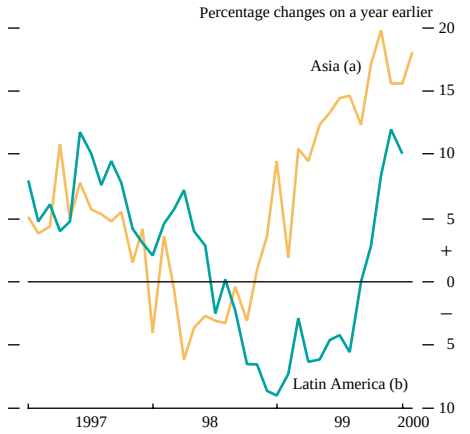
Chart C
Growth of UK exports and export markets



Sources: ONS and Bank of England.

(1) The 'Asia' region excludes Peoples' Republic of China, Japan and South Korea, which are considered separately.
(2) As incorporated in the National Institute for Economic and Social Research Global Economic Model.
(3) The IFS series publishes US$ import values and import unit values for IMF member countries, which can be used to compile import volumes series.

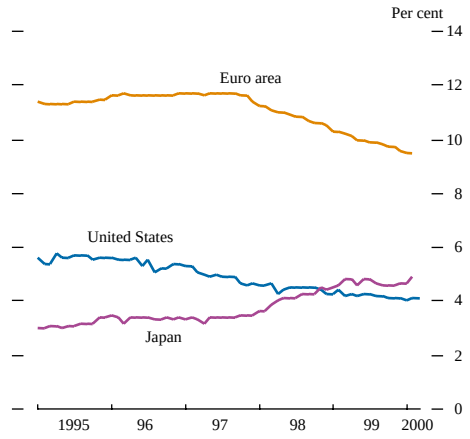
Chart 9
Industrial production in Latin America and Asia



Sources: Primark Datastream and Bank of England.

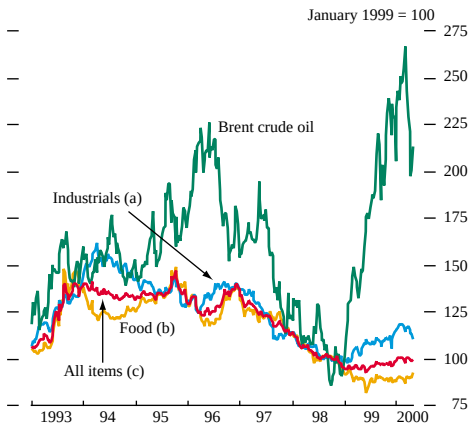
(a) India, Korea, Taiwan and Thailand.
(b) Argentina, Brazil, Chile, Mexico, Peru and Venezuela.

Chart 10
Unemployment rates



Source: Primark Datastream.

Chart 11
Commodity prices



Source: Primark Datastream.

(a), (b), (c) *The Economist* index, all items and industrials excluding oil.

former possibly more optimistic because of an improvement in overseas markets, despite concerns about the strength of the yen.(1)

Emerging markets

Prospects for the Latin American and Asian economies have improved in recent months, as illustrated by Table B, which shows the revisions to Consensus forecasts since the time of the February 2000 *Quarterly Bulletin*. But the two regions are at different stages of economic recovery, with the Asian recovery more advanced. In January Asian industrial production was nearly 16% higher than a year earlier (see Chart 9),(2) while Latin American industrial production grew by 10% in the twelve months to January. The stronger recovery in Asia may partly reflect the severity of the crisis in 1998 when, according to IMF estimates,(3) the worst-hit economies of Indonesia and Thailand both contracted by more than 10%. Stronger growth has also been supported by the pick-up in world demand and Asian intra-regional trade.

Labour markets

In the United States, stronger output growth has meant that employment growth has remained robust. The monthly average increase in non-farm payrolls was 272,000 in the first quarter, compared with 283,000 in 1999 Q4, and the unemployment rate, at 4.1% in March (see Chart 10), was unchanged from the previous month and the same as in 1999 Q4, but below the average for previous years.(4) The February 2000 *Quarterly Bulletin* discussed the implications of recent labour market developments for estimates of the trade-off between unemployment and inflation in the United States.

In the euro area the unemployment rate was 9.5% in February, 0.8 percentage points lower than a year earlier.(5) It has been on a downward trend since August 1997 and is now at its lowest level since October 1992. The decline in the unemployment rate over the past few years is notable, given that previous recoveries have not always translated into similar improvements in labour market conditions. It is possible that some of the reduction in unemployment reflects progress with structural labour market reforms, while in some countries (eg Germany) government schemes continue to provide an alternative to unemployment for the part of the labour force that has most difficulty finding a job.

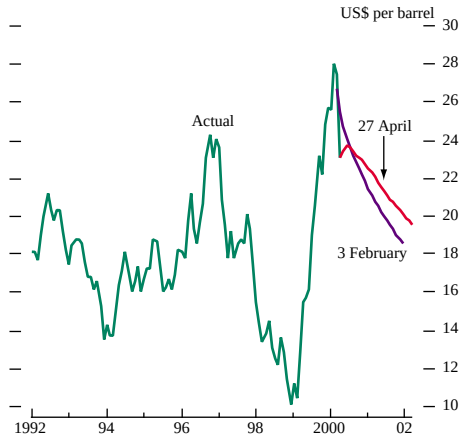
In Japan, the unemployment rate reached 4.9% in February, the highest level on record, having been at an average rate of slightly less than 4.7% in the second half of 1999. Compared with a year earlier, employment has declined in all sectors except wholesale and retail, partly reflecting the effects of continuing corporate restructuring.

Prices

The dollar-denominated *Economist* non-oil commodity price index fell by 1.3% from 3 February to 27 April (see Chart 11), with a

(1) The November 1999 *Quarterly Bulletin*, page 349, discusses the possible effects on Japanese export volumes and exporters' profitability of a yen appreciation.
(2) In February, it was nearly 20% higher than a year earlier (February figures are not yet available for the other areas).
(3) IMF *World Economic Outlook*, April 2000.
(4) The average unemployment rate was 4.5% in 1998, 4.9% in 1997 and more than 5% in the three previous years.
(5) The lowest rates were registered in Luxembourg (2.2%) and Austria (3.5%), the highest in Spain (15.2%) and France (10.4%).

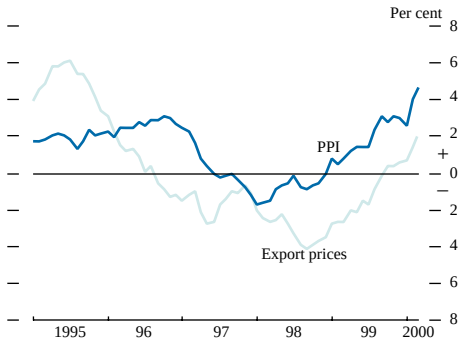
Chart 12
Oil price and futures



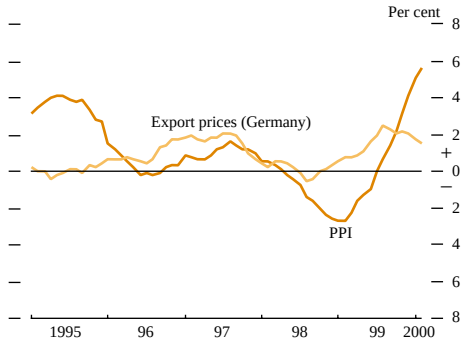
Source: Bloomberg.

Chart 13
PPIs and export prices

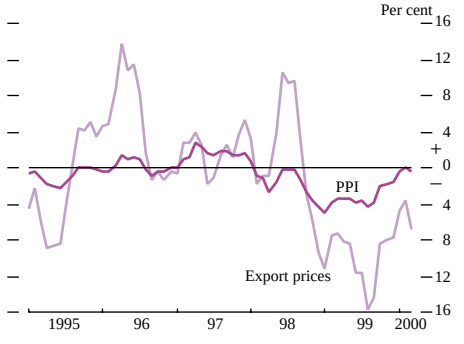
(a) United States



(b) Euro area



(c) Japan



Source: Primark Datastream.

6.0% fall in prices for non-oil industrial commodities outweighing a 2.5% rise in food prices.(1) Industrial commodity prices have displayed a steady increase since their trough in January 1999 (up 14.0% to 27 April), while food prices have been on a downward path since May 1997 (down 34.1% to 27 April).

Oil prices peaked at $30.4 on 6 March, but have since fallen by more than 20% (to $24.0 on 27 April). At the end of March, members of the Organisation of Petroleum Exporting Countries (OPEC), excluding Iran and Iraq, agreed to raise production targets by 1.45 million barrels per day, equivalent to an increase of just over 6% on the production targets agreed a year earlier.(2) OPEC's decision to raise production targets came in the wake of the sharp increase in oil and oil-related product prices, which reflected the stronger increase in world demand and a marked decline in oil and related inventories since the middle of last year following OPEC's decision to lower production in March 1999.

The oil futures curve has flattened since the February 2000 *Quarterly Bulletin*. Chart 12 shows that the contract price for June delivery is now $0.3 lower at $23.8 per barrel. The contract for December 2001, however, increased by $1.5 to $20.1 per barrel and at a two-year period (March 2002) the price is $19.6. These movements in futures suggest that the decline in oil prices over the two-year period is expected to be somewhat slower than previously thought.

The immediate impact of higher oil prices has been on producer prices. In the United States, intermediate producer prices (where the oil content is higher than in final producer prices) rose by 6.1% in the year to March, while final producer prices rose by 4.6%. In the euro area, intermediate producer prices rose by 9.2% in the year to February, but the increase in final producer prices was 5.7% over the same period.

Chart 13 illustrates the pick-up in producer price inflation as the impact of higher oil prices has begun to work through. It also shows export prices for the major economic areas (goods and services for the United States, goods for Germany and Japan). In the United States export prices have followed the movement in producer prices quite closely. The same is true for Japan, where the relationship between producer and export prices has been less clear-cut in the past.

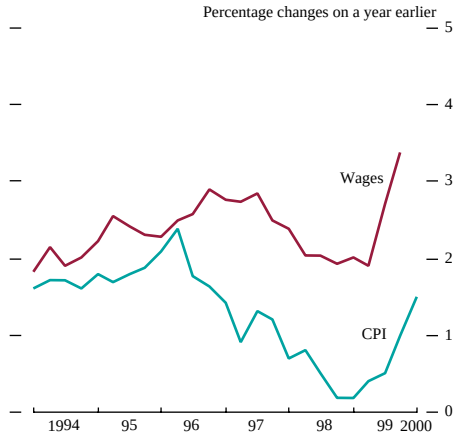
Turning to consumer price inflation, the oil price rise has meant that core inflation (which generally omits energy costs) in the major economies has increased by less than headline inflation.(3) In the United States, headline CPI inflation grew by 3.7% in the year to March, while core CPI inflation was 2.4%. This was somewhat

(1) The chart shows the new *Economist* index, in which the weight of industrials is 42.5% and the weight of food is 57.5%. This compares with previous weights of 47.4% and 52.6% respectively.

(2) Subsequently Iran stated that it would increase production by an amount equal to the change in target level that it would have achieved under the agreement. This brings the increase in production targets to 1.72 million barrels per day (mbd), equal to the production cut agreed a year earlier, and raises production levels to 24.7 mbd. But OPEC production in 2000 Q1 is estimated to have been around 24.3 mbd, implying that strict adherence to the new target levels would involve a smaller increase in production. Similar production increases have also been announced by those non-OPEC members that had reduced production in line with OPEC last year.

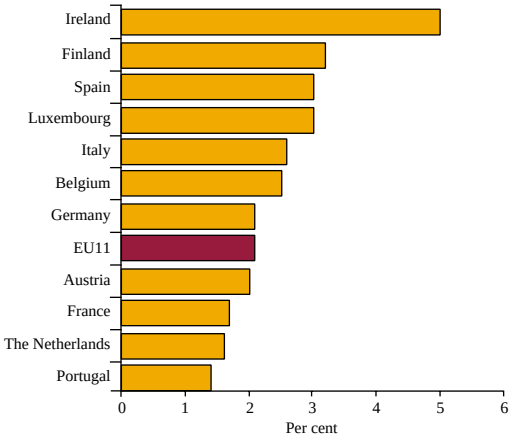
(3) The note on pages 147–49 discusses the contributions of the energy component to CPI inflation, which are shown in Charts D-F.

Chart 14
French wage and CPI inflation



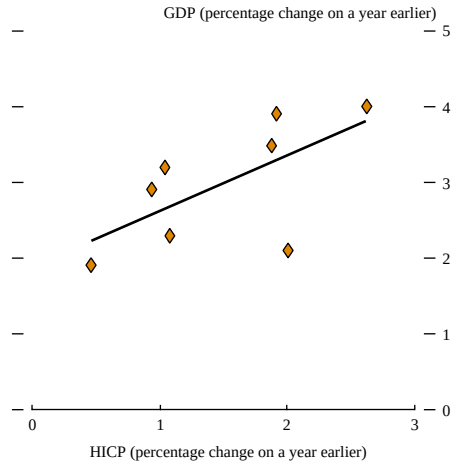
Source: Primark Datastream.

Chart 15
Euro-area HICP (March 2000)



Source: Eurostat.

Chart 16
Growth and inflation in the euro area



Note: 1994 Q4 for Finland, France, Germany, Italy, the Netherlands and Spain, 1999 Q3 for Belgium and Austria. No data are plotted for Ireland, Luxembourg and Portugal. The line represents a linear trend fitted to the data shown.

Source: Eurostat.

higher than in the previous month, when the numbers were 3.2% and 2.1% respectively. In addition, the rise in the core index in March was more broadly based across categories.

In the euro area, consumer price inflation (measured on a harmonised basis) was 2.1% in the year to March, up from a low point of 0.9% in the twelve months to June 1999, while core inflation (excluding energy prices) was 1.1%, little changed from 0.8% in June 1999. In Japan, headline consumer prices declined by 0.6% in February on a year earlier. However, excluding fresh food (Japan has a different definition of core inflation), prices fell by 0.1%.

Labour costs have started to pick up somewhat in the United States. The growth rate of average hourly earnings rose to 3.7% in the year to March, reflecting an average monthly increase of 0.4% in the first quarter compared with 0.2% in 1999 Q4. But unit labour costs for non-farm businesses fell by 0.6% from 1999 Q3 to 1999 Q4, implying a slowdown in the annual growth rate to 0.7%, its lowest since 1996 Q4. The latest release of the quarterly Employment Cost Index points at a pick-up in wages and salaries in 2000 Q1 (up 4.1% on a year earlier compared with 3.5% in 1999 Q4).

In the euro area labour costs (based on the hours measure) increased by 2.2% in the year to 1999 Q4, unchanged from the previous quarter, and unit labour cost growth was 0.8% in the year to 1999 Q3, the latest quarter for which data are available. There is typically a pick-up in productivity in parallel with the cycle, given that employment follows activity with a lag, and such an increase in productivity has recently tended to limit the increase in unit labour costs in the euro area.

Some commentators have suggested that inflation prospects in the euro area may be affected by the reduction in the working week in France to 35 hours, through a possible effect on French unit labour costs.(1) An overly simple calculation suggests a possible step increase of around 11.4% in hourly wages and unit labour costs.(2) But several considerations would lead to a lower and more delayed impact. The implementation of the legislation, via incorporation in firm-level agreements, has been quite gradual, and many of the firm-level agreements implementing the law incorporate wage freezes, while around 80% exhibit features designed to increase the flexibility of working agreements. In addition, reductions in social charges and subsidies will further mitigate the impact on labour costs. Chart 14 shows that hourly wage inflation has increased over the past year or so, but not as sharply as the simple calculations would suggest.

Chart 15 illustrates inflation differentials within the euro area. In March, HICP inflation was highest in Ireland and Finland (5.0% and 3.2% respectively) and lowest in Portugal (1.4%) and the Netherlands (1.6%). The dispersion of inflation rates, measured by the standard deviation, has been broadly unchanged since January 1999, having risen somewhat in 1998. To some extent these inflation differentials are attributable to the different cyclical positions. Chart 16 shows a scatter plot of GDP growth rates and HICP inflation in the euro area in the fourth quarter, as well as a linear trend. The upward slope of the trend line illustrates that the

(1) The French weight in the euro-area HICP is 21%.
(2) Assuming unchanged monthly wages and a reduction from 39 hours.

Table C
Forecasts for CPI inflation

Per cent

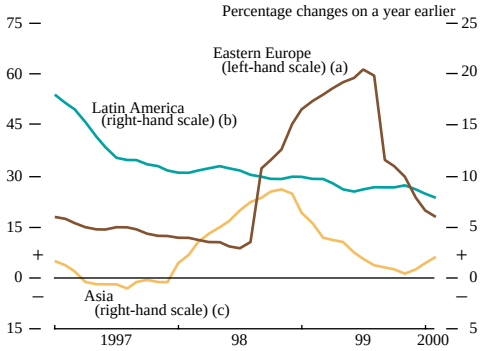
	IMF (a)				Consensus Economics (b)			
	2000		2001		2000		2001	
United States	2.5	*+0.0*	2.5	*n.a.*	2.8	*+0.3*	2.5	*+0.0*
Japan	0.1	*+0.1*	0.9	*n.a.*	-0.2	*-0.1*	0.1	*+0.2*
Euro area	1.7	*+0.4*	1.6	*n.a.*	1.7	*+0.0*	1.6	*+0.0*

n.a. = not available.

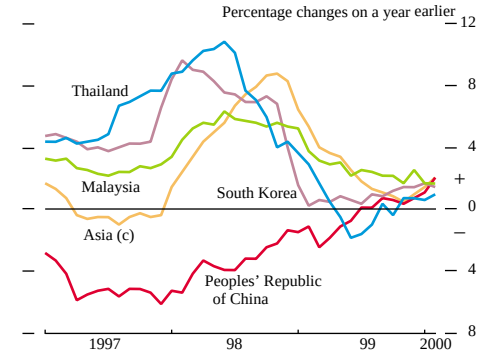
(a) IMF *World Economic Outlook*, April 2000 (differences from October 1999 in italics; percentage points).
(b) *Consensus Forecasts*, April 2000 (differences from January 2000 in italics; percentage points).

Chart 17
Consumer prices

(a) Emerging markets



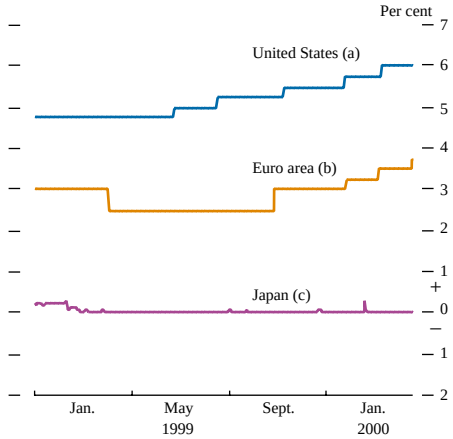
(b) Asia



Source: IMF.

(a) Czech Republic, Hungary, Poland and Russia.
(b) Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.
(c) Peoples' Republic of China, India, Indonesia, Malaysia, South Korea, Taiwan and Thailand.

Chart 18
Official interest rates



Sources: Bank of Japan, ECB, Federal Reserve.

(a) Federal Funds target rate.
(b) Refinancing rate.
(c) Uncollateralised overnight rate (market rate).

two variables are positively correlated (ie higher growth tends to be associated with higher inflation). But there are other factors behind changes in inflation differentials, eg changes in indirect taxation, convergence in the prices of tradable goods and the so-called 'Balassa-Samuelson effect'.(1)

Looking forwards, Table C shows forecasts for CPI inflation from the *World Economic Outlook* and *Consensus Forecasts*. Since the February 2000 *Quarterly Bulletin*, there have been upward revisions to the inflation outlook in the euro area, which may, at least in part, reflect the improved outlook for growth. There have also been upward revisions to inflation forecasts for the United States, in line with upward revisions to output forecasts (see Table A). For Japan, there have been both upward and downward revisions, which may reflect the uncertainty surrounding the short-term outlook.

Although oil consumption is generally greater per unit of output in the emerging market economies, Chart 17 (a) shows that consumer prices have not yet increased substantially, though there has been some, albeit modest, upward movement in headline inflation rates in Asia, notably in South Korea and the Peoples' Republic of China (see Chart 17 (b)).(2) In South Korea this has been accompanied by strong nominal wage growth (14.9% in 1999), slightly higher than the increase in productivity over the same period (14.6%), but the authorities have reduced oil taxes to limit the direct effects of the recent oil price rises.

Monetary policy and financial markets(3)

In both the euro area and the United States, official interest rates were at their low point in the first half of 1999, following cuts undertaken in the wake of the Asian and subsequent financial crises (see Chart 18). Since then, rates have moved up by 1.25 percentage points in both the United States and the euro area.(4) Charts 19 (a) and 19 (b) show that as of 27 April markets expect short-term interest rates in the United States and the euro area to approach 7.25% and 4.75% respectively by the end of the year, implying future increases of 1.25 and 1 percentage points. These expectations are about 0.25 percentage points higher than those of three months ago.

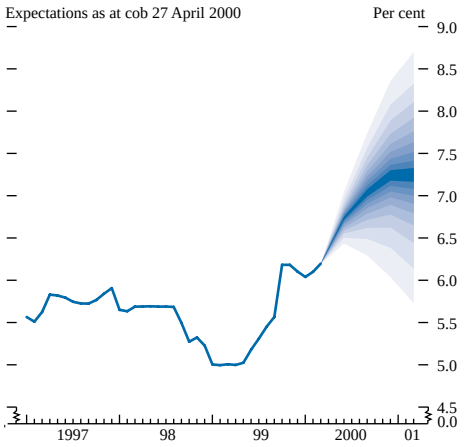
On 21 March, the FOMC raised the Federal Funds target rate from 5.75% to 6% (see Chart 18). The FOMC stated that it remained 'concerned that increases in demand will continue to exceed the growth in potential supply, which could foster inflationary imbalances that would undermine the economy's record economic expansion'. At the same time, it maintained its view that the 'risks are weighted mainly toward conditions that may generate heightened inflation pressures in the foreseeable future'.(5)

The ECB raised the refinancing rate for the euro area from 3.5% to 3.75% on 27 April, having raised it to 3.5% on 16 March (see

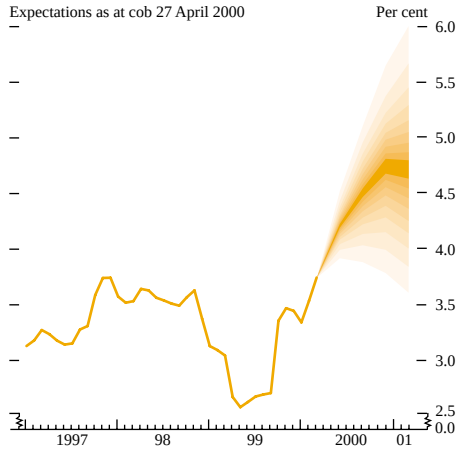
(1) This predicts that the price of non-traded goods rises by relatively more in countries with higher productivity growth.
(2) In China, monthly inflation fell to -0.2% in March from 0.7% in February (the first positive rate of inflation in almost two years).
(3) For details on movements in foreign exchange, equity and bond markets see the 'Markets and operations' article on pages 117–34.
(4) Interest rate rises took place in the United States on 30 June (4.75% to 5%), 24 August (to 5.25%), 16 November (to 5.5%), 2 February (to 5.75%) and 21 March (to 6%); in the euro area on 4 November (2.5% to 3%), 3 February (to 3.25%), 16 March (to 3.5%) and 27 April (to 3.75%).
(5) FOMC press release, Washington DC, 21 March 2000.

Chart 19 (a)
Implied distribution for three-month interest rates

(a) Eurodollar[a]



(b) Euribor[b]

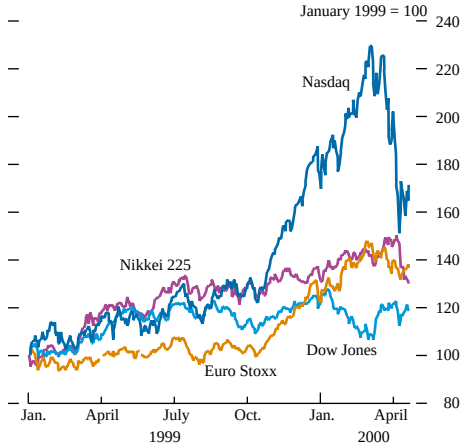


Sources: CME, LIFFE and Bank of England.

(a) Using options on CME eurodollar futures.
(b) Using options on LIFFE euribor futures. The historical time series are euromark rates up to January 1999 and euribor rates thereafter.

The chart depicts the probability distribution of short-term interest rates, and is rather like a contour map. So at any given point, the depth of shading represents the height of the probability density function implied by the markets over a range of outcomes for short-term interest rates. The markets judge that there is a 10% chance of interest rates being within the darkest, central band at any date. Each successive pair of bands covers a further 20% of the probability distribution until 90% of the distribution is covered. The bands widen as the time horizon is extended, indicating increased uncertainty about interest rate outcomes.

Chart 20
Equity prices



Source: Primark Datastream.

Chart 18). In its statement accompanying the most recent rise, the ECB expressed 'concern about upside risks to price stability which, given the prospects for strong economic expansion, arise from strong growth in monetary and credit aggregates, as well as from the current level of the euro'. In addition, the ECB noted that it 'continues its policy of reacting to upside risks to price stability in the medium term in a pre-emptive manner'.(1)

Chart 18 shows that the uncollateralised overnight rate in Japan has remained close to zero, as a result of the continued 'zero interest rate policy' adopted by the Bank of Japan (BoJ) in February 1999. In the context of this policy the BoJ 'will flexibly provide ample funds and encourage the overnight call rate to move as low as possible', in order to 'assure permeation of the effects of monetary easing'.(2)

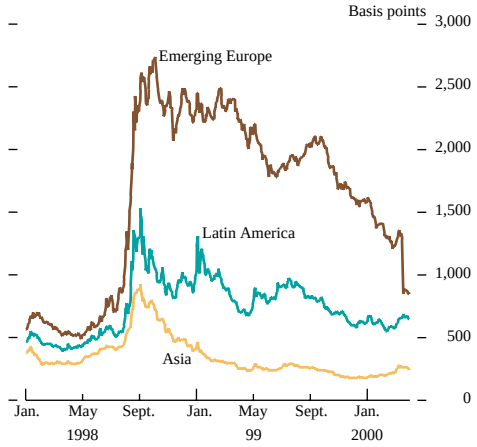
Monetary data for the early part of this year have been influenced to some extent by increased cash holdings around the millennium changeover and leap year dates. In the United States, after the impact of the year-end effect passed, money growth slowed somewhat. The M3 aggregate grew by 7.4% in February relative to a year earlier, whereas it grew by 8.8% for 1999 as a whole. In the euro area, the three-month moving average of M3 grew by 5.9% in the year to January,(3) slightly higher than a month earlier, but this was partly due to a base effect linked to the launch of the euro. However, the growth rate of M3 was 6.2% in February compared with 5.2% in the previous month, and private sector credit increased by 10.5% in February compared with 9.5% a month before.

In Japan, the growth of broad money (defined as M2 plus certificates of deposit) has slowed since 1999 Q1. In the year to March 2000, the growth rate was 1.9%, compared with an average of 3.6% over 1999. According to a recent Bank of Japan working paper, the changing relationship between nominal GDP growth and broad money reflects a shift in money demand.(4) It suggests that the slowdown in broad money growth has reflected a decline in precautionary demand from households and the corporate sector as fears about financial fragility ease.(5) As a result, households are less likely to hold cash outside the banking system, while firms can run down demand deposits and either invest in new equipment or repay debts. If firms decide to reduce holdings of precautionary on-hand liquidity, those funds could be used to repay debt or fund new projects.

Since the February 2000 *Quarterly Bulletin*, the main share indices have changed by –1.1% in the United States (Dow Jones), +0.3% in the euro area (Euro Stoxx) and –8.9% in Japan (Nikkei 225) (see Chart 20). It is unclear, however, to what extent these changes can be attributed to increases in official interest rates (which would argue for more widely spread declines across companies) or to

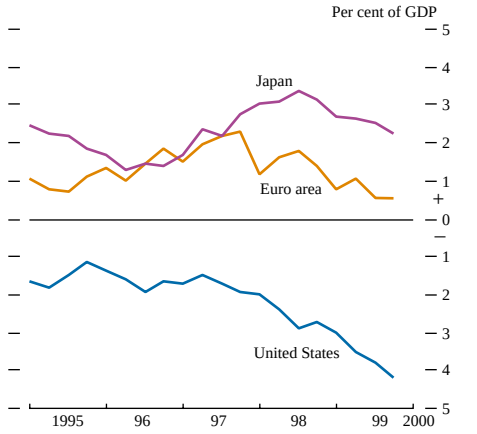
(1) ECB press release, Frankfurt am Main, 27 April 2000.
(2) Bank of Japan press release, Tokyo, 27 April 2000.
(3) The ECB's reference rate is 4.5%.
(4) Hayakawa, H and Maeda, E, 'Understanding Japan's financial and economic developments since autumn 1997', *Bank of Japan Working Paper 00-1*, January 2000.
(5) Recent developments are viewed as reversing earlier changes in money demand occurring between early 1997 and 1999 Q1, when the Japanese economy entered a downturn after fiscal tightening in April 1997, exacerbated by the Asian crisis and by the collapse of three large financial institutions in November 1997. During that period, the increase in precautionary demand (public cash holdings and bank reserves) led to a decline in both the money multiplier and the velocity of circulation.

Chart 21
Emerging markets spreads



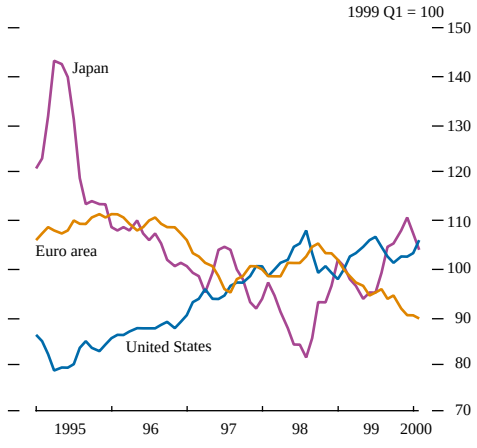
Source: J P Morgan.

Chart 22
Current account balances



Source: Primark Datastream.

Chart 23
Real effective exchange rates



Source: Primark Datastream.

other reasons linked perhaps to perceptions of overvaluation in some sectors. The changes were larger for indices based on technology stocks (in the United States, for example, the Nasdaq fell by 10.4% over the same period), and these had experienced far larger movements than other indices between October 1999 and February 2000 (see Chart 20).

There is little evidence that interest rate increases in the major economies have had a significant influence on sovereign bond spreads in emerging market economies.(1) Chart 21 shows these spreads by region. Since the February 2000 *Quarterly Bulletin* the spread has increased by 39 basis points for Asia and decreased by 24 basis points for Latin America, while it fell by 701 basis points for emerging Europe (27 April). The movement in emerging Europe to a large extent reflects the restructuring of Russian debt following successful resolution of Russia's debt negotiations with its London Club creditors.(2) Nevertheless, the spreads for emerging Europe and Latin America remain above the levels recorded before the Russian crisis (here defined as 1 June 1998), by 240 and 135 basis points respectively. Spreads for Asia, by contrast, are now 130 basis points below.

External balances

In the United States, the current account deficit widened to 4.2% of GDP in 1999 Q4 (see Chart 22). For 1999 as a whole, the current account deficit was equal to 3.7% of GDP. Net investment income was negative for the third year running, after being in surplus for the preceding 25 years. There was a current account surplus of 0.6% of GDP in the euro area in 1999 Q4 and 0.7% of GDP for 1999 as a whole. In Japan, for 1999 as a whole, the current account surplus was 2.5% of GDP (2.25% of GDP in Q4).

For the major economies, much of the recent evolution of current accounts is attributable to the difference in growth rates between the United States on the one hand and the euro area and Japan on the other. The current accounts for the euro area and Japan were in surplus over the second half of the 1990s (see Chart 22), while the United States experienced a deficit throughout, which has widened noticeably since 1998. As a result, US net foreign liabilities had built up to 19% of GDP in 1999 and Japanese net foreign assets to 27% of GDP in 1998 (the latest year for which data are available).

The past year has seen a real depreciation of the euro while the real effective exchange rates of the dollar and yen have been more volatile, with less of a detectable trend (see Chart 23). In the previous years since early 1995, real exchange rates have tended to appreciate for the deficit country (the United States) and to depreciate for the surplus countries (Japan and, to a lesser extent, the euro area).

The current account, which equals the difference between savings and investment for an economy as a whole, does not entirely reveal

(1) The effect on emerging market spreads (through the base to which spreads are calculated) is only one of the possible effects of higher interest rates in the major economies. In addition, higher rates directly affect interest rates in economies linked through currency pegs or currency boards (eg Hong Kong SAR and Argentina, which peg to the dollar). They could also affect economies that have strong trade links with the economies where interest rates have risen.
(2) Russian principal loans and interest rate arrears loans (both restructured commercial bank loans) were taken out of the index on 14 April and replaced by eurobonds to be issued in exchange.

developments in internal and regional savings-investment balances. In the United States the private sector has been in deficit since 1997, after many years in surplus, while the government balance has recently moved into surplus. In the euro area, some of the smaller economies have had larger current account imbalances than the euro area as a whole. In Japan, recent fiscal packages have led to a government deficit of 7.4% of GDP in 1999, while the private sector had net savings of 9.9% of GDP.

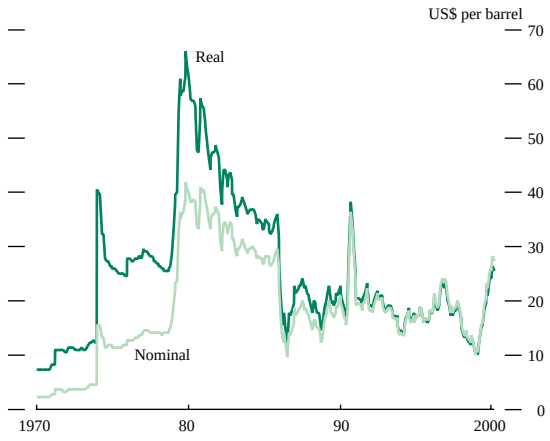
What do the recent movements in oil prices imply for world inflation?

Crude oil prices almost tripled from $11 per barrel at the start of 1999 to more than $30 per barrel in March 2000. The price then fell back markedly (to $21 per barrel on 10 April) in the wake of increased production agreed by the Organisation of Petroleum Exporting Countries (OPEC), before returning to $24 on 27 April. This note considers the channels through which oil price rises pass through to domestic inflation. It compares the current situation with the experience of the oil shocks in the 1970s. It also briefly discusses whether the effects of higher oil prices on domestic prices might differ across the major economies.

Recent developments in oil prices

Between 1990 and 1997, nominal oil prices averaged around $18 per barrel. The fall in global demand during the Asian crisis caused prices to fall well below this level in 1998, down to $11 per barrel at the start of 1999. During 1999 the rebound in world growth increased the demand for oil. At the same time production was restricted by OPEC as a reaction to the earlier fall in prices, fuelling the sharp rise in oil prices to around $25 per barrel at the time of the February 2000 *Quarterly Bulletin*. The imbalance in supply and demand also led to a steady decline in OECD countries' oil inventories, which by December 1999 had fallen to their lowest level in a decade. In the first quarter of 2000 the same factors resulted in a further increase in prices, to $31 per barrel in March, the highest nominal level since 1991. It should be noted, however, that the increase has been less pronounced in real terms than previous oil price hikes (see Chart A).

Chart A
Oil prices



Note: The real oil price is the nominal oil price deflated by US producer prices (1995 = 100).

Source: Primark Datastream.

At their meeting in Vienna at the end of March, nine OPEC members agreed an increase in oil production of 1.4 million barrels a day, about 6% of supply. OPEC produce more than 40% of global supply. Iran was not formally party to this agreement, but subsequently indicated that it would raise production in line with other members. That brought the target increase for OPEC to around 1.7 million barrels per day. The increase in production needed to meet the new target was only about 0.5 million barrels per day, however, as OPEC output in early March was already about 1.2 million barrels per day higher than the previous target. Discrepancies between OPEC's targets and actual production have been a long-standing feature of the oil market, and make it difficult to predict actual future supply.

Markets had discounted some increase in oil production prior to the agreement, but prices subsequently fell back further to $21 per barrel by mid-April, compared with just over $24 per barrel at the time of the agreement. As at 27 April the spot price is $24 and futures markets predict a fall to around $20 per barrel by the end of next year.

Pass-through from oil prices to inflation

The impact of higher oil prices on domestic consumer price inflation will depend on a number of factors, including the cause of the rise—whether it reflects stronger world demand and therefore a build-up of inflationary pressure, or a supply-side shock which may reflect a change in relative prices that has an impact on resource allocation but not necessarily on the world price level in the long run. Of course, it is not uncommon for a rise in oil prices to reflect elements of both demand and supply shocks.

It is important to distinguish between the direct or first-round effects of oil price changes on domestic prices and the second-round effects. First-round effects occur because oil, as well as goods and services with a direct or indirect oil content, enters indices of domestic prices. But the importance of oil varies between countries, so the first-round effects are not necessarily uniform, and will also depend on other factors such as margins and exchange rates.

Second-round effects arise when oil price changes feed into inflationary expectations and subsequently wages. Once this happens, there is a possible circular wage-price causality. In the extreme, if the change in oil prices led to an identical change in wages and the CPI, a one-time change in oil

prices would permanently affect the rate of inflation. So for second-round effects, the processes of wage-setting and how agents form inflationary expectations are crucial, and both partly depend on the monetary policy regime and its credibility. There is evidence of an increase in the credibility of many monetary policy regimes over the past 30 years, which suggests that the recent oil price rise may not pass through to inflation expectations as strongly as in the 1970s.

First-round effects

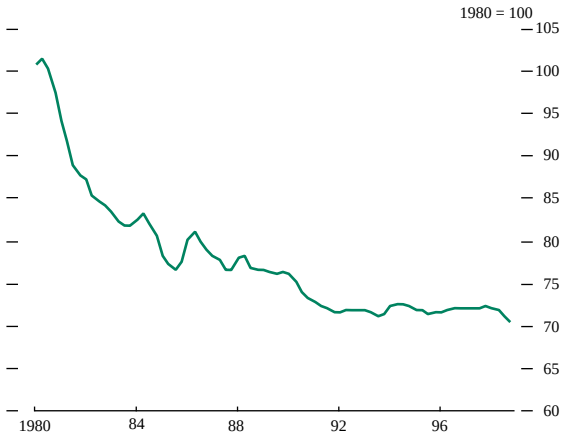
First-round effects depend on the importance of oil as an input, based on the energy intensity of production, the share of oil in total energy consumption and the share of oil prices in final petrol prices (margins and exchange rates will also impact on first-round effects.) Oil dependence can be inferred from oil consumption per unit of GDP, and is influenced by the production technology and the availability of alternative energies in the long run. Since the 1970s there has been a downward trend in oil dependence in the industrialised world, as Charts B and C illustrate. Indeed, OECD countries' consumption of oil per unit of GDP has fallen by almost a half since 1972, as countries have switched to more energy-efficient sources of production and alternative types of energy. So first-round effects in industrialised economies should now be lower.

Oil dependence in some emerging market economies (EMEs) has risen, however, as Chart C illustrates, so the global picture is somewhat different to that for industrialised countries only. In 1997, OECD countries accounted for about two thirds of world oil consumption, and other EMEs almost one third.

Data are not available for the weight of oil, as opposed to energy, in individual countries' consumer price indices (CPI). In the United States, gasoline accounts for 3.1% of CPI, while energy as a whole constitutes 7.0%. Energy has a weight of 9.0% in the euro-area CPI and 5.9% for Japan. But these numbers—which will be affected by differences in the tax rates on energy usage—do not include the oil content of other goods and services, which should also be included to capture first-round effects more fully.

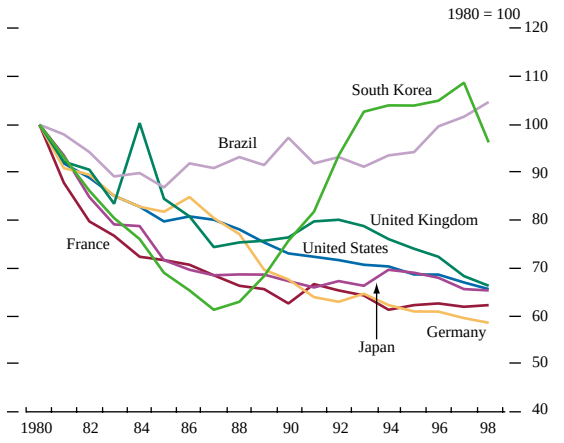
Charts D to F show the simple arithmetical contribution of the energy component to CPI inflation over the past few

Chart B
OECD consumption of oil per unit of GDP



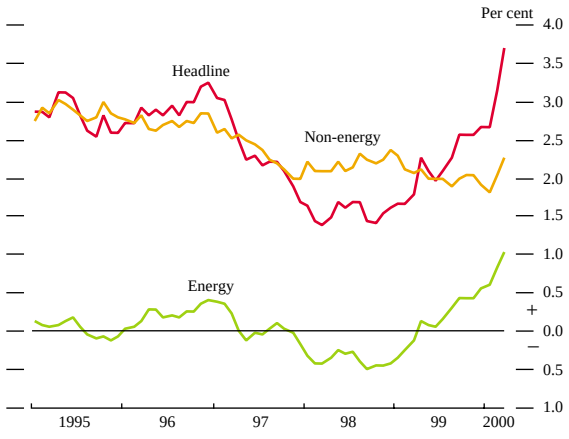
Source: OECD.

Chart C
Petroleum consumption per unit of GDP



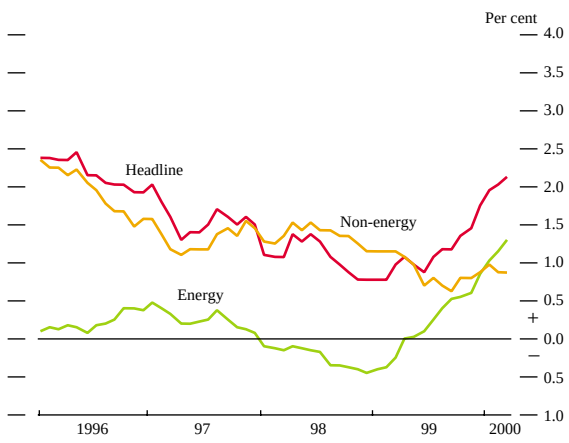
Source: United States Department of Energy.

Chart D
Contributions to US CPI inflation



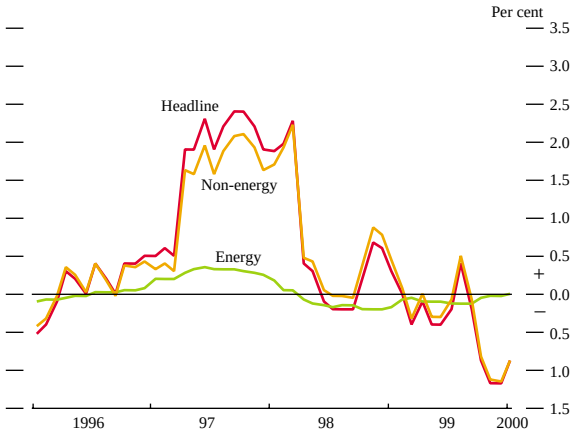
Source: Primark Datastream.

Chart E
Contributions to EU CPI inflation



Source: Primark Datastream.

Chart F
Contributions to Japan CPI inflation



Note: Energy consists of fuel, light and water charges.

Source: Primark Datastream.

years. For the United States and euro area, non-energy inflation has declined slightly over the past two years, while energy inflation has pushed the headline inflation measure up since the beginning of 1999. This is in marked contrast to 1998, when a negative contribution from the energy component pushed headline inflation figures down. In Japan, the contribution from energy has remained close to zero, suggesting that exchange rate developments have worked to offset movements in dollar-denominated oil prices.

Empirical estimates of the effect of oil prices on domestic inflation

Macroeconomic models can be used to gauge the likely impact of higher oil prices on domestic and export prices in the major economies. The use of such models is often criticised on two counts: first, that models reflect the average behaviour over the past two or three decades, so for example they would give too high a weight to oil based on past consumption patterns; and second, that they suffer from the Lucas critique, in that insufficient account is taken of agents' anticipation of future events. So, if monetary policy is more credible, inflation expectations may not respond as strongly to an oil price 'shock' as they did previously.

Considerable care is needed in interpreting such simulations, as they can be sensitive to the assumptions chosen. The weights used for the share of oil in input prices, which could be current weights, those of the past or an average over time, will affect the outcome. Another sensitivity would arise from choosing a model that assumes no reaction from the monetary authorities, rather than one in which monetary policy is assumed to respond and wage-setting behaviour to be forward-looking. So such simulations can be only indicative, and are generally accompanied by a considerable degree of uncertainty.

Nevertheless, there is considerable common ground in the results of simulations. They typically suggest that higher oil prices have a greater impact on export prices than on consumer prices, reflecting the higher oil content of exports (which typically have a larger share of goods than services). The more muted impact on consumer price inflation also reflects the reduced dependence of the OECD member economies on oil compared with the 1970s.

Higher oil prices will, other things being equal, increase inflation and lower output in most OECD countries, via lower real income and adverse terms of trade. The loss in output is mitigated to some degree, however, if oil-producing countries are assumed to spend most of their additional oil revenues (in contrast again to the 1970s). This assumption, and the large reduction in oil dependence in the OECD area, produces a much smaller terms of trade loss relative to GDP in the OECD than in previous oil shocks.

In general, the more modest pass-through from oil to wider measures of inflation seems consistent with the lesser dependence of OECD countries on oil than at the time of previous sharp oil price rises. It is also consistent with the higher credibility of monetary policy observed through the more modest rise in measured inflation expectations.

A comparison of long bond yields in the United Kingdom, the United States, and Germany

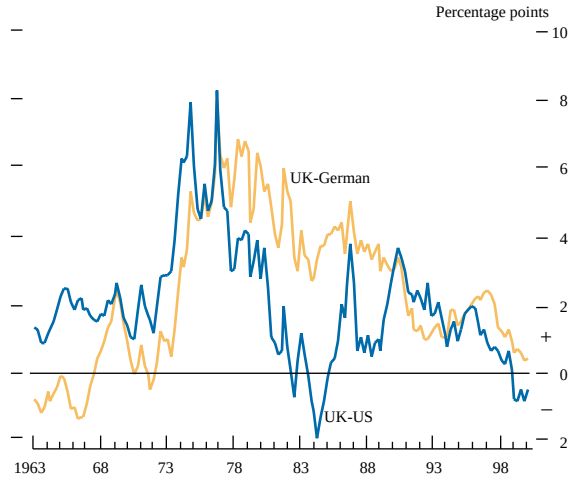
By Martin Brooke of the Bank's Gilt-edged and Money Markets Division, and Andrew Clare and Ilias Lekkos of the Bank's Monetary Instruments and Markets Division.

Long-dated gilt yields are currently well below the comparable German and US government bond yields for the first time in many years. This article considers what factors are likely to have contributed to these changes in nominal rates of return. We conclude that much of the decline in long gilt yields can be attributed to a decline in UK inflation expectations since the mid-1970s. However, we find evidence to suggest that gilt yields have more recently also fallen in response to a significant reduction in net gilt issuance combined with an increase in demand for gilts from UK institutional investors.

Introduction

For most of the past 30 years, investors have demanded a higher nominal rate of return on UK government bonds (gilts) than on either German or US government bonds (Bunds and Treasuries respectively). As can be seen from Chart 1, the gilt-Treasury and gilt-Bund spreads reached a peak of around 8 percentage points in 1976 (using quarterly data). Since then, however, the size of this yield premium on gilts has declined steadily; in February 2000, the redemption yield on the 5¾% Treasury Stock 2009 (the current benchmark ten-year gilt) fell below the comparable German Bund yield. Furthermore, longer-maturity gilt yields are now well below comparable Bund and US Treasury yields (see Chart 2).

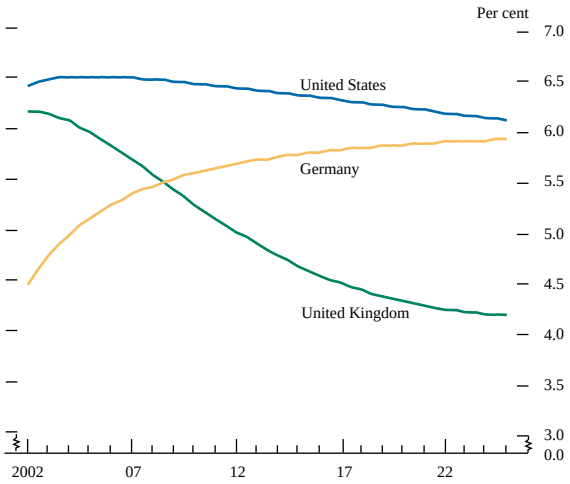
Chart 1
Ten-year yield differentials(a)



(a) Using redemption yields.

This article begins by outlining the main determinants, according to economic theory, of these changes in relative bond yields. It then goes on to discuss what other UK-specific factors may have influenced the bond yield differentials in recent years.

Chart 2
Par yield curves, as at 1 March 2000(a)



(a) Curves derived using Svensson curve-fitting technique.

UIP, PPP and the Fisher equation

Three theoretical economic relationships can be used to illuminate movements in international bond yield differentials: uncovered interest rate parity (UIP); purchasing power parity (PPP); and the Fisher equation.

The UIP condition says that, in a world of freely floating exchange rates and perfect capital mobility, interest rates and exchange rates should be such that a rational investor will be indifferent between the choice of holding an interest-bearing asset denominated in his or her domestic currency and an alternative asset with the same characteristics denominated in a foreign currency. Expressed more formally, this implies that the difference between the one-period return on holding assets denominated in different currencies should be equal to the expected exchange rate movement between the two currencies over the period, plus any risk premium attached to the uncertainty of the exchange rate forecast. This can be written as:

$$i_t^* - i_t = s^e_{t+1} - s_t + \rho_t \qquad \textbf{(1)}$$

where i_t^* is the foreign one-period nominal interest rate; i_t is the domestic one-period nominal interest rate; s_t is the spot exchange rate (defined as the foreign currency price of domestic currency); s^e_{t+1} is the market's one step ahead forecast for the spot exchange rate made at time t;(1) and ρ_t is a risk premium. The implication of the UIP condition is that the bond yield differentials observed in Chart 1 reflect expected exchange rate movements between sterling, the US dollar and the Deutsche Mark over the life of the bonds, plus a risk premium.

Economic theory also suggests that differentials between the expected inflation rates in two countries should be the key factor affecting the expectation of any exchange rate movement between the two countries' currencies. This is known as the purchasing power parity (PPP) relationship:

$$\Pi^{e*}_{t+1} - \Pi^{e}_{t+1} = s^e_{t+1} - s_t \qquad \textbf{(2)}$$

where Π^{e*}_{t+1} is the market's forecast for the change in the foreign price level between periods t and $t+1$, and Π^{e}_{t+1} is the market's equivalent one step ahead forecast for domestic inflation. Combining the UIP and PPP conditions, we can see that most of the observed spreads between the yields on UK, US and German government bonds should be related to expected inflation rate differentials between the three countries over the life of the bonds. So the risk premium in **(1)** represents uncertainty surrounding future inflation differentials.

Finally, the Fisher equation (1930)(2) states that the nominal return (i) required by investors to induce them to purchase and hold a bond is made up of two components: the expected rate of inflation over the holding period for the bond (Π^e), and the real rate of return (r):

$$i_t = \Pi^{e}_{t+1} + r_t \qquad \textbf{(3)}$$

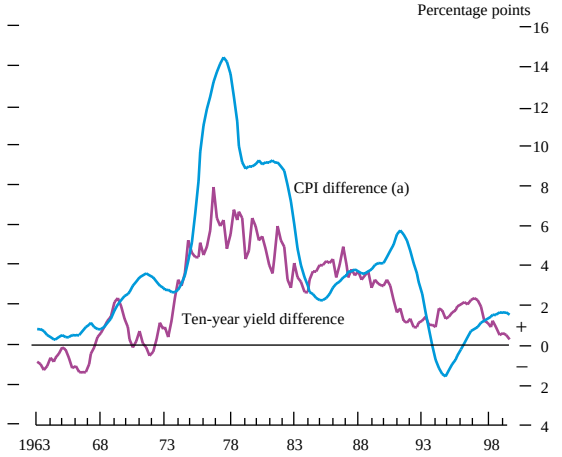
Clearly, if equations **(1)** and **(2)** hold, then the real rates of return in different currencies should be the same. However, there is strong evidence to suggest that PPP often does not hold, particularly in the short and medium term. This implies, therefore, that the nominal bond yield differentials that we observe between the United States, Germany and the United Kingdom may be affected by changes in relative real rates of return, as well as by changes in relative inflation expectations and changes in risk premia.

The role of inflation expectations

A possible explanation for the narrowing in the yield spreads between gilts and both Bunds and Treasuries over the past 25 years is that expected inflation has fallen more in the United Kingdom than in the United States and Germany. Inflation expectations are generally thought to be influenced by a combination of the following factors: the current rate of inflation; the economy's position in the business cycle; its historical inflation performance; and perceptions about the policy objectives of the monetary authority. The measure of inflation expectations that is relevant for nominal bonds is the expected change in the price level over the life of the bond—in this case, ten years. Unfortunately, as most survey measures of agents' inflation expectations focus on much shorter time horizons than this, typically only one or two years, they are not particularly appropriate benchmarks to use. We are therefore forced to consider alternative measures.

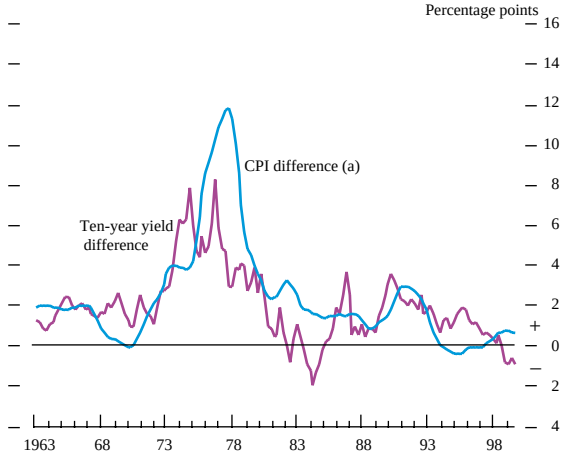
The simplest approach is to assume that an average of past inflation can be used as a rough proxy for the expectation of average annual inflation over the following ten years. Though this is a crude approach, Charts 3, 4, and 5 show that three-year backward-looking moving averages of inflation differentials between the United Kingdom, Germany and the United States go a long way towards explaining the relative bond yield differentials between these countries. Inflation differentials have declined with yield

Chart 3
UK-German bond yield and inflation differentials



(a) Using three-year backward-looking moving averages of headline consumer price inflation.

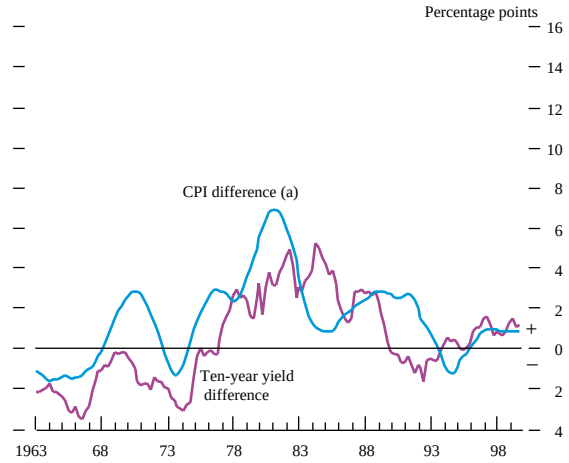
Chart 4
UK-US bond yield and inflation differentials



(a) Using three-year backward-looking moving averages of headline consumer price inflation.

(1) The exchange rates in **(1)** are expressed as logs.
(2) *The theory of interest*, New York, Macmillan.

Chart 5
US-German bond yield and inflation differentials



(a) Using three-year backward-looking moving averages of headline consumer price inflation.

spreads. In all three cases the correlation coefficients between the quarterly movements in bilateral inflation and bond yield differentials are at least 0.64. Hence it seems reasonable to conclude that the convergence of UK inflation towards the levels prevailing in Germany and the United States helps to explain much of the narrowing in the yield spread between UK nominal bonds and US and German nominal bonds.

An alternative, and possibly better, measure of ten-year average inflation expectations can be derived for those governments which issue both conventional bonds and index-linked bonds. By rearranging the Fisher equation, we can obtain a measure of inflation expectations from the difference between the nominal yields and real yields prevailing on conventional and index-linked government bonds. However, the German government does not issue index-linked debt and the United States began to do so only recently. Hence it is not yet possible to derive long time series of expected inflation differentials in this way.

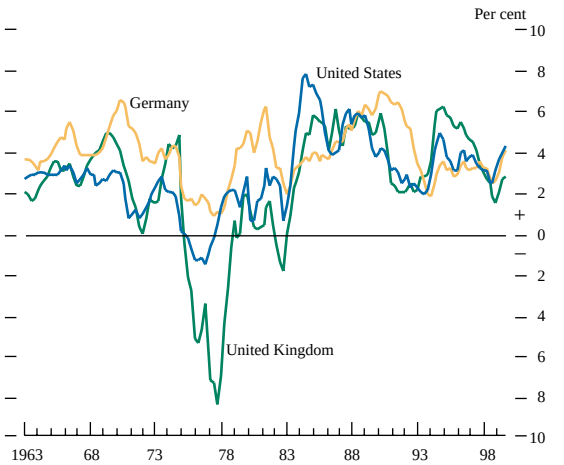
The discussion so far has focused exclusively on ten-year bond yields. The reason for this is that the German, UK and US governments have historically tended to issue bonds of this maturity and so long time series of yields are readily available. Issuance of government bonds with greater maturities has not been as common—Germany has issued relatively few bonds beyond ten years in duration. As a result, it is more difficult to assess the extent to which movements in inflation differentials can also explain changes in 20 or 30-year government bond yield differentials. However, both the UK and US governments have regularly issued bonds with maturities as long as 30 years. Furthermore, the correlation between quarterly movements in 10 and 20-year government bond yields in both the United States and the United Kingdom has been high over the past three decades, at almost 0.9. Although there have been episodes when the UK-US 10 and 20-year yield spreads diverged from one another, these have been relatively short-lived. Over most of the period, the UK-US 10 and 20-year yield spreads have moved broadly in line with each other. So it seems reasonable to conclude that changes in expected inflation differentials also help to explain a large proportion of the changes in government bond yield differentials at maturities greater than ten years.

The role of the real rate of interest

As noted above, another factor that might have contributed to the decline in the gilt-Bund and gilt-Treasury spreads since the 1970s is the possibility that the real rate of return on UK government debt has fallen, relative to the real rates of return on US and German government bonds. In a world with perfect capital mobility, freely floating exchange rates, and risk-neutral investors, both UIP and PPP should hold, implying that the real rates of return on bonds with identical characteristics issued by different governments should be the same. This might suggest that differential movements in real rates of return are unlikely. However, most empirical studies suggest that PPP does not hold in the short run and that the degree of international capital mobility has increased over the past three decades. Hence, if international capital mobility was more limited in the 1970s and early 1980s, the full equalisation of real rates of return on UK, US and German government bonds may have been impeded.(1) So, if real rates of return were higher in the United Kingdom than in the United States and Germany in the past, this development could also explain falling relative gilt yields.

In Chart 6, we plot the real yield on UK, US and German ten-year government debt, derived as the difference between the nominal yield and a three-year moving average of CPI inflation (used as a proxy for the average rate of inflation expected over the following ten years). This approximation (which assumes that there is no change in the relative prices of consumption baskets) suggests that real rates of return on UK, US and German government debt have diverged

Chart 6
Proxy ten-year real government bond yields(a)



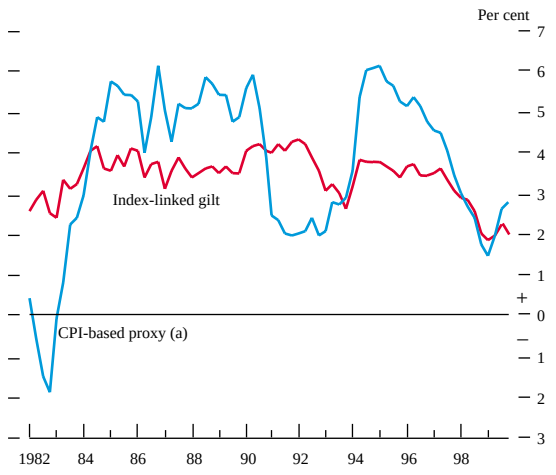
(a) Ten-year nominal redemption yield minus three-year moving average of headline CPI inflation.

(1) The United Kingdom abolished its exchange controls in October 1979.

markedly in the past, and often for considerable periods of time. Some divergence in these real rates should be expected, given the crude nature of our proxy for inflation expectations. In particular, although *ex ante* real returns should be equal if UIP and PPP hold, *ex post* real rates need not be equal if some unexpected event occurs. It is interesting to note, however, that the degree of divergence between these proxy measures of real rates appears to have diminished over the past 30 years. This appears consistent with an improvement in international capital mobility; but it could also be related to declines in differential international risk premia and reduced expectational errors. However, there is no clear sign that real rates of return in the United Kingdom in the 1960s and 1970s were higher than in Germany or the United States. Rather, Chart 6 suggests that the opposite may have been true—UK real rates appear to have been lower than in Germany and the United States. It is difficult to argue, therefore, that long-run convergence in real rates has contributed significantly to the decline in the United Kingdom's relative nominal yields.

The United Kingdom began issuing index-linked bonds in 1981. Chart 7 compares real zero coupon rates derived from UK index-linked gilts with the measure shown in Chart 6. As can be seen, the long-term real rate derived from the index-linked bonds is less variable than our CPI proxy measure. This suggests that long-term inflationary expectations may be slower to respond to current inflation outturns than implied by our three-year moving-average proxy. Nevertheless, index-linked bonds tend to confirm the indication from the proxy measures that real rates of return can differ between countries—at the beginning of April, the yield on the benchmark ten-year US index-linked bond was around 4%, while the equivalent yield on a ten-year index-linked gilt was around 2%. With the increases in international capital mobility observed in the past 20 years, such differences may reflect country-specific, institutional factors (or differences in the measurement of inflation between the United States and the United Kingdom).

Chart 7
Alternative measures of ten-year UK real gilt yields



(a) Ten-year nominal redemption yield minus three-year moving average of headline CPI inflation.

The role of risk premia effects

According to expressions **(1)**, **(2)** and **(3)**, differences between nominal yields will be determined by expected inflation differentials and a risk premium, where the risk premium will be related to uncertainty about future inflation differentials, about the exchange rate and about the real rate of interest. It is possible that risk premia effects may be able to explain some of the longer-term decline in bond yield spreads.

In order to gauge the size of any risk premia effects among major government bond markets, we need a model of government bond yields that will enable us to estimate the proportion of the yield spread determined by what we call 'bond market fundamentals' ($r + \prod^{e}$) and the proportion that is determined by risk premia effects (ρ). The model we use is based on a technique proposed by Campbell and Shiller (1987)[1] and involves estimating a vector auto-regression (VAR). From the model we can obtain a forecast of future short-term interest rates based on the estimated relationship between the variables in the VAR. Then, by invoking the pure expectations hypothesis (PEH) of the term structure of interest rates, we can obtain a measure of the theoretical long rate—the rate that would prevail in the absence of a risk premium. The pure expectations hypothesis refers to the idea that the entire term structure of interest rates reflects the market's current expectations of future short-term interest rates. According to this theory, if there were no risks attached to investing in bonds, an investor should be able to replicate the return available on a long bond by buying combinations of shorter-maturity bonds. We rely on the notion that PEH holds to derive our theoretical long rates. The difference between actual yields and the calculated theoretical rates derived from the model can then be used as a proxy for risk premia effects.

It should be noted, however, that this proxy for risk is an *ex post* measure. As such, it will include both risk premium elements and elements related to unanticipated shocks. We assume that the shock component is genuinely random and therefore that systematic movements reflect changes in risk premia. Furthermore, it is impossible to distinguish between the potential components of the measure, such as uncertainty about future exchange rates, future inflation rates, and future real rates of return.

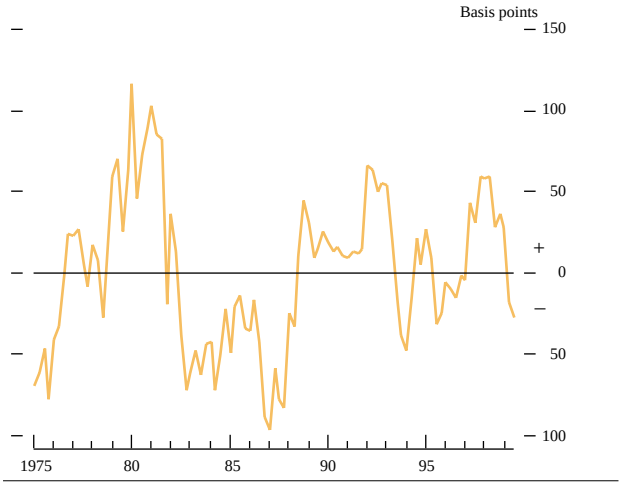
The system of equations used in our model was estimated with UK, US and German data. This framework allows us to calculate the actual and theoretical bond market spreads between these three markets. From the estimated econometric model, and after imposing the PEH condition,

(1) 'Cointegration and tests of present value models', *Journal of Political Economy*, Vol 95, pages 1,062–88.

we can monitor the changes in the bond spreads that are due to changes in financial market risk premia as defined above and the changes that are due to movements in the underlying, fundamental relationships between the markets. The estimated VAR includes the change in a short rate and a measure of the slope of the yield curve for the United States, the United Kingdom and Germany (see Clare and Lekkos (2000)[1] for a more detailed description of the methodology).

In Chart 8 we present the difference between the actual gilt-Bund yield spread and the theoretical gilt-Bund yield spread. Positive values in Chart 8 indicate that actual UK rates are higher relative to German rates than the PEH theory would predict them to be, and *vice versa*. We can discern three distinct periods: 1975 to 1982, 1983 to 1988, and from 1988 to the end of our sample. In the first and third of these periods, investors generally attached a positive risk premium to gilts relative to Bunds. Between 1982 and 1988 the situation was reversed, with investors attaching a higher risk premium to German government securities.

Chart 8
Difference between actual and theoretical £-DM spreads

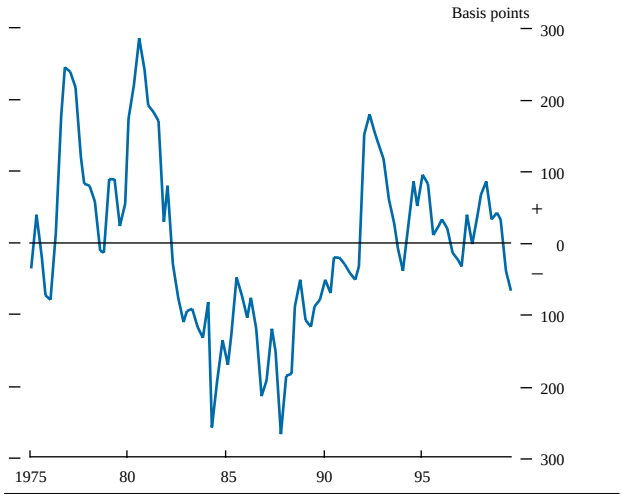


In June 1980, the relative premium on gilts peaked at more than 116 basis points. At this time the actual spread between gilts and Bunds was approximately 530 basis points. Thus our measure indicates that around a fifth of the spread might have been attributable to risk premia considerations. This, in turn, would imply that the rest of the spread was due to either expected inflation differentials or differences in the real rates of interest. Since 1988, the relative risk premium on gilts (over Bunds) has averaged around 20 basis points. However, it reached 57 basis points in June 1998, when the actual spread was around 110 basis points. This suggests that, at this time, a greater proportion of the observed spread was due to risk premia effects and less to expected inflation differentials and real interest rates.

Between 1982 and 1988 the risk premium was negative. In June 1987 the spread was -95 basis points, and the actual spread was around 350 basis points. The change in the sign of the risk premium may have reflected the impact of the Conservative government's monetary policy regime, which may have caused market agents to change the way in which they formed expectations about future short rates.

Chart 9 plots the difference between the actual and theoretical gilt-Treasury spreads. The chart is qualitatively similar to Chart 8, with positive risk premia at the beginning and end of the sample and a negative gilt premium in the middle of the sample. The key difference between the two charts is that the implied relative risk premium in Chart 9 is much larger than that in Chart 8. It is consequently more difficult to rationalise some of the model's results. In December 1980, for instance, the risk premium was 287 basis points while the actual spread between gilts and Treasuries was around 100 basis points, implying that expected inflation in the United Kingdom must have been lower than in the United States at the time. Given that actual UK inflation was around 3 percentage points higher than US inflation at the end of 1980, the model's results need to be interpreted with caution.

Chart 9
Difference between actual and theoretical £-$ spreads



Nevertheless, over the entire sample, Charts 8 and 9 do seem to indicate some decline in the risk premium attached to gilts, relative to Bunds and Treasuries. But the risk premium does not seem to have declined monotonically and could be said to time-vary around zero. If this is true (and our sample is too short to say definitively whether the premium cycles around zero) then risk premia are probably not the major contributory factor to the decline in the gilt-Bund and gilt-Treasury spreads over the past 25 years. A final point worth noting is that there has been a general increase in the relative importance of the risk premium as a component of the actual spreads, as rates of inflation between the respective economies have converged.

(1) Decomposing the relationship between international bond markets, *The Proceedings of the Autumn BIS Central Bank Economists' Meeting—International Financial Markets and the Implications for Monetary and Financial Stability*, The Bank for International Settlements, Basel, Switzerland, Vol 8, pages 196–213.

More recent changes in gilt-Bund and gilt-Treasury spreads

Chart 1 shows that the gilt-Bund and gilt-Treasury spreads have been declining since the mid-1970s. However, the decline in these spreads, or more specifically the decline in gilt yields, has received particular attention over the past two to three years. Since the beginning of 1997, UK-US and UK-German 20-year yield differentials(1) have declined by around 230 and 265 basis points respectively. Can changes in expected inflation rates, real rates, or risk premia account for this recent and dramatic decline?

Contemporaneous UK-US and UK-Germany twelve-month inflation differentials have declined by around 90 and 55 basis points since 1997. Furthermore, headline inflation rates in all three countries have been less than 4% since 1994. It is difficult, therefore, to rationalise the full extent of the decline in the 20-year yield spreads in terms of plausible changes in inflation expectations. Chart 6 offers weak evidence of a recent decline in UK real rates, while Charts 8 and 9 indicate similarly weak evidence of a decline in the relative risk premium attached to gilts. But it is possible that these changes have occurred as a result of other factors, ie changes unrelated to Fisher's equation.

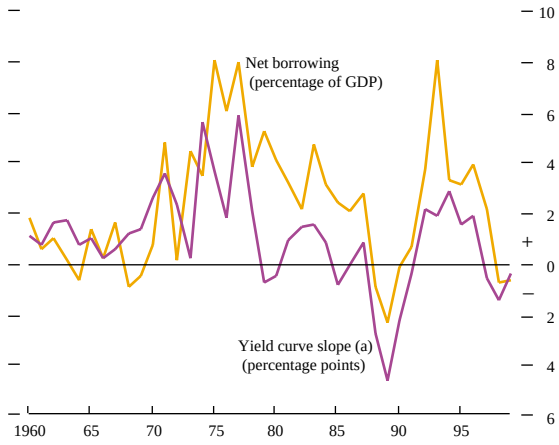
Recent gilt market specific factors

As Chart 2 shows, the UK yield curve is currently inverted. This inversion began in the second half of 1997 and has become more pronounced since. If this development were related to UK-specific factors then it will also have affected the current spreads between gilt yields and Bund and US Treasury yields.

There are a number of UK-specific supply and demand-side factors that may have influenced the shape of the gilt yield curve over the past few years. On the supply side, although all three countries have reduced their general government deficits, the improvement in the UK government's financial balance has been the most significant, changing by 9% of GDP since 1993, to a surplus of 0.7% of GDP in 1999. Net borrowing by the UK government has been negative since 1998 and the outstanding stock of gilts has, therefore, been contracting. In Chart 10 we plot net borrowing as a proportion of GDP and the spread between ten-year gilt yields and three-month interbank lending rates. We can see that there is generally a positive relationship between the two, and that the recent flattening of the UK yield curve, which began in 1996, coincides with a significant decline in net borrowing.

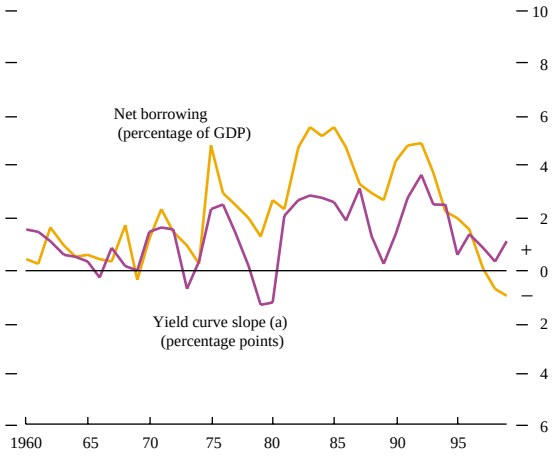
Similar relationships between net issuance and the slope of the yield curve can be observed in both the United States and Germany (see Charts 11a and 11b). However, the improvements in the US and German governments' fiscal positions have not been as large. Over the same six-year period, the US general government balance increased by

Chart 10
United Kingdom: government net borrowing and yield curve slope



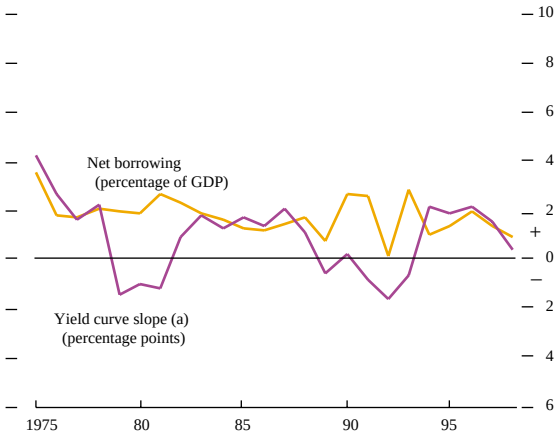
(a) Ten-year gilt yield minus three-month interbank lending rate.

Chart 11a
United States: government net borrowing and yield curve slope



(a) Ten-year gilt yield minus three-month interbank lending rate.

Chart 11b
Germany: government net borrowing and yield curve slope



(a) Ten-year gilt yield minus three-month interbank lending rate.

(1) 20-year bond yields derived using the Svensson curve-fitting technique.

6 percentage points to a surplus of 1% of GDP and the German balance improved by around 1½ percentage points to a deficit of 1½% of GDP. Hence, while the rate of gross new bond issuance has been falling in all three countries, the gilt market has experienced the largest relative adjustment since 1993. Furthermore, the outstanding stock of gilts is smaller than either the outstanding stock of US Treasuries or the stock of Bunds (both in gross terms and as a fraction of GDP). This might suggest that the relative impact of any given reduction in gross issuance would be larger in the gilt market than in either of the other two debt markets.

At the same time, the average maturity of UK pension funds has continued to increase. This has prompted pension fund managers to adjust the balance of their portfolios away from higher-risk equity investments in favour of less risky gilts (particularly long-dated gilts) in an attempt to match the expected return on their assets more closely with the known profile of their liabilities. In addition, over the past two or three years, many market participants have cited the Minimum Funding Requirement (MFR), applied under the Pensions Act 1995, as stimulating pension funds' demand for long-dated conventional gilts and making it less price-sensitive. Under the MFR, the liabilities of pension funds with a mature membership and obligations defined in nominal terms are discounted using 15-year gilt yields. This gives funds an incentive to hold long-dated gilts to reduce the regulatory risk of failing the funding requirement. These developments help to explain why the share of outstanding gilts held by pension funds has increased from around 18% in 1994 to more than 25% in 1998. Furthermore, the existence of these MFR benchmarks suggests that UK pension funds are unlikely to be indifferent between holding a 15-year gilt and holding any other 15-year fixed interest asset, regardless of whether it is denominated in sterling or a foreign currency. This may help to explain why the UIP and PEH conditions appear not to be holding at present.

Although the authorities in the United States and Germany do employ indirect and direct controls on the investment portfolios of their pension funds, there have not been any major changes to these rules in the past few years. Furthermore, anecdotal evidence from market participants suggests that MFR-type distortions at the long end of the yield curve are not generally viewed as influencing the shapes of the US and German yield curves.

The demand for gilts from life assurance companies has also increased strongly in recent years. This is related to two considerations. First, the decline in gilt yields has put pressure on insurance companies' solvency levels. This, in turn, has prompted some insurance firms to purchase more gilts in an attempt to improve their solvency. As with pension funds, the current regulatory regime (this time in the form of the Resilience Test) appears to provide the incentive for this self-reinforcing response to falling gilt yields. The second reason for insurance firms' increased demand for gilts relates to their past practices of selling policies with guaranteed minimum annuity rates. These minimum rates are now, in many cases, well above current market annuity rates, and the margin has widened as long gilt yields have fallen. This has prompted life assurance companies to make further purchases of gilts to limit the losses to which they are exposed. Again, this demand has been relatively price-inelastic. Consequently, the share of the outstanding gilt stock held by insurance companies has increased from 28% in 1994 to more than 35% in 1998.

The combination of this reduction in gilt supply and the simultaneous increase in demand by the two largest types of institutional holders of gilts may have contributed to the fall in yields at the long end of the UK yield curve. The timing of these demand and supply factors loosely fits with the timing of changes in the shape of the gilt yield curve, which began to flatten from 1996 onwards and became inverted by the second half of 1997.

These unusual supply and demand conditions suggest that the gilt market may have become more segmented than either the US Treasury market or the Bund market, with the prices of long-dated conventional gilts rising above the levels one might reasonably have expected to find on the basis of the UIP and PEH theories. We can attempt to obtain some idea of the degree of this gilt market 'overvaluation' by comparing the yields on gilts with those prevailing on other benchmark sterling-denominated debt instruments, such as the bonds issued by multinational financial institutions or the yields available in the swap market.

Given that the World Bank's (IBRD) debt is guaranteed by its member countries (one of which is the United Kingdom), the credit quality of gilts should be similar to that of IBRD bonds. To obtain an estimate of the degree of gilt market overvaluation, we can compare the spread between sterling-denominated IBRD bonds and gilts with the spread between US dollar-denominated IBRD debt and US Treasuries and the spread between euro-denominated IBRD debt and bunds. Unfortunately, however, because of the German government's limited debt issuance at maturities exceeding ten years, reliable estimates of the IBRD-bund spread can only be derived for the six to ten-year maturity range. This, therefore, also limits the comparisons we can make with developments in the gilt and Treasury markets.

Chart 12 presents these three spreads with respect to non-callable debt issued by the IBRD (where the spread is defined as IBRD bond yields minus government bond yields). If the six to ten-year duration gilts were 'overvalued' relative to Treasuries and Bunds, then we might expect the IBRD-gilt spread to be larger than either the IBRD-Treasury or IBRD-Bund spreads. As is shown, there was little difference between the three spreads until September 1998. However, the spread between UK gilts and IBRD debt widened rapidly after September 1998 to between 50 and 70 basis points, and has remained at this level since. In contrast, the IBRD-Bund yield spread has increased only marginally, to around 15 basis points, tentatively suggesting that UK gilts at this duration may be 'overvalued' relative to Bunds by around 35 to 55 basis

Chart 12
IBRD bond spreads

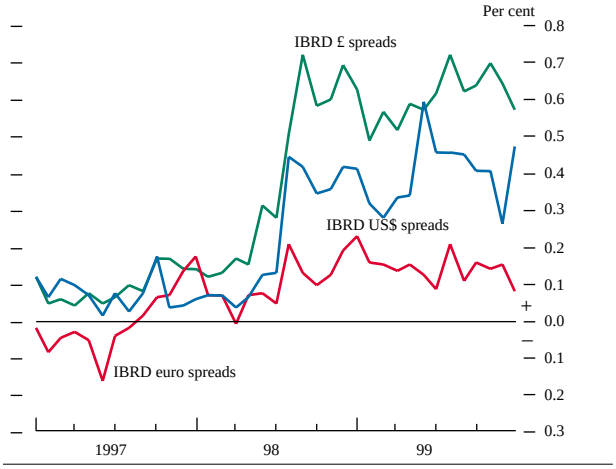
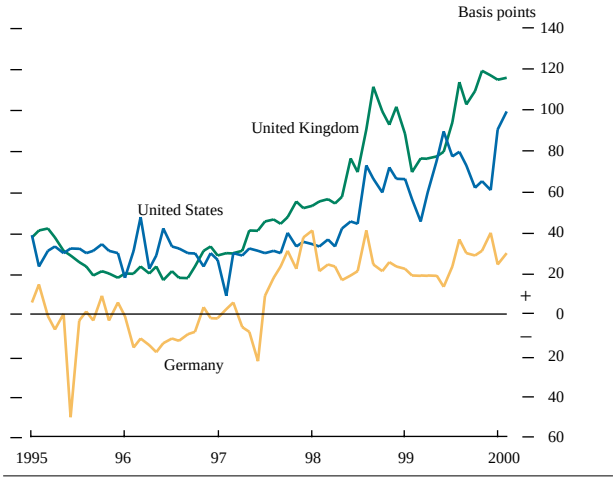


Chart 13
Ten-year swap spreads



points. But the rapid widening of the IBRD-gilt spread does not appear to be consistent with the MFR and gilt issuance developments noted above, which developed over a longer period. Also, the widening in this yield spread was not a UK-specific phenomenon. The spread between the yields on US dollar IBRD debt and US Treasuries follows a similar path to its sterling equivalent, although the US spread increases to around only 40 basis points. In both cases, the widening of these spreads coincided with the Russian debt crisis and the problems of the US hedge fund Long Term Capital Management.

An alternative approach is to use swap market yields as the benchmark against which to judge the value of gilts. However, here too it is difficult to get a reliable long-run time series of swap spreads at the 15-year maturity (where the MFR is likely to have been most influential). This is again because of the relative lack of long-duration Bunds, combined with the fact that the UK swap market becomes relatively illiquid beyond the ten-year maturity. Nevertheless, there is some evidence at the ten-year maturity of a gradual increase in gilt market 'overvaluation'. Since 1997, the swap-gilt yield spread has widened by a greater amount than either the swap-Bund spread or the swap-US Treasury spread (see Chart 13). This spread suggests that, at the end of 1999, ten-year gilt yields were 'overvalued' by around 60 basis points relative to US Treasuries and by almost 80 basis points relative to Bunds.

More recently, however, the US yield curve has inverted markedly, following announcements by the US authorities about their intentions to buy back the outstanding stock of government debt quicker than had previously been expected. As can be seen from the chart, this has led to a rapid widening in the ten-year swap-US Treasury spread, thereby closing most of the 'overvaluation' difference between the gilt and Treasury markets. This suggests that supply-related considerations in both the United Kingdom and the United States have had a larger influence on the shape of the yield curve than demand-related considerations.

Finally, it should be noted that 15-year gilt yields have fallen by around 290 basis points since the beginning of 1997, 65 basis points more than the decline in 10-year yields and 150 basis points more than the decline in 6-year yields. Given that the MFR benchmark relates to the 15-year gilt, both of the above estimates of gilt market 'overvaluation' may be underestimates. We might tentatively conclude, therefore, that around a third of the decrease in UK-US and UK-German bond yield differentials observed since the beginning of 1997 may have been related to reduced net issuance of gilts combined with the increase in demand for long-dated gilts from pension funds and life assurance companies.

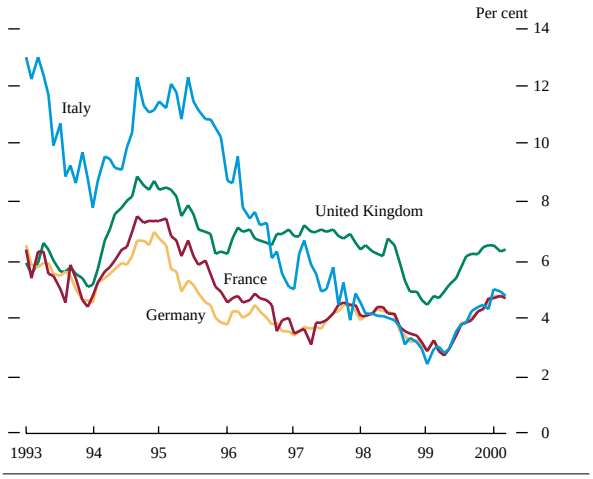
Expectations of European convergence

Another potential explanation for the convergence of UK long-term interest rates towards the level of German yields, particularly recently, relates to the possibility of the United Kingdom joining the European Economic and Monetary Union (EMU). There is only one official short-term interest rate for all EMU member countries, set by the European Central Bank. If financial markets believed that there was a realistic chance of the United Kingdom joining the euro area, then there would also be an associated expectation that UK short-term interest rates would converge on the levels prevailing in the euro area prior to entry.

As noted above, if there were no risk and liquidity premia effects, then the pure expectations theory of the term structure would hold, and forward interest rates would reflect forecasts of future short-term interest rates. In order to have convergence in implied short-term interest rates at all dates in the future, one also has to have convergence in long-term bond yields. So, if the perceived probability of UK participation in EMU had increased over the past five years, this would have added to the other factors discussed above leading to convergence in long bond yields.

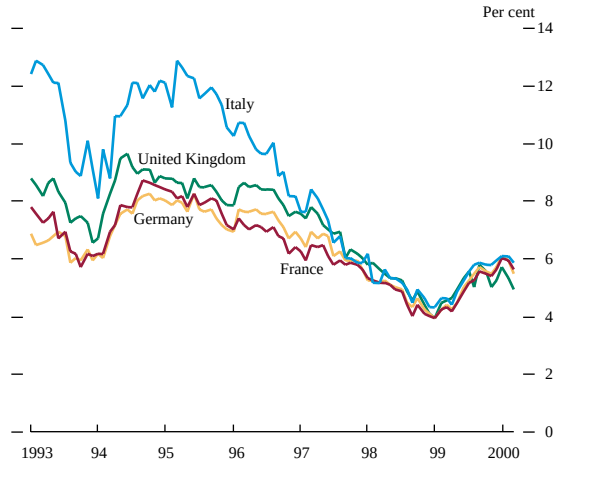
Chart 14 indicates that from the beginning of 1998 onwards there was full convergence in one year ahead implied six-month rates for Germany, France and Italy. This suggests that, by January 1998, there was a widely held expectation in the financial markets that these three

Chart 14
EMU convergence (implied six-month rates, one year ahead)



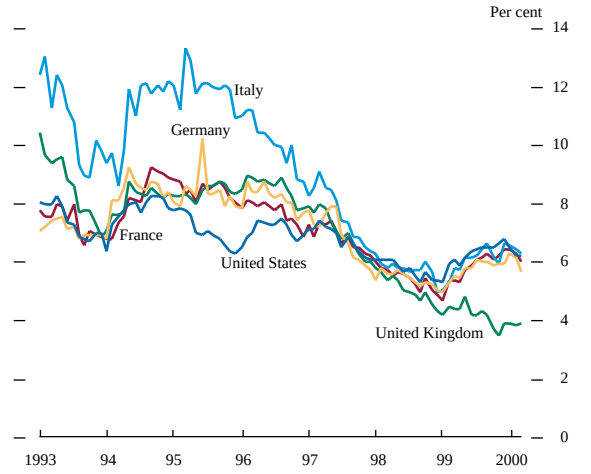
countries would all become members of EMU in January 1999. In contrast, UK one-year forward rates have remained more than 100 basis points above those in Germany and France since 1995, suggesting that the market believes there is little prospect of UK entry into EMU in the near term. At the five-year horizon, however, the perceived chance of UK participation in EMU appears to be much greater. As can be seen from Chart 15, UK five-year forward rates have closely mapped German and French rates since around 1995. This might suggest that the markets believe the United Kingdom will participate in EMU at some stage in the medium term.

Chart 15
EMU convergence (implied six-month rates, five years ahead)



However, this explanation clearly cannot be used to rationalise the convergence of UK and US long bond yields. Furthermore, forward interest rates in different countries may be aligned for reasons quite independent of the prospects for monetary union. As Chart 16 shows, ten-year forward rates from the United States, Germany, France and the United Kingdom have tracked each other reasonably closely since 1994. Interestingly, UK ten-year forward rate expectations fell below the levels prevailing in the other four countries from early 1998 onwards. This would appear to confirm the significance of the UK-specific factors noted above.

Chart 16
EMU convergence (implied six-month rates, ten years ahead)



Conclusions

We have considered some of the factors that may be behind the decline in the spreads between long-term gilt yields and yields on both Bunds and Treasuries. Much of the decline over the past 25 years or so appears to be attributable to a fall in inflation expectations in the United Kingdom relative to inflation expectations in Germany and the United States. We find little evidence to suggest a convergence of real rates of interest or a secular decline in relative, country-specific risk premia. While much of the decline in the yield spreads can be attributed to changes in relative inflation expectations, we also believe that the dramatic decline in these spreads over the past three years cannot be entirely due to this. Instead, we believe that some of the recent decline is due to gilt market specific factors. Around one third of the decrease in UK-US and UK-German bond yield differentials observed since the beginning of 1997 has been, we suggest, related to a significant reduction in net gilt issuance combined with an increase in the demand for long-dated gilts from pension funds and life assurance companies. The evidence from long gilt yields does not appear to be consistent with EMU-convergence stories. Indeed, US forward rates are closer to euro rates in ten years' time than are UK forward rates.

Money, lending and spending: a study of the UK non-financial corporate sector and households

By Andrew Brigden of the Bank's Structural Economic Analysis Division, Alec Chrystal of the Bank's Monetary Assessment and Strategy Division and Paul Mizen, consultant to the Bank's Monetary Assessment and Strategy Division.

Many empirical studies over the past three decades or so have reported estimates of the determinants of consumption, investment and the demand for money. This article summarises recent Bank work that seeks to understand more fully the demand for bank and building society loans, and the interactions between these borrowings and the demand for money and decisions to consume and invest. This work aims to enhance our understanding of the links between the monetary sector and real spending decisions.

Introduction

The main aim of this article is to assess whether the data on bank and building society lending to private non-financial corporations (PNFCs) and households contain information that could improve our understanding of the links between monetary policy and aggregate demand.

There is a long tradition of modelling monetary conditions in the economy by focusing on the demand for money, ie banks' liabilities. But monetary policy is implemented via changes in short-term interest rates, and these are thought to affect aggregate spending partly through changes in the demand for loans, ie banks' assets.(1) Loans are usually taken out in order to finance some form of spending, so lending and spending should be related, at least to some degree.

We examine lending for two reasons. First, the demand for bank loans can be thought of as an intermediate variable that interest rate decisions will influence. Higher interest rates affect spending, partly by reducing the demand for loans. So the behaviour of lending is part of the transmission mechanism of monetary policy. Second, data on M4 lending are produced every month, along with those on the money aggregates, and ahead of the national income accounts. The latter are available only on a quarterly basis, and initial releases may be subject to considerable subsequent revision. It is useful to know whether the lending data contain timely information about the likely course of spending that is additional to the information contained in the money data. Even if 'credit' does contain such additional information, it will not remove the need to study 'money', but rather will complement such work.

The article reports results for the PNFC and household sectors.(2) It shows that it is possible to model successfully the interaction between M4 lending to PNFCs, their money holdings, and investment spending. It also reports estimates of the interactions between *unsecured* M4 lending to households, and their money holdings and consumption spending.

A credit channel?

Recent academic literature has suggested that there is a 'credit channel' of monetary policy (see, for example, Bernanke and Gertler (1995)). We do not formally test for the existence of such a credit channel, but draw on the ideas raised in the literature to explain why an understanding of the determinants of credit might help us to understand better the transmission mechanism of monetary policy. Consider firms, for example. Small and medium-sized enterprises (SMEs) are typically more dependent on bank finance than large firms, because the latter can often borrow more easily and on better terms through securities markets. Prudent banks will limit their exposure to any specific firm, so firms will generally not have unlimited access to bank lending; hence the available supply of bank loans will be an important influence on these firms' spending, in addition to any effect from market interest rates.

Two variations on the credit channel story identify respectively a 'balance sheet channel' and a 'bank lending channel'. The first links the determinants of lending to observable characteristics of the financial health of the borrowing firms, and the second suggests some influences on lending flows originating within the banking system.

Banks typically have an ongoing relationship with the companies to which they lend, and they use information about a company's financial position obtained through this banking relationship to determine the loan facility they will offer. The nature of this relationship gives rise to what is

(1) See 'The transmission mechanism of monetary policy', *Bank of England Quarterly Bulletin*, May 1999, pages 161–70.
(2) This work is reported more fully in two Bank *Working Papers*: Brigden and Mizen (1999), and Chrystal and Mizen (forthcoming).

known as the balance sheet channel. Factors that are easily monitored, such as cash flow, financial wealth, previous loan payments history and outstanding debt, will affect the ability of a company to obtain loans; as will the value of collateral that firms are able to offer.

The extent to which SMEs are dependent on banks for finance, rather than on retained profits (internal sources) or securities markets (other external sources), gives rise to the bank lending channel. This channel refers to the extent to which factors internal to the banking industry influence the willingness of banks to lend; for example, capital losses on overseas lending or changes to the amount of regulatory capital required. These types of shift in loan supply, via the bank lending channel, may lead directly to changes in aggregate spending.

Factors affecting banks' readiness to extend credit to firms are also likely to influence the demand by firms to take up such credit. As the economy moves into an upturn, firms will demand more credit from banks to finance an expansion of production, whereas in a downturn they will reduce their demand for credit as activity declines. Firms will invest when they wish to expand their capital stock; bank credit will help to finance this expansion of capacity. Hence measures of real economic activity, as well as measures of financial health, are likely to be associated with increasing demand for bank credit in the long run. As indicators of firms' financial health affect both firms' willingness to borrow and banks' willingness to lend, we cannot easily distinguish empirically between demand-side and supply-side explanations using time series data.

Households are also affected by the availability of credit. The spending of credit-constrained households will be limited by current income, whereas the unconstrained can borrow against future income. In practice, different individuals face a range of differing degrees of credit availability, and changes in the supply of credit influence how much spending can exceed current income. Credit variables appear to have a significant influence on consumer spending (see Astley and Haldane (1995) and Bacchetta and Gerlach (1997)), and have been used empirically in consumption functions in models intended for forecasting (see Church *et al* (1994)).

Many households simultaneously hold positive money balances and some debt. This may seem odd, because the interest rate on debt is higher than the interest rate on savings deposits. But where households wish to consume the services of large durable goods, such as cars and houses, over time (and where there may be inefficient rental markets), it may be quite rational to finance the purchase of the durable good with a loan. At the same time, a working balance of money will be required to finance regular consumption patterns that are normally smoother than income receipts.

Most household debt is secured on housing, but this article focuses on unsecured debt. It is likely that most unsecured household borrowing finances either unusually high current spending that will be paid for later, or the purchase of durable goods.(1) Borrowing to finance the purchase of durable goods enables the services of the goods to be consumed over time, while paying off the capital cost. The borrowing usually occurs almost simultaneously with the act of spending: a loan facility may be arranged prior to the spending taking place, but in most cases the loan itself is activated in the process of paying for the good, such as by the extension of an overdraft or an increase in credit card debt.

Increased borrowing could be 'in distress', ie to maintain consumption in the face of an unanticipated fall in income, but borrowing may also allow early consumption in the face of unchanged or rising income. For example, a consumer may finance a holiday to be repaid out of future income, repay excess Christmas spending in January and February, or temporarily overdraw an account in anticipation of a pay rise or bonus in the near future.

The supply of bank lending to specific households is likely to be driven by the same types of variables as bank lending to firms. Though households typically do not construct balance sheets for their bank managers, the amount of credit will be conditional on measurable indicators of ability to repay, such as disposable income, liquid savings, previous loans history and outstanding debts. And, as with firms, those with the largest assets and income are likely to be those able to sustain, and therefore demanding, the largest loans. So some of the factors driving supply are also likely to drive demand.

Modelling lending

We are not aware of any previous attempts to estimate a structural model of the interactions between money, credit and spending for the main sectors of the UK economy.(2) In this article we examine this interaction for the PNFC and household sectors. We hypothesise that, just as there are demand functions for specific asset classes (such as money), so there are likely to be demand functions for specific classes of debt, and we attempt to model these simultaneously with the relevant expenditure functions.

The approach adopted to the study of 'credit' builds on earlier work in the Bank which focused on 'money'. The key innovation is the addition of a lending equation for the household and PNFC sectors. The econometric method

(1) Two points are worth noting. First, around 84% of the stock of bank and building society lending to individuals at the end of 1999 was secured on housing, and most of this has been built up directly to finance house purchases. Second, it is possible that some individuals borrow in order to finance speculative securities transactions, though such behaviour is likely to be a tiny part of aggregate personal sector activity. In this article we study only lending not secured on housing, though secured lending may also be used to finance non-housing consumption (mortgage equity withdrawal).
(2) Though causality tests in a VAR context are available in Dale and Haldane (1995).

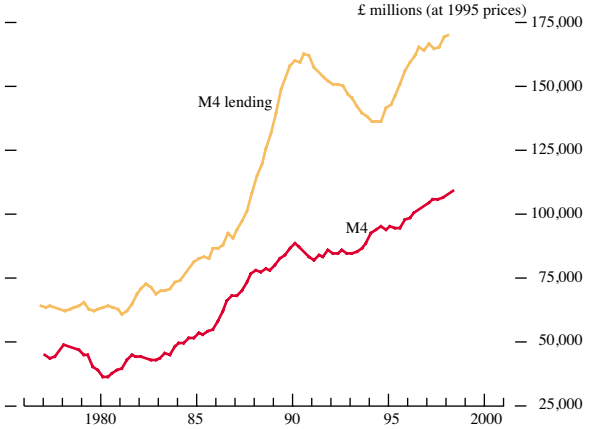
adopted uses the encompassing VAR technique proposed by Hendry and Mizon (1993), and applied to US money demand by Hoffman and Rasche (1996) and UK money demand by Thomas (1997a,b). The approach is a variation on the SVAR work outlined in Chapter 5 of *Economic models at the Bank of England*. This facilitates the estimation of long-run behavioural equations corresponding to familiar macroeconomic relationships, such as the consumption function, sectoral money demand functions, and the investment function. It then provides a framework for estimating dynamic interactions between variables. Thomas (*op cit*) modelled investment and money simultaneously for PNFCs, and consumption and money simultaneously for households. We have added lending to Thomas's system, so that we can study how lending influences spending, and how money and lending interact in different sectors. We first discuss our empirical model for PNFCs' money, lending and investment. This is followed by the results for the household sector.

Private non-financial corporations

Investment by firms can be financed from either internal or external sources, and among external sources there is a choice (for some) between bank borrowing and issuing securities. In this study we look only at bank finance and its links with investment. This is because we are particularly interested in the determinants of bank lending and its leading indicator properties. However, a comprehensive study of the links between corporate borrowing and investment would need to incorporate other forms of borrowing.

PNFCs' real money balances and bank lending follow different patterns over the cycle. Chart 1 shows the real value (at 1995 prices) of PNFCs' money holding (M4) and bank lending to PNFCs (M4L) from 1977 to 1998. PNFCs' money holding and bank borrowing follow a similar trend, but the latter is much more cyclical. It grew much faster than PNFCs' money balances from mid-1987 to mid-1990, but fell sharply in the recession of the early 1990s. As the economy recovered in the mid-1990s, lending to PNFCs picked up sharply. Bank lending to UK companies is clearly pro-cyclical. In contrast, PNFCs' money holding displays a relatively steady upward trend throughout the 1980s and 1990s. This suggests that lending is much more closely related than money to the cycles in economic activity, and so may provide better information about the prospects for domestic spending.

Chart 1
PNFCs—real M4 and M4 lending



The main component of domestic spending for which PNFCs are responsible is investment. We focus here on gross fixed investment, ie total investment excluding inventory accumulation. It is likely that bank borrowing is used partly to finance inventory accumulation, but we do not attempt to explain changes in inventories. We do however use firms' own perceptions of whether their inventory levels are 'excessive' as one of the explanatory variables in our model.(1) This enables us to pick up a relationship between inventories and bank borrowing, as well as a relationship between inventories and money holding if one exists.

The modelling approach adopted was to estimate a system of equations that determine simultaneously each of the three (endogenous) variables of interest. These are real gross domestic fixed capital formation (i_t),(2) real money holding (M4) of PNFCs (m_t), and real M4 lending to PNFCs (l_t). The explanatory variables used are: real GDP at market prices (y_t); a measure of the proportion of firms reporting more than adequate stocks of finished goods, taken from the CBI monthly survey (s_{ut}); PNFCs' real financial wealth (w_t); PNFCs' real retained earnings (π_t); the real user cost of capital (c_{kt}); the spread of the M4 deposit rate over three-month sterling Libor (r_{dt}), referred to as the 'deposit spread'; the spread of the interest rate on bank lending to companies over Libor (r_{lt}), referred to as the 'lending spread'; and the real value of mergers and acquisitions (ma_t). All except interest rates are converted to natural logarithms, and estimates are for the sample period 1978 Q1–1998 Q1.

Real GDP measures the general level of economic activity, and this is likely to influence the demand for investment goods and the demand for bank borrowings. The CBI survey question on stocks can be thought of as a barometer of confidence about future demand prospects and is indicative of outturns in the recent past relative to expectations. If firms consider themselves 'overstocked', they are likely to be relatively pessimistic about demand prospects and may be less willing to undertake further investment in fixed capital. They may also need to undertake distress borrowing. Total financial assets measure the liquidity of the sector, which will be related to money holdings and bank borrowing. Undistributed earnings are a

(1) Chart 1.2 on page 4 of the May 1999 *Bank of England Inflation Report* shows that there is a high correlation between PNFCs' stock-output ratios and their net M4 borrowing (change in loans minus change in deposits). Here we are looking at the stocks of borrowing and money holding separately and over a longer period.
(2) The results reported here use whole-economy gross domestic fixed capital formation, but similar results can be obtained using business investment.

measure of the supply of internal finance, which is an alternative to bank finance. The real user cost of capital is an indicator of the cost per period of raising capital in the financial markets. The deposit spread and the lending spread are, respectively, the return on retail deposits relative to wholesale money market rates and the cost of bank borrowing relative to money market rates.

Estimation takes place in two stages. The first stage identifies long-run relationships between the levels of the variables listed above. The second stage estimates the determinants of the growth rates of investment spending, money holding and lending. The second stage uses as one of the explanatory variables the deviations of actual levels of investment, money and lending from their long-run relationships. The coefficients on these deviations indicate how quickly adjustments take place to return each variable involved to its long-run equilibrium level.

The estimated long-run relationships for the PNFC sector are:

$$i_t = y_t - s_{ut} - 2.813c_{kt} \quad \textbf{(1)}$$

$$m_t = 0.5i_t + 0.5w_t + 0.5s_{ut} + 11.204r_{dt} + 0.107ma_t \quad \textbf{(2)}$$

$$l_t = 0.5i_t + w_t + 0.5s_{ut} - 0.5\pi_t + 4.432r_{dt} + 0.107ma_t \quad \textbf{(3)}$$

Equation **(1)** shows that investment is proportional to real GDP in the long run, and is negatively related to the survey measure of more than adequate stocks, and to the cost of capital.(1) The former captures the effects of excess capacity(2) and lack of business confidence about planned investment, while the latter captures the normal inverse relationship between quantity demanded and price.

Equations **(1)** to **(3)** explain long-run investment, money demand and demand for bank lending, but **(2)** and **(3)** both contain investment as one of the explanatory variables, which itself depends on other variables. To obtain expressions for money and bank lending that do not rely on investment, we substitute out for investment using equation **(1)** to obtain:(3)

$$m_t = 0.5y_t - 1.407c_{kt} + 0.5w_t + 11.204r_{dt} + 0.107ma_t \quad \textbf{(4)}$$

$$l_t = 0.5y_t - 1.407c_{kt} + w_t - 0.5\pi_t + 4.432r_{dt} + 0.107ma_t \quad \textbf{(5)}$$

Equation **(4)** can be thought of as the PNFCs' long-run money demand function. The stock of PNFCs' M4 deposits varies positively with GDP, financial wealth, the bank deposit rate, and mergers and acquisitions activity. It is negatively related to the cost of capital.

Equation **(5)** shows the long-run determinants of the stock of bank lending to PNFCs. This varies in proportion to financial wealth, and is also positively related to GDP, the deposit spread, and mergers and acquisitions activity. Lending is negatively related to the cost of capital and to retained earnings. The latter indicates that bank lending to PNFCs falls as the alternative, and preferred, internal source of funds expands. Note that borrowing from securities markets is also available to firms. This is excluded from the present study but could be included to provide a more complete picture.

The second stage of our analysis looks at the growth rates of the investment, money and lending variables; it incorporates the deviations from the estimated equations **(1)**, **(2)** and **(3)** discussed above. We refer to the fitted values of the long-run relationships for investment, money and lending as i^*, m^* and l^* respectively, so the deviations of their actual values from the fitted values consistent with the long-run equations are labelled (i-i^*), (l-l^*) and (m-m^*). In equations for the growth rates of investment, money and lending, the estimated coefficient on each of these terms indicates how quickly these variables revert to their long-run values.

The estimated dynamic equations appear in Table A, and the actual and fitted values for each of these equations are shown in Chart 2. The coefficient on the deviation term in the investment equation indicates that investment adjusts by about 16% per quarter towards its long-run equilibrium. In the same equation, the coefficients on both (l-l^*) and (m-m^*) are significant at the 5% level.(4) The negative coefficient on the lending deviation term indicates that when lending is above its long-run equilibrium, investment tends subsequently to fall, while the positive coefficient on the money deviation term indicates that excess money holding by firms is associated with higher investment. Lending adjusts by about 12% per quarter towards its long-run equilibrium, while money adjusts more slowly at 6% a quarter.

The influences of these deviation terms are supplemented by the influence of current and lagged changes in the other variables, as shown in Table A. Chart 2 shows that these equations do a reasonable job of tracking the data on the actual values of investment, lending, and money growth. More detailed diagnostic tests and further discussions of the equation specification are available in Brigden and Mizen (1999).

(1) Note that all round-number coefficients are restricted. Some restrictions are necessary to achieve identification. The over-identifying restrictions are not rejected by the data. See Brigden and Mizen (1999) for further details.
(2) It could be questioned whether a cyclical variable such as excess stocks should appear in the long-run relationships; however, this series is non-stationary in our sample. This may be because the sample period is shorter than ideal, but it may also reflect changes in inventory behaviour since the early 1980s.
(3) These can be thought of as 'reduced forms' which relate endogenous variables to exogenous variables only.
(4) Not all deviation terms appear in all equations. Some are excluded to satisfy the requirements of econometric identification, while others may be eliminated as they are insignificant. See Thomas (1997a) on this issue.

Table A
Estimates of the dynamic structural model for PNFCs

Standard errors in brackets. Data period 1978 Q1 to 1998 Q1.

$$\Delta i_t = -0.1565(i\text{-}i^*)_{t-1} - 0.0923(l\text{-}l^*)_{t-1} + 0.0839(m\text{-}m^*)_{t-1} + 0.5430\Delta y_t - 0.4815\Delta c_{kt-1}$$
(0.0266) (0.0261) (0.0297) (0.2545) (0.2175)

$$- 0.7779\Delta r_{lt} - 0.9988\Delta r_{lt-1} + 0.2580$$
(0.7154) (0.5666) (0.1021)

$$\Delta l_t = 0.1631\Delta i_{t-1} + 0.4107\Delta l_{t-1} - 0.1246(l\text{-}l^*)_{t-1} + 0.0734(m\text{-}m^*)_{t-1} + 0.3466\Delta y_t$$
(0.0503) (0.0685) (0.0212) (0.0196) (0.1674)

$$- 0.2516\Delta y_{t-1} - 0.0418\Delta\pi_t + 0.0216\Delta\pi_{t-1} + 0.1796\Delta s_{ut} - 0.7787\Delta r_{dt} - 1.307\Delta r_{dt-1}$$
(0.1556) (0.0104) (0.0102) (0.0453) (0.4218) (0.4323)

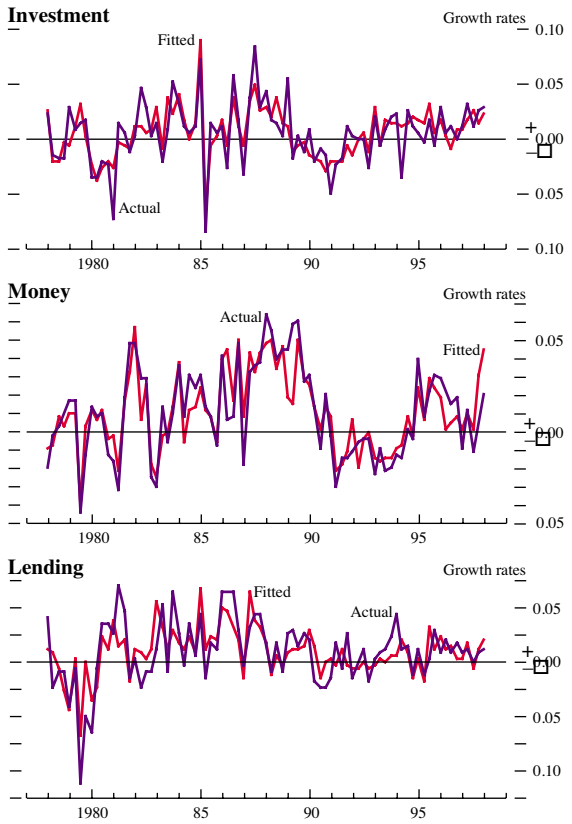
$$- 0.7539\Delta r_{lt} + 0.0072\Delta ma_{t-1} - 0.3172$$
(0.3730) (0.0017) (0.0598)

$$\Delta m_t = -0.1233\Delta i_{t-1} - 0.1863\Delta l_{t-1} + 0.2812\Delta m_{t-1} - 0.0350(l\text{-}l^*)_{t-1} - 0.0632(m\text{-}m^*)_{t-1}$$
(0.0928) (0.1084) (0.0881) (0.0334) (0.0316)

$$+ 0.8271\Delta y_t + 0.1708\Delta w_t + 0.5427\Delta c_{kt} + 0.5527\Delta c_{kt-1} + 3.1371\Delta r_{dt}$$
(0.2778) (0.0837) (0.2455) (0.2423) (0.7383)

$$+ 1.4435\Delta r_{dt-1} - 1.0273\Delta r_{lt-1} + 0.0084\Delta ma_t$$
(0.8026) (0.6413) (0.0031)

Chart 2
Actual and fitted values for the dynamic structural model for investment, money and lending (PNFCs)



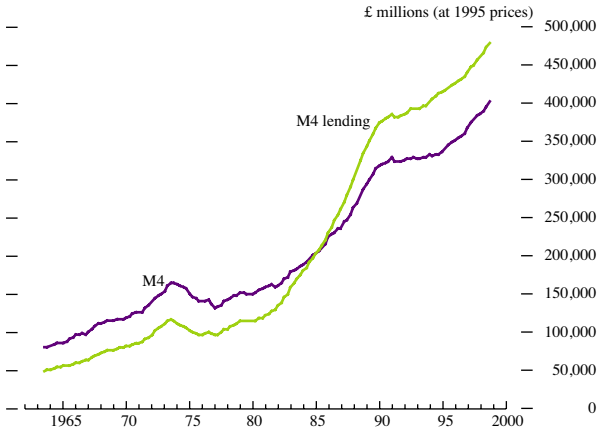
For PNFCs, the long-run level of lending is found to be heavily dependent on balance sheet items, such as real financial wealth and retained earnings, rather than on factors operating through the bank lending channel, such as the lending spread, which appears only in the short-run dynamics. A direct credit effect operates through 'excess' lending, which is associated with a decrease in investment, but the influence of the company balance sheet on banks' willingness to lend and firms' readiness to borrow supports both a supply-side 'balance sheet channel' and a demand-side interpretation.(1)

A key question is whether the inclusion of lending in the model adds significant explanatory power, particularly in relation to investment (which is a major component of domestic spending). There is sufficient evidence to support this view from the significance of the lending deviation term in the dynamic investment equation. This means that deviations of lending from its long-run equilibrium (as indicated by equation **(2)** above) add significant explanatory power to the investment equation, and so could improve investment forecasts. Of course, the decision to invest and the decision to borrow are made simultaneously, but the point is that 'excess' borrowing in one quarter helps to explain investment in the subsequent quarter, at least in this sample. In addition to this direct evidence, the lending deviation term is significantly linked to money, and money in turn has significant explanatory power in the investment equation. In short, we have found that when analysing investment, the lending data contain useful supplementary information to that found in the money data. It would be desirable in future to incorporate other forms of corporate borrowing into this analysis, but this does not detract from the fact that using bank lending provides an advance on using money data alone.

Households

Chart 3 shows the level of real household M4 holdings and of M4 lending to households since 1964. Until the early 1980s, households held deposits with the banking system that were substantially larger than their borrowings. However, M4 lending to households grew rapidly in the 1980s, following the liberalisation of financial markets. It settled down in the 1990s at a higher level than money holding but with a similar trend. Much of the increase in borrowing was housing-related, but there was also an

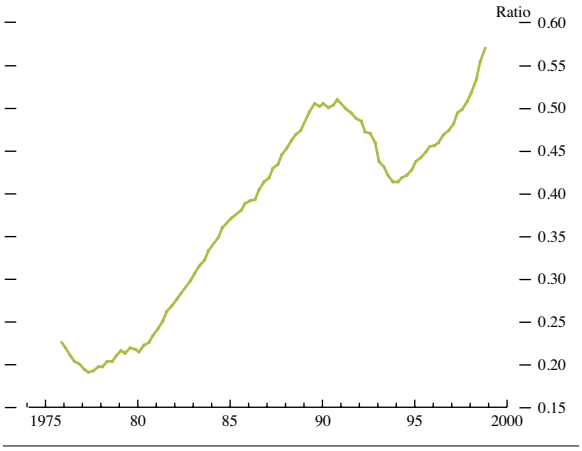
Chart 3
Households real M4 and M4 lending



(1) This is consistent with a credit channel, although we recognise that the limitations of using sectoral time series data mean that the evidence may be consistent with alternative interpretations.

increase in unsecured credit, which is the focus of our study. Chart 4 shows unsecured M4 lending to the household sector as a ratio of consumers' expenditure. This ratio also rose rapidly in the 1980s. It fell in the early 1990s but has risen sharply again since 1994.

Chart 4
Unsecured M4 lending to households as a ratio of consumer spending



The variables used in our model for the household sector are: real consumer expenditure by households (c_t); the stock of real M4 balances held by households (m_t); the stock of real unsecured M4 lending to households by banks and building societies (l_t); real net labour income (y_t); household real net total wealth (w_t), defined as housing wealth plus financial assets minus total debt; inflation (π_t), measured as the annual rate of change of the consumer expenditure deflator; a deposit spread, measured by the difference between the retail deposit rate and base rate (r_{dt}); and a credit spread of the credit card rate over base rate (r_{ct}). Two additional stationary variables used are an aggregate measure of consumer confidence ($conf_t$) and the percentage change in unemployment (Δu_t), measured by the claimant count. All data except the inflation rate, interest rate spreads, and the change in the percentage unemployed are converted to natural logarithms. The sample period is 1978 Q1–1998 Q4.

As with the PNFC model, we estimate three long-run relationships between the variables—one for each of the endogenous variables c_t, m_t and l_t:

$$c_t = -0.2m_t - 0.12l_t + 1.0y_t + 0.32w_t - 0.7\pi_t \quad \textbf{(6)}$$

$$m_t = 0.32l_t + 0.81y_t + 0.75r_{dt} \quad \textbf{(7)}$$

$$l_t = 0.85y_t + 0.77w_t - 1.5r_{ct} - 2.9\pi_t \quad \textbf{(8)}$$

As with the PNFC sector, there are interactions between consumption, money and lending.(1) The levels of real money and credit appear in the equation for household's real consumption. The inclusion of money in **(6)** can be interpreted as indicating that money has a different impact on consumption in the long run than do other components of wealth. A higher stock of lending lowers consumption in the long run (for given wealth and labour income) as the debt has to be serviced.

Substituting out in order to have only exogenous variables on the right-hand side, we derive equations that can be thought of as a long-run consumption function, money demand function and credit demand function.

$$c_t = 0.69y_t + 0.18w_t - 0.17\pi_t - 0.15r_{dt} + 0.28r_{ct} \quad \textbf{(9)}$$

$$m_t = 1.08y_t + 0.25w_t + 0.75r_{dt} - 0.48r_{ct} - 0.9\pi_t \quad \textbf{(10)}$$

$$l_t = 0.85y_t + 0.77w_t - 1.5r_{ct} - 2.9\pi_t \quad \textbf{(11)}$$

Lending to households, equation **(11)**, is positively related to income and wealth, although it is less sensitive to labour income and more sensitive to net wealth than is money demand. As the credit spread rises the stock of bank lending falls. The credit channel story suggests that these effects could represent the influence of the balance sheet (ie the importance of net wealth for credit provision) and bank lending channels (ie the dependence of households on banks and the stock of credit on the price of credit set by banks). But the results could also reflect demand factors—the negative effect of the credit spread is consistent with households undertaking less unsecured borrowing when credit rates rise relative to savings rates or rates on secured borrowing.

Equation **(9)** is the implied long-run consumption function. Real consumption has a plausible elasticity with respect to real labour income of 0.69, and is positively related to real net wealth. Both coefficients are smaller than those reported in equation **(6)**, as the positive influence of income and wealth on money and credit feeds through to reduce the net effect on consumption. In theory, the sign of the impact of inflation on consumer expenditure is ambiguous. However, most previous studies have found that inflation reduces real consumption. This could be because inflation increases uncertainty or because households expect a tightening of future monetary policy with rising inflation. A further reason could be that households attempt to restore the real value of their savings balances after erosion by inflation.

The deposit spread has a negative effect on consumption, but surprisingly the credit spread has a positive effect. Notice that this effect does not come directly from any term in equation **(6)**, rather it comes from the fact that lending appears in this equation with a negative sign and the credit spread appears in the lending equation with a negative sign. Both of these effects are highly plausible—borrowing is reduced by a widening in the credit spread, and consumption is reduced (in the long run) if debt is higher (because interest on the debt has to be paid out of

(1) Again some of these coefficients are restricted. Details can be found in Chrystal and Mizen (*op cit*).

disposable income, so sustainable consumption will be lower). So the positive effect of the credit spread on consumption arises because the higher is this spread, the lower is the stock of debt in the long run.

The money demand function, equation **(10)**, has a coefficient on labour income close to unity and a smaller positive coefficient on net financial wealth. These are very similar to estimates on aggregate data provided by Hall, Henry and Wilcox (1989). As deposit spreads increase, households hold more money on deposit. The credit spread and inflation are both negatively related to long-run money demand.

As above, we can generate deviation terms from equations **(6)** to **(8)** and use these in the dynamic equations to indicate the influence of long-run forces. These equations are reported in Table B, and the actual and fitted values are shown in Chart 5. We refer to deviations from the long-run equations as (c-c^*), (m-m^*) and (l-l^*) respectively. Our identification assumptions imply that (c-c^*) appears in all three equations, (m-m^*) appears in the equations for money and lending, and (l-l^*) appears in the lending equation alone.

Table B
Estimates of dynamic structural model for households

Standard errors in brackets. Data period 1978 Q1 to 1998 Q4.

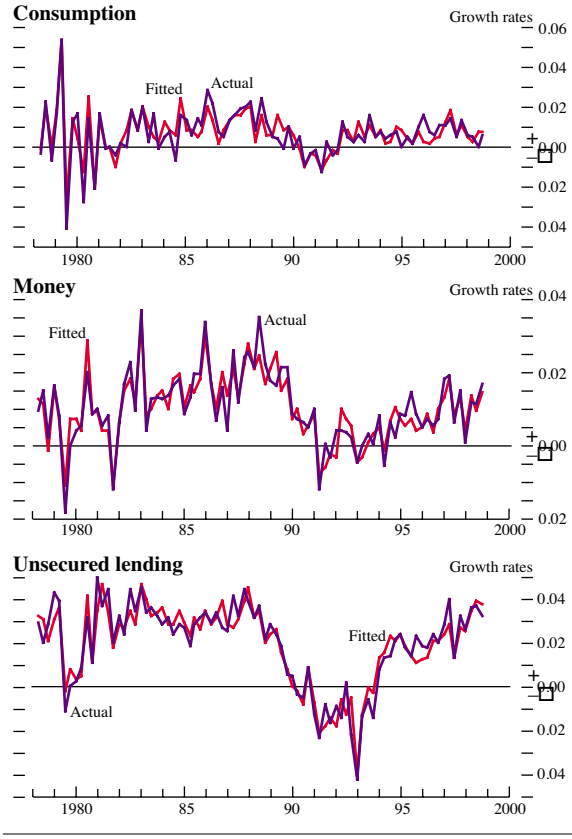
$$\Delta c_t = -0.47840\Delta c_{t-1} + 1.0720\Delta m_t + 0.21298\Delta m_{t-1} - 0.42172\Delta l_t + 0.16647\Delta l_{t-1}$$
$$(0.10039) \quad (0.17877) \quad (0.13024) \quad (0.15033) \quad (0.11404)$$
$$- 0.19998(c\text{-}c^*)_{t-1} + 0.14894\Delta y_{t-1} - 0.21103\Delta r_{dt-1} - 0.18266\Delta r_{ct-1} - 0.00922\Delta u_t$$
$$(0.04461) \quad (0.078614) \quad (0.18126) \quad (0.06852) \quad (0.004937)$$
$$+ 0.00947\Delta u_{t-1} + 0.00058\, conf_t - 0.00032 conf_{t-1} - 0.15265$$
$$(0.00499) \quad (0.00020) \quad (0.00018) \quad (0.026576)$$

$$\Delta m_t = -0.13773\Delta m_{t-1} + 0.19201\Delta l_t + 0.07308(c\text{-}c^*)_{t-1} - 0.13878(m\text{-}m^*)_{t-1}$$
$$(0.07729) \quad (0.04384) \quad (0.02143) \quad (0.02248)$$
$$+ 0.21249\Delta y_t + 0.03227\Delta y_{t-1} + 0.03701\Delta w_t + 0.03879\Delta w_{t-1} - 0.35582\Delta r_{dt}$$
$$(0.04118) \quad (0.04356) \quad (0.01504) \quad (0.01989) \quad (0.10317)$$
$$+ 0.11334\Delta r_{dt-1} - 0.19330\Delta r_{ct} - 0.31999\Delta\pi_t - 0.12454\Delta\pi_{t-1} - 0.009379\Delta u_{t-1}$$
$$(0.10146) \quad (0.04521) \quad (0.05263) \quad (0.06116) \quad (0.001702)$$
$$- 0.000295 conf_t + 0.045911$$
$$(0.000007) \quad (0.012100)$$

$$\Delta l_t = -0.45759\Delta c_{t-1} + 0.32978\Delta l_{t-1} + 0.31556\,(c\text{-}c^*)_{t-1} - 0.50685(m\text{-}m^*)_{t-1}$$
$$(0.09673) \quad (0.08441) \quad (0.09312) \quad (0.07401)$$
$$- 0.17603(l\text{-}l^*)_{t-1} - 0.48094\Delta r_{dt-1} - 0.38030\Delta r_{ct} - 0.52959\Delta\pi_t - 0.32658\Delta\pi_{t-1}$$
$$(0.03225) \quad (0.17818) \quad (0.09175) \quad (0.10147) \quad (0.12426)$$
$$+ 0.00691\Delta u_{t-1} + 0.00058 conf_t - 0.00054 conf_{t-1} - 1.5292$$
$$(0.00366) \quad (0.00019) \quad (0.00019) \quad (0.26598)$$

Taking the equations in reverse order is helpful, given that deviations of money and consumption from their long-run fitted values influence the dynamics of lending, and the deviation of consumption from its long-run value affects the dynamics of money. The adjustment speed of lending towards its long-run value is 18% per quarter. Excess money and consumption have a very strong influence on lending, with estimated adjustment speeds per quarter of 31% and 50% respectively. Excess money balances are associated with reduced lending, suggesting that excess money balances are used to pay off borrowing. Excess

Chart 5
Actual and fitted values for the dynamic structural model for consumption, money and unsecured lending (households)



consumption leads to increases in lending, suggesting plausibly that a build-up of unsecured borrowing results from periods of abnormally high consumer spending. Past changes in lending have a positive influence on the contemporaneous change in lending, and increases in the cost of credit and the return on deposits (relative to base rate) reduce the growth rate of unsecured lending. The growth of lending is also affected negatively by inflation. Past changes in unemployment and the level of consumer confidence have a small but significant positive influence on credit.

In the dynamic equation for money, the adjustment speed to excess money balances is 14%, slightly higher than the 11% reported by Thomas (1997a), but slower than the adjustment speed of unsecured credit. A smaller adjustment speed on money balances is consistent with the view that money is used as an inventory or buffer stock to 'mop up' shocks to financial resources coming from either unexpected income or unplanned spending. Excess consumption has a positive effect on the dynamics of money balances, as it did on lending, although the adjustment speed, at 7%, is a quarter of the rate recorded for the lending equation. Contemporaneous adjustments to lending have a positive effect on current changes to money balances in these results, suggesting that when households borrow to spend they also run up money balances, reversing the effect in subsequent quarters. Changes to income and wealth increase money balances, although changes to deposit rates have a perverse

negative effect on money balances. Higher unemployment reduces money growth, again supporting the idea that money is a buffer stock. Also money growth is negatively related to confidence and inflation. Both these effects support the view of money holdings as being to some extent precautionary.

Lastly, the consumption equation implies that 20% of the difference between actual consumption and its long-run fitted value is eliminated in each quarter. Consumption growth is negatively related to its own lagged value, which appears contrary to the idea of consumption smoothing, but this result may simply be an offset to the strong positive influence from current and lagged money growth. It could also result from the inclusion of durables in our consumption data. Consumption is negatively related to lending growth but this is unwound in the following quarter. Growth of labour income is associated with a contemporaneous increase in consumption growth. Higher deposit and credit spreads over base rates lower consumption growth with a lag. The former reflects the attractiveness of saving over consumption while the latter is associated with the higher costs of borrowing to pay for consumption. The change in the rate of unemployment has a small negative contemporaneous impact on consumption growth, as does consumer confidence.

Thus one key feature of our equations for households appears to be the rapid speed of adjustment towards the long-run fitted values. This suggests that adjustments to restore long-run desired positions are quickly implemented so disequilibria do not persist for long, but while they do exist they are a major determinant of changes in household spending. Other details of the specification and testing of this model are discussed in Chrystal and Mizen (*op cit*).

A second key feature of these results is that the addition of lending does appear to add significant explanatory power. The lending deviation term does not appear in the consumption equation in this case, but lending growth is significant in the consumption equation. Lending growth is also a significant determinant of money growth, which itself is a significant determinant of consumption growth. In addition to these dynamic effects, lending is significant in the long-run equation for consumption. The combined impact of all these effects gives the clear message that lending does influence the path of household consumption.

One important limitation of the present study is that it excludes household borrowing via loans secured upon housing. Some such secured loans are undoubtedly used from time to time to finance non-housing consumption in the form of mortgage equity withdrawal (MEW) and are a substitute for unsecured credit. The incorporation of MEW must, however, await future research. For the present we are content to have shown that the study of one component of bank credit adds useful information to that available from the study of 'money' alone.

Summary and conclusions

This article demonstrates that it is possible to estimate relationships that explain lending to firms and households, and that lending is driven by the same factors that drive the more intensively researched categories of money demand, consumption and investment. The results show that there are identifiable interactions between credit, money and spending in the United Kingdom, and that there are econometric advantages from estimating these relationships simultaneously. These results also offer some helpful insights for the interpretation of monetary data. Money and credit are related to spending at the sectoral level. The long-run values of money, spending and lending are driven by a small number of explanatory variables. Deviations from long-run fitted values have a significant impact on spending growth in the PNFC and household sectors.

So what might this evidence add to our understanding of the transmission mechanism of monetary policy? We can be confident in the prediction that excess money growth would eventually lead to higher nominal spending and then inflation. But the interpretation of 'excess' lending is not obvious, *a priori*, as it could signal either a future cut in consumer spending or an imminent spending increase. In the former case, borrowing would be used to sustain short-term (committed) consumption in the face of declining income, but this could not be sustained forever, and spending cutbacks would follow. Alternatively, a pick-up in borrowing could indicate an increase of confidence in future income growth, and credit growth would then be an indicator of future inflationary pressure. It could be that both of these forces work together. Evidence from Dale and Haldane (1995) suggests that individuals react to some degree almost immediately to a monetary tightening, ie higher interest rates, by cutting both spending and borrowing. However, firms might extend their credit lines to finance rising stocks and constant wage bills, in the face of falling final demand.

The results reported above do not fully resolve this issue. But they have improved our understanding of the links between money and credit and the spending decisions of households and firms. There do appear to be significant interactions between lending to firms and households, and money, consumption and investment. The estimated system of equations potentially gives a framework that helps us to interpret the likely impact of observed credit growth on future spending. These estimates are tentative and require further empirical verification. Notwithstanding these reservations, channels that involve credit as well as money balances appear to matter for the transmission mechanism of monetary policy.

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Monetary policy and the euro

In this speech,[1] *the* ***Governor*** *first discusses the long-term changes that have occurred in the approach to economic management in the United Kingdom, then sets out the improvement in recent economic performance. The Governor goes on to say that the economic problem for the United Kingdom is the imbalance between the domestically orientated and the most internationally exposed sectors, identifying as the most important causal factor the persistent weakness of the euro. He comments that it is difficult to see what the authorities in the United Kingdom can do to resolve this, as substantially lowering interest rates would not help the suffering sectors in anything other than the short term and would have a potentially destabilising effect on the wider economy. Finally, the Governor surveys the economic pros and cons of UK membership of the euro and considers the prospects for structural reform in the euro area.*

It's a real pleasure to be here in Yorkshire and I am greatly honoured to have this opportunity to speak to such a large and distinguished audience. I am honoured—but also, I must confess, somewhat daunted. I am acutely aware of the fact that, while there are some parts of the region that are—economically—doing extremely well, other parts, particularly those most exposed to international competition, are under the hammer. That's true of course of the UK economy as a whole. I'm equally aware that the suffering sectors ascribe their pain to the strength of sterling, particularly against the euro, which is certainly a contributory factor; and that they ascribe the strength of the exchange rate to our domestic monetary policy and to the Monetary Policy Committee.

I should like to address some of these concerns this evening and then go on to say a few words about the great euro debate.

Let me begin with some comments on the very profound changes that have occurred, gradually over a long period, in the approach to economic management in the United Kingdom and in our more recent economic performance.

For most of the first half of my own working life—through the 1960s and much of the 1970s—the essential emphasis of economic management in the United Kingdom was on short-term aggregate demand management, with too little regard to the structural, supply-side, capacity of the economy to meet that demand. Monetary and fiscal policy were used in combination to try to maintain an appropriate balance between what were seen as conflicting objectives of growth and full employment on the one hand, and price stability and balance of payments equilibrium on the other. Slow growth and high unemployment were typically met with monetary and fiscal stimulus. As the symptoms of imbalance inevitably emerged—in the form of external deficits or accelerating inflation—attempts were made initially to suppress those symptoms through various forms of direct control (for example, foreign exchange controls, credit ceilings or prices and income policies), but as demand pressures built up, macroeconomic policies had eventually to be thrown sharply into reverse. This was the go-stop policy cycle that resulted in the exaggerated boom-bust economic cycle, which was for a long time a pronounced characteristic of British economic performance.

Such macroeconomic instability was disruptive in itself, but it also had the effect of encouraging short-term attitudes to both financial and non-financial investment, with a corrosive effect on our longer-term, supply-side, capacity. And the pressures within the economy threatened to become explosive, in that the rate of inflation increased from cyclical peak to cyclical peak, while the rate of unemployment increased from trough to trough.

Over time we learned many lessons from this experience.

We learned first the importance of macroeconomic stability. We came to understand that there is in fact no trade-off—in anything other than the short term, and not necessarily even then—between growth and stability.

Emphasis on short-term demand management gave way to emphasis on the creation of a stable longer-term economic environment, within which the private sector could operate more efficiently and plan with greater confidence for the future.

In terms of fiscal policy, this meant a medium-term framework, with tighter control over public expenditure, to ease the tax burden on the private sector and to limit the

(1) Given to the Leeds and Bradford Chartered Institute of Bankers and Bradford Chamber of Commerce at the St George's Hall, Bradford on 11 April 2000. The speech may be found on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech81.htm

overall deficit and debt burden to a sustainable level at which it did not pre-empt national saving and deter private investment.

And monetary policy—which is inherently more flexible—was assigned the particular role of providing a stable nominal framework for economic decision-taking, with the immediate aim of permanent effective price stability, but as a means to the end of sustainable growth rather than as an end in itself.

But we also learned to pay more attention to the structural, supply-side, capacity of the economy and in particular to the role of reform—and deregulation, subject to appropriate safeguards—of goods, capital and labour markets, as the means of increasing the economy's flexibility and the underlying rate of growth that can be sustained.

We learned finally that these twin approaches—of macroeconomic stability and supply-side reform—reinforce each other.

It is these understandings that lie at the heart of our present economic policy framework.

On the macroeconomic side, the Government has enacted legislation that requires it to set out transparent rules for fiscal policy. For the current Parliament it has chosen to adopt two specific rules:

First, over the economic cycle, government borrowing will be restricted to borrowing for investment, and not to fund current spending; and

Second, net public debt as a proportion of GDP will be kept at a prudent and stable level over the economic cycle.

These rules taken together are designed to ensure financial stability in the medium term, but also allow for automatic stabilisation in response to fluctuations in output growth in the short term.

On the monetary side, the Government has set a low, symmetrical, target for underlying retail price inflation as the objective of monetary policy; and it has devolved technical responsibility for setting short-term interest rates to achieve that objective—on average over time—to the Monetary Policy Committee of the Bank of England. Its members, individually and collectively, are publicly accountable for the way in which that responsibility is exercised.

The supply-side agenda, under successive governments, has inevitably been more diverse.

It has included a strong commitment to free markets and competition as the motive forces for productive efficiency, and as the essential means of allocating financial and real resources. It includes an equally strong, parallel, commitment—both regionally within the European Union but also more broadly—to international free trade in goods and services and to the global free flow of capital.

The supply-side agenda has included an extensive programme of 'privatisation', bringing market disciplines to bear on commercial activities previously undertaken within the public sector, but often involving new forms of regulation in areas of activity that might otherwise be dominated by natural monopolies.

It has included extensive deregulation—for example in relation to financial services, including banks and building societies—though this has been accompanied by improvements in the financial infrastructure and by enhanced prudential supervision.

It has included measures of labour market deregulation and trade union reform. And it has included increased emphasis on education and training; measures to encourage business enterprise, especially among smaller businesses; and reforms to the welfare system to improve incentives to work. The list could go on.

The point is that there has been increasing recognition that it is the complex interaction of policies across the board—often involving difficult political judgments as to how best to reconcile economic and other social objectives—that influences the supply-side capacity of the economy. And it is that which determines the underlying rate of growth that can be sustained and sets the limits to what can be achieved through macroeconomic demand management.

Against that background our recent economic performance has improved. In fact, since the broad monetary policy framework of inflation targeting was adopted in the United Kingdom some seven years ago, the United Kingdom as a whole has in fact achieved the longest period of sustained low inflation we've known for a generation. Retail price inflation, on the Government's target measure, has averaged around 2.7%.

But alongside low inflation we've had the lowest nominal interest rates that most of us can remember. Short-term rates have averaged some 6¼%, compared with some 11¼% over the preceding decade. And ten-year government bond yields have fallen, with inflationary expectations, to around 5¼%, which, apart from a brief period last year, is the lowest they've been for nearly 40 years.

Much more fundamentally, we've enjoyed the longest period of uninterrupted, quarter by quarter, economic growth since records began some 45 years ago, with annual growth averaging 2.8%—between ¼% and ½% above most estimates of our underlying trend rate. The number of people in employment is the highest on record. And unemployment has fallen from a peak of 10½% on a claimant count basis at the beginning of 1993 to the present rate of 4%. That is the lowest for 20 years in the United Kingdom as a whole, and just about the lowest in nearly

every region. In Yorkshire and Humberside unemployment is 4.7%, the lowest rate since June 1980.

Our problem—and it is a real problem, as we have recognised for some time—is the imbalance, within the overall economy, between the domestically oriented businesses and sectors, and those that are most internationally exposed. In part that imbalance is a hangover from the slowdown in global activity from the end of 1997 through to the start of 1999—though the welcome recovery in global demand means that this influence is now diminishing. The more important factor now is the persistent weakness of the euro—not exclusively against sterling but equally against the dollar and the yen. The impact is particularly severe on the United Kingdom because of the closer ties between our economy and that of the eurozone.

I've not heard a wholly convincing explanation for the euro's persistent weakness. Many analysts relate it to market concerns about structural rigidities in some parts of the eurozone, which are encouraging direct capital outflows attracted elsewhere by higher prospective earnings growth.

Whatever the cause, few of those I talk to expect the weakness of the euro to persist. But in the meantime, given that the problem is driven by perceptions of the eurozone, rather than any particular strength of sterling, it is very difficult to see what we in the United Kingdom can do directly to resolve it.

The weak euro affects us at the macroeconomic level in two ways: it has a dampening effect on our price level; and it reduces net external demand on our economy. To offset these influences—to prevent overall demand growth falling short of underlying capacity growth, causing inflation to fall significantly below our 2½% target—and I remind you it is a symmetrical target—we have had to keep interest rates lower than would otherwise have been necessary, in effect encouraging stronger domestic demand growth, to keep the economy as a whole on track. The risk in this approach, of course, is that we could find it difficult to moderate the pace of domestic demand growth to a sustainable rate as and when the euro recovers. But that's a bridge we will need to cross when we get there.

Now some of you involved in those sectors that are suffering most from the weakness of the euro would—from your own perspective—like us to go further and try more actively to drive the exchange rate down. If I were in your shoes, I'd be tempted to argue that myself. Euphemistically it is suggested that we should 'pay more attention to the exchange rate'—than, as I've explained, we do already. In practice what that would be likely to mean in our present situation is substantially lower interest rates: the intended effect would be to stimulate external demand, but it would inevitably also involve further stimulus to domestic demand. In effect, it implies that we should acquiesce in increasing overall demand pressure, leading inevitably to faster inflation. That might conceivably even provide some relief to the suffering sectors in the short term. But increasing demand pressure, including labour market pressure, and accelerating inflation would—as we've repeatedly seen in the past—ultimately need to be brought back under control, involving a more abrupt tightening of policy. That frankly would not do the suffering sectors themselves much good at least for very long—and it would have a potentially serious destabilising effect on the economy as a whole. That is precisely what we are trying to avoid.

The more hopeful news is that we have recently seen strong signs of recovery—of both economic activity and exchange rates—in a number of emerging markets and transition economies. And we are seeing a strengthening of domestic demand and of output in the eurozone, which may help the euro to appreciate. To the extent that these trends persist, it will help to ease the exceptional pressures on the most internationally exposed sectors, and contribute to a better balance within the UK economy. But it will need to be accompanied by corresponding moderation of the growth of domestic demand—after the offsetting stimulus of a year ago—if we are to maintain overall stability. That essentially is why interest rates in the United Kingdom have had to rise since last autumn.

We are now in a position where the economy as a whole is again growing above trend—after a pause a year or so ago—while inflation is running—and has been running for nearly a year—slightly below the Government's 2½% target.

Looking ahead, there is the tantalising prospect of new factors that might help to hold the rate of inflation down, at least in the short term. There is evidence for example, although it is hard to evaluate, of more intensive retail price competition, squeezing retail margins across the board, and that could hold down prices, at least for a time. And this effect could intensify and extend further into the future as a result of the spread of e-commerce. And there is, on the supply side of the economy, the possibility (though so far sadly not much actual statistical evidence) that the spread of IT will accelerate productivity growth across the economy—as it has in the United States—raising the underlying rate of potential output growth at least for a time.

We certainly have not closed our minds to the possibility that these developments might allow us to sustain, for a time, stronger growth consistently with meeting our inflation target. But we can't afford to gamble on that outcome either. The truth is that the jury is still out. What we have to do is to monitor intensively all of the data as it becomes available to us, and draw what inferences we can as to how those data affect the balance of risks around the inflation target looking ahead.

What is encouraging, Mr Chairman, is that for all these uncertainties and complications, the broad prospect for the UK economy as a whole over the next couple of years is for continuing relatively strong growth—at or above trend—with continuing relatively high employment, and continuing relatively low inflation. The monetary policy debate in the

United Kingdom is a narrow one, it is about just how strong the growth, just how high the employment and just how low the rate of inflation.

Against that background, let me finally say a few words about UK membership of the euro.

Let me make clear, from the outset, that monetary union is fundamentally a political rather than an economic issue. It necessarily involves the deliberate pooling of national sovereignty over important aspects of public policy, in the interest not just of collective economic advantage, but of a perceived wider political harmony within Europe.

As a central banker, I have nothing to say about the politics of monetary union—that's for elected politicians. But it is also an economic issue and that is my concern.

So what are the economic pros and cons?

The potential economic advantages and disadvantages are now reasonably well defined—though different opinions inevitably attach different weights to the respective arguments.

On the plus side, the crucial and unique economic advantage of monetary union is nominal exchange rate certainty within the eurozone—which takes over a half of UK exports. I'm not talking just about reasonable exchange rate stability—which might result over time from each country pursuing disciplined macroeconomic policies in parallel. I'm talking about nominal exchange rate certainty for the indefinite future.

That very real economic advantage is well understood in the United Kingdom—especially by businesses that trade with, or compete with, businesses in the eurozone. And on that ground alone many of them, who have suffered from excessive sterling strength against the euro, would see our joining as an advantage, provided of course the exchange rate were initially fixed at an appropriate—and significantly lower—level than at present. At the broader macroeconomic level the potential benefit of joining—as a result of greater transparency of costs and prices and lower transaction costs—leading to greater competition and more efficient economic resource allocation is well understood.

Exchange rate certainty within Europe—even though it is nominal certainty rather than real exchange rate certainty—would potentially enhance the benefits to be derived from the European Single Market.

The euro's second very powerful advantage is the possibility it opens up for much broader and more liquid financial markets. It will mean a progressive narrowing of spreads between borrowers and lenders—and that will be good news too for financial intermediaries as a group, because it will lead to higher volumes of financial activity—though not every individual intermediary will benefit, of course, in the more competitive environment. The City of London is already making an important contribution to this process of financial euro-market integration.

So there are potentially powerful advantages. What then are the risks—the possible arguments against our joining the euro?

Essentially the potential downside can be summed up as the risk that the single—one-size-fits-all—short-term interest rate within the eurozone—which is the inevitable consequence of a single currency—will not in the event prove to be appropriate to the domestic monetary policy needs of all the participating countries.

Countries may have divergent cyclical positions. They may face divergent fiscal positions which would affect their appropriate fiscal/monetary policy mix in different directions—though this should be contained by the Growth and Stability pact. Or their domestic policy needs may diverge as a result of economic shocks of some sort—a classic but unique example being German unification, but the recent global economic disturbance is perhaps another example.

So the risks of divergent monetary policy needs within the monetary union are real. They are essentially similar to the risks of sectoral and regional divergences within a national currency area. And if there were to be material divergence within the eurozone the tensions could be more severe than in a national currency area, because alternative mechanisms—labour migration or fiscal redistribution through a central budget—which help to alleviate regional disparities in the national context—are less well developed at the eurozone level.

Some commentators point to the present inflationary pressures in Ireland as an example of the problems that could arise on the upside as it were—though I'm not sure how far one can generalise from the Irish case.

The fact that the United Kingdom did not join in the first wave of EMU was a disappointment to some people, including to some of our European partners. But it was also a considerable relief to them—we could have been the elephant in the rowing boat! It was I must confess also a relief to me. If we had joined EMU from the start—and had eurozone interest rates over the past year or so—it is very difficult to envisage how we would have avoided an inflationary boom in this country. It is true that, to the extent that the present imbalance within the economy reflects sterling's appreciation against the euro, we would have been protected against that. But, with accelerating inflation in the economy as a whole, the price of such protection of the suffering sectors would have been tantamount to real exchange rate appreciation, which would in any event have damaged their competitive position. And it would not in that case be possible to reverse that effect through exchange rate adjustment. Joining EMU from the start would in fact, as things have turned out, have been a

strong form of relaxing our objective for consistently low inflation in the economy as a whole to ease the pressures on the internationally exposed sectors, which I argued against a few moments ago. There are no easy answers so long as our economies continue to diverge.

Coping with such tensions as may emerge within the eurozone—with or without the United Kingdom—is likely to be easier in a context of structural, supply-side, flexibility and adaptability—which also, as I say, essentially determines the underlying rate at which the economy can expand in the medium and longer term. The eurozone started with chronically high unemployment. Some countries still have very high ratios of public debt to GDP. And most face the prospect of an increasing burden on their public finances with ageing populations.

Some people in the eurozone acknowledge these concerns, but they are inclined to argue that if a country participating in the monetary union were to find itself in an unsustainable situation and given that it would have no macroeconomic way out—through exchange rate adjustment, independent monetary policy action, or fiscal stimulus beyond the limits of the Growth and Stability pact—and given limited labour migration or fiscal redistribution at the pan-European level—then it would have an overwhelming incentive to undertake the supply-side reforms which have proved so difficult to introduce up until now. One of my ECB colleagues in fact once put it to me that 'when we have closed off every other policy option, we will finally be forced to do the things we know that we should have done all along!'

I hope that this proves to be right and that it does help ease the tensions. Supply-side flexibility within Europe is crucial in my view not just to the success of the euro, but to the success of the European economy in a much broader sense—to the resolution of Europe's chronic unemployment problem and to the contribution which a strong European economy can make to the whole of the world economy.

In all of this—in our pursuit of both macroeconomic stability on the one hand and structural reform on the other—we share much the same basic philosophy as our partners in the European Union, though it may be true to say that, at least as a matter of degree, while we were later than some of them in coming to macroeconomic stability, we may have gone further in the direction of improving the supply-side flexibility of our economy through structural reform.

The best thing that we can do for the time being—on both sides—is to pursue this common approach in parallel. That should help to bring about greater convergence between us, to reduce the risks of UK membership of the euro and to help meet the Government's five economic tests for joining. In the meantime, ahead of any decision, it seems sensible to prepare in order to keep open the option to join.

The new economy and the old monetary economics

In this speech,[1] Willem H Buiter, member of the Bank's Monetary Policy Committee,[2] argues that the behaviour in recent years of the world economy, led by the United States, can, in the opinion of a number of observers, only be understood by abandoning the old conventional wisdoms and adopting a 'New Paradigm'. Prominent among the structural transformations associated with the New Paradigm are the following: increasing openness; financial innovation; lower global inflation; lower profit margins, reflecting stronger competitive pressures; buoyant stock markets defying conventional valuation methods; a lower natural rate of unemployment; and a higher trend rate of growth of productivity.

In this speech, Professor Buiter makes two distinct points. First, the New Paradigm has been over-hyped. Second, to the extent that we can see a New Paradigm in action, its implications for monetary policy have often been misunderstood.

1 Introduction

Whenever expressions like 'New Paradigm' and 'New Economy' are in the air, caution is in order. There are a few thoughtful and well-informed proponents of the view that recent and likely future 'supply-side' developments have shifted the path of future potential output, and may have invalidated the old empirical relationships between real economic performance and inflation. My MPC colleagues DeAnne Julius and Sushil Wadhwani are among these.[3] Unfortunately, the 'New Paradigm' label has been much abused by professional hype merchants and peddlers of economic snake oil.

Stripped of the razzmatazz surrounding it, the 'New Paradigm' can be summarised as follows. First, increasing and unprecedented *globalisation*, driven partly by technological change and partly by the deliberate removal of government-created barriers to the international movement of goods, services, people, financial capital, enterprises and ideas, has transformed the international and domestic competitive environments.

Second, information and communications technology (ICT), the marriage of cheap and near universally available digital computing power and telecommunications, is transforming the global economy and the way we work, shop and live. The Internet is the most visible expression of this: e-commerce, e-shopping, e-tailing and e-business are becoming as common as e-coli. B2B is the 'to be or not to be' of the trendy entrepreneur and manager. New products, new processes, new forms of organisation, and new ways of trading and exchanging information are made possible by the new information networks that are sprouting everywhere, courtesy of 'Moore's Law' and broadband technology.

Economists have to rethink the meaning of competition, which is Schumpeterian rather than Arrow-Debreu. 'Information goods', with their public good properties of non-rivalness (associated with indivisibility, high (and sunk) fixed costs or start-up costs, and low marginal costs) and non-excludability or inappropriability, are destructive of the conventional competitive paradigm.[4] More visibly than ever before, competition is seen to be a process of creative destruction, of rivalry between alternating or succeeding monopolies, not the peaceful and passive price-taking behaviour of the old textbooks. The rewards for being first with a new product or process are larger than ever before, as are the penalties for being pipped at the post—a winner-takes-all economy.

The new economy creates challenges for measurement and for the interpretation of data. The new weightless and intangible sectors make it ever more difficult to measure and value either inputs or outputs.

Third, financial innovation is transforming existing patterns of financial intermediation. The flow of funds between the ultimate wealth-owners (households and their agents) and enterprises now passes through new intermediaries, institutions, markets and financial instruments. New sources and forms of risk capital and rapid improvements in the accessibility of conventional forms of finance are creating new modalities for trading risk and transforming the allocation of existing asset portfolios. Home bias in portfolio allocation is diminishing. More households are directly active in the retail investment markets.

(1) Given to the Aberdeen Chamber of Commerce on 27 October 1999. A more detailed version of the speech is available at www.econ.cam.ac.uk/faculty/buiter/newecon.pdf
(2) And Professor of International Macroeconomics, University of Cambridge.
(3) See, for example, Julius (1999) and Wadhwani (1999).
(4) See, for example, Giordano (1999). The term 'experience goods' is due to De Long and Froomkin (1998). The formalisation of the concept goes back at least to Arrow (1962).

Globalisation, ICT and financial innovation are not independent. New developments in information technology are among the technological forces driving globalisation and financial innovation. The removal of man-made obstacles to the international flow of funds encourages FDI and hostile cross-border take-overs.

Globalisation is not new. The current wave of globalisation started in the immediate post Second World War period. A highly globalised economy existed also in the second half of the 19th century, until the First World War and the inter-war crises caused the fragmentation of the global capitalist system (see Bordo, Eichengreen and Kim (1998) and Bordo, Eichengreen and Irwin (1999)).

Technological revolutions also did not start with the 'information age'. The industrial revolution gave us, more than 200 years ago, the systematic application of science and engineering to production, distribution and exchange. The information revolution pre-dates the industrial revolution. It started with the invention of the printing press and accelerated with the arrival of the telegraph, photography, the telephone, telex, radio, television, fax and photocopier.(1) Recognisable computers are almost 50 years old.

2 The 'New Paradigm' and the real economy

The New Paradigm (globalisation and ICT) could have any or all of the following implications for the real economy of the United Kingdom.

(1) The UK economy could become more open. This could manifest itself as enhanced trade in real goods and services or in financial claims; as increased international movements of real factors of production (including labour and physical capital) and of corporate headquarters and other organisational units. Know-how and technology also become more footloose. Finally, people can move more freely across national boundaries in any or all of their capacities: as workers, consumers, shoppers, portfolio holders, tax-payers and subsidy or benefit-seekers. This threatens national tax bases and puts upward pressure on national public spending programmes. It may lead to tax or subsidy competition between national or regional governments. It also creates incentives for intergovernmental co-operation and harmonisation of tax and benefit regimes, ie for fiscal policy cartels.

(2) Global inflation could be lower.

(3) There could be a permanent reduction in profit margins or mark-ups in many sectors.

(4) Stock market valuations could be boosted to unprecedented levels.

(5) The NAIRU (the equilibrium or natural rate of unemployment) could be lower than before.

(6) The level or the underlying rate of growth of productivity could be higher than before.

2.1 Openness

As regards increased international openness, it seems likely that there is more to come. For trade in goods and services, we are unlikely to see growth of the kind seen in the 1960s and 1970s, but a more gradual increase in import and export shares in GDP is on the cards. Exports and imports as shares of UK GDP are still about 5 percentage points below their pre First World War peak.

International trade in financial claims is intense for a rather limited range of financial instruments. In years to come, we are likely to see both an extension of this range of international financial instruments and a further gradual erosion of the home bias in the portfolio allocations of UK financial institutions. Labour mobility is likely to increase, but will remain small in relation to the UK labour force. Enterprises will become more footloose, with corporate headquarters, back-office operations and R&D establishments following in the wake of manufacturing assembly plants and call centres. FDI flows, bundling finance, technical expertise and managerial skills are likely to become more significant. The traffic will be two-way. In recent years inflows of FDI into the United Kingdom have grown rapidly. Outflows have grown even more rapidly.

The greater scope for tax-payers and benefit-seekers to move to jurisdictions with lower tax rates or more relaxed enforcement, and to jurisdictions with higher benefits and easier eligibility, will put increasing strains on the public finances everywhere. Unless more effective ways are found to link the liability for tax payments in a given jurisdiction to eligibility for benefits from public spending in the same jurisdiction, the threat of mobility of tax-payers and benefit recipients will severely constrain the fiscal authorities. I expect that governments all over the world will begin to think much more systematically about ways of enhancing the excludability of their public goods and services, and of linking entitlement to public goods and services to lifetime tax contributions. Without that, people will work where taxes are lowest and retire where retirement benefits are highest. National governments will be torn between tax and benefit competition and attempts at greater co-operation and harmonisation.

2.2 Financial innovation

Financial globalisation and innovation are a mixed blessing. Properly functioning financial markets improve the global allocation of resources, by offering effective vehicles for channelling saving into domestic capital formation and

(1) The first known printed book, using block printing, came from China (AD 868). Block printing appeared in Europe during the late 1300s. Movable type using clay was invented in China during the 1000s. Koreans invented movable type in the 1300s. Europeans reinvented this particular wheel in the mid-1400s.

foreign investment and by providing the means for efficient trading of risk. Efficient risk trading means that risk ends up with the economic agents and institutions most willing and able to bear risk. The superior availability of risk capital in the United States is widely thought to have contributed significantly to the New Economy lead the United States has taken.

Unfortunately, financial markets also can and do shift the non-diversifiable risk in the economy to the imprudent, the reckless, and the fraudulent. The misalignment of the private and social costs of risk that causes such perverse risk trading occurs for legal and institutional reasons and because of asymmetric information among the parties trading risk.

ICT provides unprecedented means for collecting and processing information and for tracking economic agents and performance across space and time. It also provides unprecedented means for concealing information or for creating false audit trails. Normal human greed and widespread access to the Internet, combined with ignorance and hubris, create an unhealthy and possibly dangerous stew of speculative excess at the retail level. Day traders and Internet financial chat rooms are manifestations of this.

When risk is mispriced and misallocated, financial crises and collapses can occur. Financial crashes and associated defaults and bankruptcies are socially costly because they involve a waste of real resources as well as a reshuffling of property rights. When that happens, the aggregate non-diversifiable risk in the economy is not just distributed inefficiently, but its total quantum is increased. Risk that should be diversifiable under orderly market conditions ceases to be so.

Despite inadequate supervision and regulation, the financial innovation process that started in the final quarter of the 20th century probably improves overall economic performance during normal times. It does, however, increase the likelihood of abnormal times—panics, manias and crashes—occurring, and exacerbates the scope and severity of financial crises.

2.3 Global inflation

The long-run trend in global inflation will be determined by the weighted sum of the various national inflation objectives, adjusted for the degree of seriousness with which they are pursued. There is no evidence that the rest of the world is likely, on balance, to pursue inflation objectives and to achieve inflation outcomes that are significantly different from those pursued and achieved in the United Kingdom.

We cannot be confident that the relative prices of commodities, hard or soft, to other internationally traded goods and services will have any clear trend. Even if they did, changes in the relative price of commodities and more highly processed goods and services have no straightforward implications for global inflation. Global inflation itself has no straightforward implications for UK inflation when the United Kingdom's nominal exchange rate floats.

In the short run, global inflation is driven in part by the global output gap, just as domestic inflation is driven, in part, by the domestic output gap. Commodity price inflation is more responsive to supply constraints in the producer nations and to changes in global economic activity than inflation in more broadly based indices of internationally traded goods and services.

2.4 Stock market valuation

It should be clear that reduced margins and unusually strong stock market valuations are uncomfortable bedfellows. Equation **(2.1)** is a fairly standard representation of stock market valuation, involving only minor hand-waving. The real value of the stock market index is denoted V, the stream of real profits Θ, the risk-free real interest rate r, the growth rate of real profits g^{θ}, and the equity risk premium ρ^{q}. E_t is the expectation operator conditional on information available at time t. The term F is the fundamental valuation of the stock market.(1) B is the speculative bubble component.(2)

$$V_t = F_t + B_t$$
$$F_t = E_t \sum_{j=0}^{\infty} \left[\prod_{k=0}^{j} \left(\frac{1 + g^{\theta}_{t+k}}{(1 + r_{t+k})(1 + \rho^{q}_{t+k})} \right) \right] \Theta_t \qquad \textbf{(2.1)}$$

If μ is the mark-up of price on unit labour cost and Y is real GDP, then (ignoring profit taxes):

$$\Theta_t = \left(\frac{\mu_t}{1 + \mu_t} \right) Y_t \qquad \textbf{(2.2)}$$

I believe that recent ICT developments are making many markets more competitive and more contestable. Entry and exit in many industries is easier than before.(3) This is good news for consumers, for productivity and efficiency, and quite possibly for human happiness, but it is bad news for profits. In terms of equations **(2.1)** and **(2.2)**, the New Paradigm will boost the future path of real GDP, which is, other things being equal, good for profits, but it will depress margins, μ, which is, other things

(1) Hall (1999) argues that this fundamental valuation should include not just the physical capital stock, but also 'intangible capital' or organisational capital. His empirical investigation does not, however, consider the possibility of persistent and significant monopoly rents.
(2) Rational speculative bubbles, ie bubbles that do not violate the no-arbitrage assumption of technically efficient financial markets, would have to satisfy $E_t B_{t+1} = (1+r_t)(1+\rho^{q}_{t})B_t$.
(3) There are exceptions. If a private company manages to establish a monopoly of a product with strong network externalities which effectively becomes an industry standard, entry becomes very difficult and very large rents can be extracted.

being equal, bad for profits.(1) Valuations based on projections of earning growth, which imply that, before too long, profits will exhaust all of GDP, are not believable.(2)

Two misunderstandings distort a sensible discussion of stock market performance and the New Economy. The first is the view that the strength of stock markets globally, and especially in the United States, cannot be a bubble because the New Economy is a reality. The second is the view that the strength of stock markets during the past few years is a bubble and that therefore the New Economy is a figment of overexcited imaginations. I believe both views to be wrong. A radical restructuring of the economy *is* under way as a result of developments in ICT, globalisation and financial innovation. The United States is leading the way, but the phenomenon is spreading more widely. There also is a stock market bubble, concentrated in the fashionable e-everything sectors. Historically, spectacular stock market boom and bust episodes have often occurred during periods of rapid technological change.(3)

2.5 The nominal implications of real revolutions

The key question raised by the 'New Paradigm' for the Monetary Policy Committee is: what do the supply-side developments captured under items (1) to (6) imply for monetary policy in the United Kingdom, assuming that the MPC continues to pursue its mandate, a symmetric inflation target of 2½% per annum for RPIX? I measure the stance of monetary policy through the behaviour over time of our main policy instrument, the short risk-free nominal rate of interest.(4)

Qualitative judgments on these phenomena are not enough. The actual magnitudes matter. Unfortunately, these are highly uncertain. In addition, all six developments are *real* phenomena. One of the key insights that macroeconomists and monetary economists can bring to the New Paradigm debate is the recognition that relative price changes, distributional changes and other structural changes have no straightforward, obvious implications for inflation or for the path of interest rates that supports a given inflation target.

3 Implications of the New Paradigm for UK monetary policy

3.1 Increasing openness and UK monetary policy

Increasing openness of the United Kingdom does not have clear implications for the average level of interest rates that support the inflation target, short run or long run. Increasing openness to trade in goods and services implies that monetary policy, to the extent that it works through the exchange rate, will have a more powerful effect on the price level and a weaker effect on the real economy, because greater trade openness increases the responsiveness of domestic nominal costs and prices to the exchange rate. Increasing financial openness and integration may also make the exchange rate more volatile. There is no clear link to the average level of short nominal rates, however.

3.2 Lower global inflation and UK monetary policy

The rate of inflation of world prices, including commodity prices, translated through the nominal exchange rate, is an important component of retail price inflation in the United Kingdom. In the long run, differences between the United Kingdom's rate of inflation and the inflation rate in the rest of the world that are due to differences among national monetary policies will be reflected in nominal exchange rate depreciation. Asymmetric shocks that cause shifts in the structure of the world economy and mandate changes in the relative price and cost configurations between the United Kingdom and its trading partners will lead to systematic violations of purchasing power parity (PPP).

It is difficult to establish a clear presumption that the relative prices charged and paid by UK PLC should rise or fall steadily. I therefore consider the benchmark of a constant structure of the global real economy. The United Kingdom pursues an unchanged inflation target with a market-determined exchange rate, and the inflation rate in the rest of the world reflects global monetary policy. Under these conditions, different rates of inflation in the rest of the world should not have any implications for the level of UK nominal interest rates in the long run. This argument assumes that the world real interest rate does

(1) The growth rate of profits is approximately equal to the sum of the growth rate of real GDP and the growth rate of the mark-up.
(2) Take the United States as an example. The New York Federal Reserve has recently raised its (gu)es(s)timate of the trend growth rate of US real GDP to 3.5% per annum. Assume actual GDP will, on average, grow at the same rate as potential GDP. The share of profits in GDP has been stable (albeit subject to cyclical fluctuations) since Hannibal crossed the Alps (or since George Washington crossed the Delaware). The only realistic estimate for the long-run trend growth rate of real profits for US Inc therefore is 3.5% per annum. It is of course true that even broadly based stock market indices are not representative samples of the market capitalisation of US Inc. There is a strong bias towards larger firms; enterprises whose (relative) size is shrinking are dropped from the index and recent spectacular growth stocks are added. If earnings growth in the relatively recent past is a good guide to future earnings growth (that is, if earnings growth is positively correlated over time), the practice of dropping shrinking firms from the index and including expanding ones will permit the earnings growth of the firms included in most common stock indices to exceed the earnings growth of all firms. Sample selection bias due to truncation by relative size is no doubt present. (An interesting breakdown of the recent growth rates of operating earnings per share by economic sector for the S&P 500 can be found in Cohen and Napolitano (2000).) It is most unlikely that it can rationalise all or even most of the earnings-growth-on steroids-projections that we have seen recently.
(3) For a less bearish view, see Keating and Wilmot (1999).
(4) It is possible to rephrase these policy implications in terms of the implied behaviour of the money stock. For reasons of space, this is not done here. See Buiter (2000).

not vary, in the long run, when the world inflation rate varies.

The same conclusion also applies in the short run if the United Kingdom is perfectly integrated in the international financial system. In an internationally financially integrated economy, the domestic short nominal rate of interest is related to the foreign short nominal interest rate through expectations of future exchange rate depreciation and a currency risk premium.(1) Let i_t be the one-period short UK nominal interest rate between periods t and t+1, i^f the world short nominal rate, s the (logarithm of the) nominal spot exchange rate (defined as the price of foreign exchange in terms of sterling), $\sigma_{t+1} = s_{t+1} - s_t$ the proportional rate of depreciation of the nominal spot exchange rate, and ρ^s the foreign exchange risk premium. Then:

$$i_t = i_t^f + E_t\sigma_{t+1} + \rho_t^s \qquad \textbf{(3.1)}$$

Perfect financial integration means that the currency risk premium is independent of domestic and foreign monetary and financial policy actions. Since the risk premium is invariant to policy, it can be ignored in what follows. Without the foreign exchange risk premium, **(3.1)** implies uncovered interest parity (UIP), ie:

$$i_t = i_t^f + E_t\sigma_{t+1} \qquad \textbf{(3.2)}$$

The United Kingdom is small in the global financial markets, so I take i^f to be exogenous. The (*ex ante*) domestic short real interest rate equals the short nominal interest rate minus the expected rate of inflation. I take the rate of inflation to be the rate of inflation of the retail price index, our inflation target.(2) Let $\tilde{p}$ be the (logarithm of the) retail price index (RPI) and $\tilde{\pi}$ the rate of inflation of the RPI, ie $\tilde{\pi}_{t+1} \equiv \tilde{p}_{t+1} - \tilde{p}_t$. It follows that:

$$r_t + E_t\tilde{\pi}_{t+1} \equiv i_t \qquad \textbf{(3.3)}$$

The RPI is a weighted average of the price index of domestic value added, p, and the index of world prices, p^{*f}, translated into domestic currency. Let the share of imports in the RPI index be α. The world rate of inflation is denoted π^{*f}. Then:

$$\tilde{\pi}_t = (1-\alpha)\pi_t + \alpha(\pi_t^{*f} + \sigma_t) \qquad \textbf{(3.4)}$$

The (*ex ante*) world short real interest rate, r^f, is defined as follows:

$$r_t^f \equiv i_t^f - E_t\pi_{t+1}^{*f} \qquad \textbf{(3.5)}$$

Since the United Kingdom is too small to influence the world rate of inflation, the world real rate of interest is also taken to be exogenous.

If the fall in the expected world rate of inflation is not accompanied by any fall in the world real interest rate, it must be matched by a fall in the world nominal interest rate. In that case, the lower world inflation rate would be translated into a matching increase in the rate of depreciation of sterling, with no impact on short nominal rates in the United Kingdom or on the UK rate of RPI inflation, short run or long run. Although the real world is apt to be a bit messier, this is the obvious benchmark.

3.3 Lower profit margins and UK monetary policy

A reduction in profit margins, or in the mark-up on unit variable costs, can result either from intensification of product market competitive pressures (a reduction in the degree of monopoly power of a firm in the markets for its products) or from a weakening of a firm's competitive position in the market for its inputs—labour, raw materials etc. Such changes in firms' competitive positions correspond, at the level of the economy as a whole, to a distributional change, away from profits and towards labour income.

Consider the following simple example. The bundle of goods and services entering the RPI, denoted Q, is produced using labour, capital and imported inputs. Let W be the money wage, L employment, P^f the domestic currency price of imported inputs, N the quantity of imported inputs, ρ_K the nominal rental rate of capital and K the capital stock. Output is produced using a well-behaved, constant returns to scale production function, $Q = AF(K, L, M)$, where A is the level of total factor productivity. A monopolistically competitive firm maximises pure profits, $\tilde{P}Q - \rho_K K - WL - P^f N$. Assume that input markets are competitive. Let $\varepsilon(Q) \equiv -\dfrac{\tilde{P}(Q)}{\tilde{Q}'P(Q)}$ be the price elasticity of demand. Nominal accounting profits are denoted $\hat{\Theta}$, where $\hat{\Theta} \equiv P\Theta$ and P is the GDP deflator. It is the sum of pure profits and the rental income of capital. Using the first-order conditions for profit maximisation, $\hat{\Theta} \equiv \tilde{P}A\left(F_K K + \frac{1}{\varepsilon}(F_L L + F_N N)\right)$.

Value added for the domestic economy is the sum of accounting profits and wage income: $PY = \hat{\Theta} + WL$. This permits us to write the value-added deflator as a mark-up on unit labour cost, as follows:

$$P = (1+\mu)\frac{WL}{Y} \qquad \textbf{(3.6)}$$

The proportional mark-up on unit labour cost, denoted μ, is given by:

$$\mu = \frac{F_K\dfrac{K}{L} + \dfrac{1}{\varepsilon}\left(F_L + F_N\dfrac{N}{L}\right)}{F_L\left(\dfrac{\varepsilon-1}{\varepsilon}\right)} \qquad \textbf{(3.7)}$$

(1) For recent surveys on global financial integration, see Oxford Review of Economic Policy (1999).
(2) The distinction between RPI and RPIX does not matter for the argument under consideration.

With a profit-maximising monopolist, $\varepsilon > 1$, and the mark-up is positive and decreases with the elasticity of demand. In general, the mark-up will also depend on the input ratios. When the production function is Cobb-Douglas, $Q = AK^{\alpha} L^{\beta} N^{1-\alpha-\beta}$; $0 < \alpha, \beta, \alpha + \beta < 1$, the mark-up simplifies to **(3.8)**, which is independent of input intensities:(1)

$$\mu = \frac{1 + (\varepsilon - 1)\alpha}{(\varepsilon - 1)\beta} \qquad \textbf{(3.8)}$$

A decline in the mark-up, μ, is a reduction in the *ratio* of price to unit labour cost. There is nothing in this mark-up change *per se* that tells us anything about the behaviour of nominal prices and wages. This reduction in margins could be achieved, for a given path of nominal labour costs per unit of output, through lower prices. Theoretically, such a lower path of the price level could be achieved through a single, discrete drop in the price *level*; in practice there is likely to be a gradual approach to the new equilibrium price level path, ie there is likely to be a temporary reduction in the rate of inflation. A lower mark-up could also be achieved, for given paths of money prices and productivity, with a higher path of money wages, or with a higher price level path if it were accompanied by an even larger proportional increase in the path of money wages.

In order to determine the impact of lower structural margins on price inflation, we must simultaneously determine what happens to money wage inflation. A Keynesian approach to short-run wage and price dynamics, like the one proposed in Section 3.5 below, suggests that money wage inflation is unlikely to be positively affected by a fall in margins, when this fall in margins is the result of more intense competition in the product markets. Permanently lower margins due to more intense product market competition would produce a lower path of the price level. In the real world, this will show up as a temporary dip in the rate of inflation. This means that, in the short run, short nominal interest rates can be lower than they were before, and lower than they would have been in the absence of the fall in margins, without this endangering the inflation target.

In the medium and longer run, money wage inflation ceases to be anchored in the past. It is always influenced significantly by expected future price inflation. We cannot explain inflation with inflation. We need a further inflation anchor from outside the realm of the real economic relationships. That inflation anchor is provided by the MPC's pursuit of an unchanged inflation target. If the fall in margins is not associated with other structural changes in the economy, the path of nominal interest rates will return to where it would have been in the absence of the fall in margins.

It is not difficult to think of other changes in the transmission mechanism that could be the result of a change in margins. Redistribution from profits to wages, if wage-earners have, on average, higher propensities to spend than the recipients of profit income, would widen the output gap, putting upward pressure on inflation. Alternatively, the intensification of competitive pressures reflected in the lower structural margins could reduce 'X-inefficiency' and organisational slack in firms. This would represent an increase in total factor productivity, which would exercise temporary downward pressure on inflation.

3.4 A stock market boom and UK monetary policy

Asset prices, including the exchange rate, bond prices, land and house prices and equity prices, are not a target of monetary policy. Asset prices and asset price inflation only matter to the policy-maker because they are part of the transmission mechanism of monetary policy. If equity prices are high or rising fast because of fundamental New Economy developments, the influence of equity values on consumption and investment, and through that on inflation, is of interest to the policy-maker. The same is true if equity prices are, in part, driven by a speculative bubble. As long as the bubble persists, it will influence consumption and investment, and through that the balance between aggregate demand and aggregate supply and the rate of inflation. Since bubbles do not persist indefinitely, two questions arise. First, should the monetary authorities try to puncture the bubble? Second, should their actions while the bubble persists aim to anticipate the eventual collapse of the bubble?

Bubbles are, by definition, not driven by fundamentals. There is no reason why changes in one of the fundamentals (the rule governing the monetary instrument) would have any effect on the bubble. Policy can only influence the fundamental valuation component, *F*. It does not make sense to try and influence the fundamental valuation, *F*, to offset the bubble, *B*. First, we are by no means confident about the decomposition of the observed equity valuation into its bubble and fundamental components. Second, if and when the bubble collapses, it would be extremely difficult to 're-set' the fundamental valuation at the value it would have achieved in the absence of the bubble. Trying to influence or even puncture the bubble through 'non-fundamental' policy actions, eg open-mouth operations such as expostulations on 'irrational exuberance', is also likely to be a two-edged sword. There would seem to be no alternative but to live with the bubble.

Modifying policy in anticipation of the bubble's collapse is unlikely to be helpful. Should the monetary authority, faced with a speculative stock market boom, loosen policy in anticipation of an eventual future crash of uncertain timing and magnitude? In my view, all the authorities can do is to reveal their reaction function, ie their contingent response to a dramatic fall in equity values. This does not mean that the authorities underwrite the bubble, or provide free insurance to equity owners against the risk of a collapse. Giving the

(1) Note that ε, the price elasticity of demand, need not be a constant. Different models can produce either procyclical or countercyclical behaviour of the mark-up.

markets a free stock market put at an overvalued strike price would, if anything, feed the bubble. A bursting bubble would, at the very least, weaken consumption and investment demand. It could also create a financial crunch and liquidity squeeze, if significant amounts of private borrowing have been secured, directly or indirectly, against the overvalued stocks. The authorities can do no more than commit themselves to minimising the damage to the real economy, and to cleaning up the mess when the bubble bursts.

3.5 A fall in the NAIRU and UK monetary policy

A lower NAIRU or equilibrium rate of unemployment has no straightforward implications for the path of short nominal rates that supports an unchanged inflation target. This is because, for any given path of the actual unemployment rate, a lower NAIRU will put downward pressure on the growth rate of *expected real* wages.

A simple example of a model with this property is an open-economy adaptation of the Taylor overlapping contracts model. The Buiter-Jewitt (1981) version of the Taylor model has staggered, overlapping *real* wage contracts rather than the staggered overlapping *nominal* wage contracts of the original. We restrict the analysis to a two-period contract. Lower-case symbols denote the natural logarithm of the corresponding upper-case symbol; U is the actual unemployment rate and U^N the NAIRU or the natural rate of unemployment. Money contracts last for two periods. In each period, half the labour force negotiates a new contract. The money wage contract negotiated this period, ω_t, achieves a level of the expected average real contract wage over the life of the contract, which depends positively on the real contract wage negotiated last period and the real contract wage expected to be negotiated next period. It also depends on the average unemployment rate expected over the life of the contract. Finally, it depends on an index of the target real wage, denoted $\bar{\tau}$. One would expect the growth rate of the target real wage, $\bar{g}_t \equiv \Delta\bar{\tau}_t \equiv \bar{\tau}_t - \bar{\tau}_{t-1}$, to track the trend rate of growth of labour productivity.

$$\begin{aligned}\omega_t - \tfrac{1}{2}(\tilde{p}_t + E_t\,\tilde{p}_{t+1}) - \bar{\tau}_t \\ = \gamma\,E_t\left[\omega_{t+1} - \tfrac{1}{2}(\tilde{p}_{t+1} + \tilde{p}_{t+2}) - \bar{\tau}_{t+1}\right] \\ + (1-\gamma)\left[\omega_{t-1} - \tfrac{1}{2}(\tilde{p}_{t-1} + \tilde{p}_t) - \bar{\tau}_{t-1}\right] \\ - \tfrac{1}{2}\psi(U_t + E_tU_{t+1})\end{aligned} \qquad \textbf{(3.9)}$$

$$\psi > 0; 0 \le \gamma < 1$$

We can use **(3.9)** to solve for the current real contract wage as a function of last period's real contract wage and of current and anticipated future values of the fundamental, unemployment. There are two solutions. The sensible one is given in equation **(3.10)**:(1)

$$\begin{aligned}\omega_t - \tfrac{1}{2}(\tilde{p}_t + E_t\,\tilde{p}_{t+1}) \\ = \omega_{t-1} - \tfrac{1}{2}(\tilde{p}_{t-1} + \tilde{p}_t) \\ + \bar{g}_t - \frac{\psi}{2(1-\gamma)}\left[U_t + \sum_{i=t}^{\infty}\left(\frac{\gamma}{1-\gamma}\right)^{i-1}\frac{1}{1-\gamma}E_tU_{t+i}\right]\end{aligned} \qquad \textbf{(3.10)}$$

This solution only makes sense when $\gamma < 0.5$, ie the wage-setting process must be mainly backward-looking.(2) When the unemployment rate is expected to remain constant, the equation becomes:

$$\begin{aligned}\omega_t - \tfrac{1}{2}(\tilde{p}_t + E_t\,\tilde{p}_{t+1}) = \omega_{t-1} - \tfrac{1}{2}(\tilde{p}_{t-1} + \tilde{p}_t) \\ + \bar{g}_t - \frac{\psi}{2(1-\gamma)}U_t\end{aligned} \qquad \textbf{(3.11)}$$

The average wage paid in period t, w_t, is the average of the current and previous contract wage, $w_t = \tfrac{1}{2}(\omega_t - \omega_{t-1})$. Equation **(3.6)** can be rewritten as $p = \mu + w + l - y$.

The relationship between the RPI, the domestic value-added deflator and import prices can be written as:

$$\tilde{p} = (1-\alpha)p + \alpha(p^f + s) \qquad \textbf{(3.12)}$$

Let $g_t \equiv y_t - y_{t-1} - (l_t - l_{t-1})$ be the growth rate of labour productivity and $\rho_t \equiv s_t + p_t^{*f} - p_t$ the real exchange rate. It follows that:

$$\begin{aligned}\Delta\omega_t = \tfrac{1}{2}(E_t\tilde{\pi}_{t+1} + \tilde{\pi}_t) + \bar{g}_t \\ - \frac{\psi}{2(1-\gamma)}\left[U_t + \sum_{i=1}^{\infty}\left(\frac{\gamma}{1-\gamma}\right)^{i-1}\frac{1}{1-\gamma}E_tU_{t+i}\right]\end{aligned} \qquad \textbf{(3.13)}$$

Since $\tilde{\pi}_t = \tfrac{1}{2}\Delta\omega_t + \tfrac{1}{2}\Delta\omega_{t-1} + \Delta\mu_t - g_t + \Delta\rho_t$, this model exhibits inflation persistence and not merely price *level* persistence:

$$\begin{aligned}\tilde{\pi}_t = \tfrac{1}{4}\left[E_t\tilde{\pi}_{t+1} + \tilde{\pi}_t + E_{t-1}\tilde{\pi}_t + \tilde{\pi}_{t-1}\right] + \Delta\mu_t - g_t + \Delta\rho_t \\ + \tfrac{1}{2}\left[\bar{g}_t - \frac{\psi}{2(1-\gamma)}\left(U_t + \sum_{i=1}^{\infty}\left(\frac{\gamma}{1-\gamma}\right)^{i-1}\frac{1}{1-\gamma}E_tU_{t+i}\right)\right] \\ + \tfrac{1}{2}\left[\bar{g}_{t-1} - \frac{\psi}{2(1-\gamma)}\left(U_{t-1} + \sum_{i=1}^{\infty}\left(\frac{\gamma}{1-\gamma}\right)^{i-1}\frac{1}{1-\gamma}E_{t-1}U_{t-1+i}\right)\right]\end{aligned} \qquad \textbf{(3.14)}$$

(1) The other solution is as follows:
$$\omega_t - \tfrac{1}{2}(\tilde{p}_t + E_t\,\tilde{p}_{t+1}) - \bar{\tau}_t = \left(\frac{1-\gamma}{\gamma}\right)\left[\omega_{t-1} - \tfrac{1}{2}(\tilde{p}_{t-1} + \tilde{p}_t) - \bar{\tau}_{t-1}\right] - \frac{\psi}{2\gamma}\left[U_t + 2\sum_{i=1}^{\infty}E_tU_{t+i}\right]$$
It makes little economic sense, unless γ=1, the purely forward-looking case, which I am not considering. When $\gamma < 0.5$ (ie when the model is more backward-looking than forward-looking), the real wage growth process becomes non-stationary, and it is more non-stationary, the smaller is γ. When $\gamma > 0.5$, the autoregressive component in the real wage process is stationary, but the infinite sums for the forcing variables will explode, even when the forcing variables are constant.

(2) If $\gamma > 0.5$, the infinite sums in **(3.10)** would not converge, even if the target growth rate of real wages and the unemployment rate were constant.

From **(3.13)**, lower expected real wage growth can mean lower money wage inflation, if the expected rate of price inflation is unchanged. It can mean unchanged money wage inflation if the expected rate of price inflation falls. It is even consistent with rising money wage inflation if the expected rate of price inflation rises even more.

From equation **(3.13)**, we also see how current-period contract wage inflation depends on RPI inflation during the current period and on current expectations of next period's RPI inflation. Since the current inflation rate of average money wages is a weighted average of current and last period's contract wage inflation, $\Delta w_t = \frac{1}{2}(\Delta\omega_t + \Delta\omega_{t-1})$, the RPI inflation augmentation term in the equation for the inflation rate of average money wages is:

$$\tfrac{1}{4}\left(E_t\tilde{p}_{t+1} + \tilde{\pi}_t + E_{t-1}\tilde{\pi}_t + \tilde{\pi}_{t-1}\right) \qquad \textbf{(3.15)}$$

This 'RPI inflation augmentation term' includes both past RPI inflation and past expectations of current RPI inflation (as well as current RPI inflation and current expectations of future RPI inflation).

With the RPI inflation augmentation term in the money wage equation partly predetermined, lower expected real wage growth is likely to mean lower money wage growth in the short run. Given an unchanged mark-up and an unchanged growth rate of labour productivity, price inflation on the GDP deflator measure will also be lower in the short run than it would otherwise have been. Once the influence of inherited nominal contracts wears off, however, the lower NAIRU only has implications for the path of *real wages*, not for price inflation or money wage inflation separately. Monetary policy maps real wage growth into money wage growth and inflation in the long run.

I define the NAIRU, U^N, as the constant unemployment rate that would be consistent with a constant rate of inflation, a constant share of labour in value added (ie a constant mark-up), a constant real exchange rate, a constant growth rate of labour productivity and a constant growth rate of target real wages. This very long-run definition of the NAIRU implies that:

$$U^N \equiv \psi^{-1}(1-2\gamma)\left[\bar{g} - g\right] \qquad \textbf{(3.16)}$$

Substituting **(3.16)** into **(3.11)**, we can write the real contract wage adjustment equation, when the actual unemployment rate is constant, as follows:(1)

$$\omega_t - \tfrac{1}{2}\left(\tilde{p}_t + E_t\tilde{p}_{t+1}\right) = \omega_{t-1} - \tfrac{1}{2}\left(\tilde{p}_{t-1} + \tilde{p}_t\right) + g - \frac{\psi}{1-2\gamma}\left(U - U^N\right) \qquad \textbf{(3.17)}$$

Thus, in the short run, with current contract wage inflation in part anchored to past expectations and past actual inflation, a reduction in the natural rate of unemployment will exercise downward pressure on currently negotiated money wage settlements. Short-run nominal interest rates can be lower than they would have been otherwise. Over time, the actual unemployment rate will, partly through the automatic servomechanism of a market economy and partly through deliberate policy actions, follow the natural rate down to its new lower level. At that point, nominal interest rates will have to revert to the level where they would have been in the absence of a fall in the natural rate of unemployment, if an unchanged inflation target is to be met.

3.6 Higher trend productivity growth and UK monetary policy

An increase in the growth rate of trend productivity has no straightforward implications for inflation and for the path of nominal interest rates consistent with a given inflation target, even in the short run. The common assertion that it will reduce the rate of inflation, or that it permits lower nominal rates without endangering the inflation target, appears to be based on one of two misconceptions.

The first is a partial-equilibrium, 'cost-plus' view of price determination. For simplicity, I assume the real exchange rate is constant. The rate of inflation of the value-added deflator, $\pi_t = p_t - p_{t-1}$, is the growth rate of unit labour costs, $\Delta w - g$, plus the growth rate of margins, $\Delta\mu$.

$$\pi = \Delta w - g + \Delta\mu \qquad \textbf{(3.18)}$$

Holding constant the growth rate of money wages, a higher growth rate of productivity will reduce the growth rate of unit labour costs. If margins do not increase, this will mean lower price inflation. However, the target growth rate of real wages is unlikely to be constant when the growth rate of productivity increases. For a given path of unemployment, expected real wage growth can be expected to increase in line with the underlying growth rate of labour productivity. This need not be the case if the productivity growth reflects changes in labour market institutions and practices that weaken the bargaining strength of labour, but it is a useful benchmark.

With expected real wage growth rising in line with trend productivity growth, the effect of higher productivity growth on money wage growth depends entirely on the behaviour of expected inflation. Assume the public does not make systematic errors when it forms its inflation expectations. In that case, the behaviour of money wage inflation moves, other things being equal, one-for-one with price inflation. With price inflation moving one-for-one with wage inflation (given productivity growth and given the mark-up), there is no way we can explain what happens to price inflation and wage inflation individually. Again, we need monetary

(1) For notational simplicity, I assume that the growth rate of productivity, the target growth rate of real wages and the actual unemployment rate are all constant.

policy to translate changes in expected real wage growth into paths for price inflation and money wage inflation.

The second simple productivity-growth-to-inflation nexus is based on a misinterpretation of the most basic identity in macroeconomics, the equation of exchange. Let M be the nominal stock of money and V the income velocity of circulation of money. So:

$$MV = PY \qquad \textbf{(3.19)}$$

In growth rate form this identity can be rewritten as:

$$\pi = \Delta m + \Delta v - \Delta y \qquad \textbf{(3.20)}$$

Those who argue that higher productivity growth means lower inflation make two implicit assumptions. First, higher productivity growth means higher output growth. The correct statement would be that, other things being equal, higher productivity growth means a higher growth rate of *potential* output. To translate potential output growth into actual output growth, the proper quantum of aggregate demand needs to be in place. Second, monetary policy somehow fixes the growth rate of nominal GDP, or the growth rate of the nominal money stock, corrected for changes in velocity.

The growth rate of nominal GDP is not an instrument of monetary policy. Normally it is not a target either.(1) Simple, but descriptively realistic, monetary policy rules like the Taylor rule for the short nominal rate of interest or the McCallum rule for the growth rate of the nominal stock of base money, do not support, out of steady state, a constant growth rate of nominal GDP in the face of an increase in the growth rate of potential GDP.

According to the Taylor rule, the short nominal interest rate moves more than one-for-one with (actual and expected) inflation, and also responds positively to the output gap. Let $\tilde{\pi}^*$ be the target inflation rate, $\bar{r}$ the long-run real interest rate and $\bar{y}$ capacity output, then:

$$i_t = E_t\bar{r}_t + E_t\tilde{\pi}_{t+1} + \delta_1(\tilde{\pi}_t - \tilde{\pi}^*) + \delta_2(y_t - \bar{y}_t) \qquad \textbf{(3.21)}$$

$$\delta_1, \delta_2 \geq 0$$

The McCallum rule makes the growth rate of base money a decreasing function of the deviation of inflation from its target and of the output gap:

$$\Delta m_t = \Delta\bar{y}_t + E_t\tilde{\pi}_{t+1} - \gamma_1\left(\tilde{\pi}_t - \tilde{\pi}^*\right) - \gamma_2\left(y_t - \bar{y}_t\right) \qquad \textbf{(3.22)}$$

$$\gamma_1, \gamma_2 \geq 0$$

The transitional dynamics of the velocity of circulation of money are one of the abiding mysteries of empirical monetary economics. Common models of money demand make the money-income ratio or the money-consumption ratio a decreasing function of the opportunity cost of money. In what follows I interpret money narrowly, as non interest bearing central bank money or base money. The pecuniary opportunity cost of holding this rate of return dominated asset is the short nominal rate of interest. A representative long-run money demand function would be:

$$m - p - y \equiv -v = \eta_0 - \eta_1 i \qquad \textbf{(3.23)}$$

$$\eta_1 > 0$$

In the long run, ie along a balanced growth path, velocity is constant. Therefore, across steady states, a constant growth rate of the nominal money stock supports a one-for-one reduction in the rate of inflation when the growth rates of potential and actual output rise. If the central bank is charged with achieving an unchanged inflation target, the steady-state growth rate of the nominal money stock would rise one-for-one with the growth rates of actual and potential output.

The fact that the operational monetary policy instrument, in the United Kingdom and elsewhere, is a short nominal interest rate, the two-week repo rate in the United Kingdom, matters for the long-run response of the price *level* to shocks. When the nominal interest rate is either set exogenously, or, as in the case of the Taylor rule, is a function only of real variables, the behaviour of the nominal variables, ie the price *level* and the *levels* of the money wage and the nominal money stock paths, is different from what it would be if (the growth rate of) the nominal money stock were the instrument of policy along the lines of the McCallum rule. This is true even in the long run and even if the monetary growth rule targets and achieves the same long-run inflation rate as the nominal interest rate rule.

If there are no nominal rigidities, nominal interest rules result in price level or nominal indeterminacy.(2) While the rate of inflation, the growth rate of the nominal money stock and all other real variables are determinate, the price level sequence and the nominal money stock sequence are not. In our neo-Keynesian model, the initial value of the price level and/or the money wage is anchored in history. There is no nominal indeterminacy, but the long-run values of the price level, the money wage and the nominal money stock are 'hysteretic' or path-dependent. They depend on the initial conditions. Under a nominal interest rate rule like the Taylor rule, a real, structural change, such as a permanent lowering of margins, results in a permanently lower path of the price level, even though it will have no permanent effect on the rate of inflation. This would not be the case under a monetary rule like the McCallum rule, which would support

(1) There have been proposals that monetary policy should target nominal GDP growth, but no monetary authority has adopted such a target.
(2) This will not be the case if the nominal interest rate is made a function of some nominal variable, such as past, current or anticipated values of the nominal money stock, the price level or the money wage.

an unchanged long-run path of the price level in steady state following a permanent lowering of margins.

What can we expect to happen, in the long run, and on average, to the short nominal interest rate if the growth rate of potential output rises? Ignoring, for simplicity, term and risk premia, the expected real interest rate equals the nominal interest rate minus the expected rate of inflation. In the long run, actual, expected and target inflation will coincide and the real exchange rate is constant. With the domestic real interest rate equal to the world real interest rate, domestic nominal rates in steady state are therefore given by:

$$i = \tilde{\pi}^* + rf \qquad \textbf{(3.24)}$$

If the world real rate of interest is not changed in the long run when UK productivity growth rises, the achievement of an unchanged inflation target will still require the same long-run path of UK nominal interest rates as before.

It is easy to think of circumstances where an increase in the growth rate of UK potential output is associated with an increase in the long-run global real rate of interest. This would be the case, for instance, if, in the spirit of the New Paradigm, the increase in the growth rate of productivity were a worldwide phenomenon associated with an increase in the marginal real rate of return to capital investment. If the equity risk premium is unchanged, the global real rate of interest would also rise, and the UK real interest rate would rise with it. With an unchanged inflation target, the long-run path of the UK short nominal interest rate would have to be higher.

To get the short-run effect, assume that the long-run real interest rate is unchanged. According to the Taylor rule, the short-run response of nominal rates will depend on the short-run impact of increased productivity growth on the output gap. Productive potential is given by the real value added that would be produced if employment were at its equilibrium level. Since there is no evidence of significant intertemporal substitution in labour supply, equilibrium employment can be written as $\bar{L}(1–U^N)$, where $\bar{L}$ is the exogenous labour force. Potential output is therefore given by:

$$\bar{Y} = AF\left(K, \bar{L}\left(1 - U^N\right), N\right) - \frac{P^f}{P} N \qquad \textbf{(3.25)}$$

So-called supply-side shocks or supply-side improvements almost always have direct and indirect effects on aggregate demand as well. Even with an unchanged path of nominal interest rates, aggregate demand is likely to be boosted by the kind of structural changes that boost the trend growth rate of productive potential, which we can represent here as an increase in the growth rate of total factor productivity, *A*.

Aggregate demand is the sum of private consumption, *C*, private investment, *I*, government exhaustive spending, *G*, and net exports, *X*.

$$Y = C + I + G + X$$

Private consumption depends on permanent after-tax labour income, current after-tax labour income and real financial wealth. It may also depend on the path of current and anticipated future real interest rates. 'Confidence effects' influence investment as well as consumption. Private financial wealth is the sum of real stock market wealth, *V*, real housing wealth, the real value of the stock of base money, the real value of the public debt and the real value of net claims on the rest of the world. Private investment can be viewed as driven by (marginal) *V*, by confidence effects and by corporate cash flow, liquidity and balance sheet strength. Net exports depend negatively on domestic demand and positively on real competitiveness and on demand in the rest of the world.

Higher growth of potential output is likely to boost households' perceptions of their permanent incomes, even if their current incomes do not rise immediately. Housing wealth may increase. If any part of the productivity gains is appropriated by the owners of capital, stock market valuations will rise and household financial wealth with it. Even if the valuation of existing capital is not boosted (say because technical progress cannibalises the old capital stock and reduces profit margins), the return to investment in the appropriate new sectors could be very high. Intangibles like household and business confidence may be boosted. All this will stimulate private consumption and investment. It is not at all inconceivable that aggregate demand is, in the short and medium term, boosted by more than potential output. This would call for a higher short-run path of nominal interest rates in order to achieve an unchanged inflation target, not a lower one. In the long run, if the real interest rate and the inflation target are unchanged, higher productivity growth will have no effect on the path of nominal interest rates.

All this is a long, some might say long-winded, way of saying that inflation is, always and everywhere, in part a monetary phenomenon. It is important to remind oneself of that old truth, however, lest one gets carried away on a wave of supply-side euphoria.

Whatever the plausibility and quantitative significance of the supply-side improvements reviewed here, it is vitally important that we recognise that their implications for monetary policy, given an unchanged inflation target, are by no means straightforward. The view that a sustained reduction in the natural rate of unemployment, a sustained fall in margins or a sustained increase in the rate of growth of productivity all unambiguously imply that the path of short-term nominal interest rates can be lower than it would otherwise have been, without this posing a threat to the inflation target, is almost certainly mistaken.

4 Conclusion

Even if much of the claims made for the New Economy is hype, what remains is substantial enough to matter for the

United Kingdom's real economic performance in the medium and long term and for the conduct of monetary policy. It is encouraging that, for monetary policy purposes, the qualitative implications of the New Paradigm can be analysed using conventional tools of macroeconomic and monetary analysis. Assessing their quantitative impact remains largely guesswork. The failure of many pundits to draw the correct conclusions (even qualitatively) about the implications of the New Paradigm for the conduct of monetary policy is due less to the innate novelty and complexity of the New Paradigm than to a failure to understand basic monetary economics.

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The impact of the Internet on UK inflation

In this speech,[1] Sushil B Wadhwani, member of the Bank's Monetary Policy Committee, argues that the Internet is likely to have a highly significant impact on productivity, margins, the NAIRU and inflation over the next few years. He conjectures that there may be a case, therefore, for revisiting the MPC's assumptions on productivity growth, although he concedes that the Internet is only one of many factors that will influence the outlook for inflation.[2]

1 Introduction

There is currently much discussion of the effects of the Internet. Among the several putative benefits of the World Wide Web, perhaps the most eye-catching is the assertion by Dertouzos (1997) that:

'A common bond reached through electronic proximity may help stave off future flareups of ethnic hatred and national breakups.'[3]

In my lecture today, I shall be concerned only with the narrow economic effects on productivity, profit margins and inflation.

2 Some theoretical considerations

2.1 The effect on productivity and profit margins

There are a number of ways in which the Internet might have significant economic effects.

Lower search costs

Conventional economic theory predicts that high search costs allow prices to be above marginal costs in equilibrium (see eg Salop (1979)). The lowering of search costs associated with the Internet should lead to lower prices, for both business-to-consumer (B2C) and business-to-business (B2B) commerce. So some product markets may more closely approximate the economists' concept of 'perfect competition' than before.

Lower barriers to entry

The Internet lowers market entry costs in several product areas, thereby limiting the price premiums sustainable by existing market participants (because of the increase in actual or potential competition).

Greater product market competition

Lower search costs and reduced barriers to entry, as discussed above, both tend to induce greater product market competition. This should boost productivity and limit wage demands.

In many standard models of the labour market, a reduction in a firm's product market 'power' is associated with lower nominal wages at any given level of employment, as firms will tend to partially offset the effect on their profit margins (see eg Layard, Nickell and Jackman (1991) for the conventional textbook treatment of this issue).

So, for the economy as a whole, an increase in the average degree of product market competition would be expected to be associated with a reduction in the so-called non-accelerating inflation rate of unemployment (NAIRU).

One might also plausibly expect productivity to increase in response to the intensification of competitive pressures. For example, if firms and unions bargain over effort as well as wages, the reduction in product market rents would lead to a higher level of effort (see eg Nickell, Wadhwani and Wall (1992)). Alternatively, one might expect to see less X-inefficiency in an organisation as a whole when competitive pressures increase.

A shortening of the supply chain

Many retailers currently operate at the end of a distribution chain, which might include layers of wholesalers or regional distribution centres. De Prince and Ford (1999) suggest that the Internet commerce sector uses two main distribution models—one where the end-user orders products directly from a distributor and bypasses the retailer (eg Amazon), and another which involves direct contact between end-users and producers such that there are no inventories of finished products anywhere in the system (eg Dell). Indeed, one would expect lower costs of holding inventories on either distribution model. Similar considerations should apply to corporate supply chains. Of course, electronic links between businesses have existed for decades in the form of electronic data exchange (EDI). But, as pointed out by *The Economist* (1999), EDI is very expensive to operate and

(1) Delivered at the London School of Economics on 23 February 2000. The speech may be found on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech72.pdf

(2) I am greatly indebted to Joanne Cutler and John Henderson for their help and advice on this work. Nick Oulton, Andrew Wardlow and John Whitley provided me with helpful comments on an earlier version. The views expressed in this paper are personal and do not necessarily reflect any views held by either the Monetary Policy Committee or the Bank of England.

(3) As cited in Standage (1998).

so has been used mainly by large manufacturing firms, and because it is based on proprietary technologies rather than open standards it binds suppliers and customers together. By contrast, the Internet is much cheaper and is open to everybody, which lowers the barriers to adoption and brings in a wider range of firms who may not otherwise have traded with each other. One would expect wider adoption of the Internet to reduce the costs of processing transactions. The bypassing of intermediaries in B2C and B2B commerce should, of itself, be associated with labour productivity gains. And the increased competition among suppliers induced by the Internet should facilitate a reduction in the price of inputs.

Direct effects on unemployment

The Internet is likely to improve job matching between the unemployed and available vacancies, which should lead to a fall in the NAIRU. But the turbulence that may be generated by rapid industrial change will increase the level of structural unemployment, as will the probable increase in skill mismatch, as the Internet might lead to a significant relative reduction in unskilled job opportunities.

Summary

To summarise, the initial impact of the Internet is likely to be to:

- Reduce profit margins (at least in some sectors).
- Increase productivity (including the reduction of inventory costs). Note that we would expect the boost to the level of productivity to be spread over several years, so it would show up as a boost to productivity growth during the transition period.
- Lead to a reduction in the NAIRU in response to the intensification of product market competition and superior job matching, though this may be partly offset by an increase in skill and industrial mismatch.

2.2 The effect on inflation

As my colleague, Willem Buiter (1999), has recently re-emphasised, inflation is, ultimately, a monetary phenomenon. So a fall in the NAIRU associated with the Internet would not reduce inflation in the long run, though there would be important short-run effects.

Suppose that inflation is currently 2½% and would, on unchanged interest rates, remain constant thereafter. Assuming that the NAIRU now falls for the Internet-related reasons discussed above, then, other things being equal, inflation outturns will start to be below target. A central bank with a symmetric inflation target (like the Bank of England) will respond to the below-target inflation by lowering interest rates. However, over time, the actual unemployment rate should drift down to the new, lower level of the NAIRU. When that happens, one would expect interest rates and inflation to rise back to their original levels.

So, in the short run, the benign structural factors should enable inflation to be lower than before. I should say that the 'short run' in this example could, in practice, last several years, as structural factors that lower the NAIRU can sometimes improve gradually over a number of years. But in the long run, once unemployment has fallen to the new lower NAIRU, there are no effects on inflation.

So far I have deliberately abstracted from the demand-side impact of these supply-side changes, though these might also affect the short-run level of interest rates. The expected benefits of the Internet should boost share prices, so aggregate demand may rise in line with standard wealth effects. But the restructuring that is typically associated with an intensification of product market competition usually leads to increased job insecurity, which hurts consumption. Though these demand-side factors will affect the precise path of interest rates, they are unlikely to affect the qualitative aspects of our basic thesis, although it is certainly possible that the demand-side boost of the Internet might occur before the supply-side boost (so the initial impact of the Internet may be to raise inflation).

In discussing the potential effects of the Internet on inflation, it is important to deal with two extreme, but fallacious views. On the one hand, it is sometimes asserted that the Internet is a phenomenon that only affects the real side of the economy and so it cannot affect inflation, which is determined only by the level of the money supply. But this view fails to allow for the possibility that when the Internet lowers the NAIRU, the actual unemployment rate will, for a variety of reasons, only move slowly to the lower level of unemployment. Also, if the central bank did not believe that the NAIRU had fallen and kept interest rates unchanged, inflation would start to undershoot its target.

At the other extreme, it is sometimes asserted that the Internet will kill inflation by itself. This view suffers from a neglect of the monetary determinants of inflation. In the story sketched above, once the unemployment rate has fallen to the new, lower level of the NAIRU, there should be no further tendency for inflation to undershoot the target at the original interest rate.

Turning to the Internet-related effects on productivity, we would not expect there to be any long-run effects on the NAIRU. Recall that although we experienced significant technical progress in the twentieth century, the unemployment rate has been broadly trendless. However, we may see a short-run effect on the NAIRU. Specifically, if real wage aspirations depend on past productivity increases, then, when productivity growth accelerates, we may, for some time, see firms benefiting from the fact that real wage growth is below actual productivity growth, allowing, among other things, for lower prices.

In some ways, this can be thought of as the opposite situation to that which prevailed after the 1973 oil shock, when workers were slow to reduce their real wage aspirations in line with lower actual productivity growth,

which led to upward pressure on prices. Hence, the higher productivity growth could plausibly lead to temporarily lower unemployment and inflation.(1)

An implication of the higher productivity growth is that rule-of-thumb statements like 'we need to slow the growth in real domestic demand to 2¼%' (a common estimate of trend real growth), which are often heard in the context of the UK policy debate, may no longer be relevant, in that a number rather higher than 2¼% might be used instead (this is an empirical issue to which I return below). Also, rules of thumb such as the oft-quoted assertion that average earnings growth should, over time, grow by around 4½% (a 2½% inflation target plus 2% productivity growth) might also need to be revised for the same reasons. Of course, I do not wish to imply that policy is ever set purely on the basis of these rules of thumb. It is not. Nevertheless, these rules do loom large in much popular discussion.

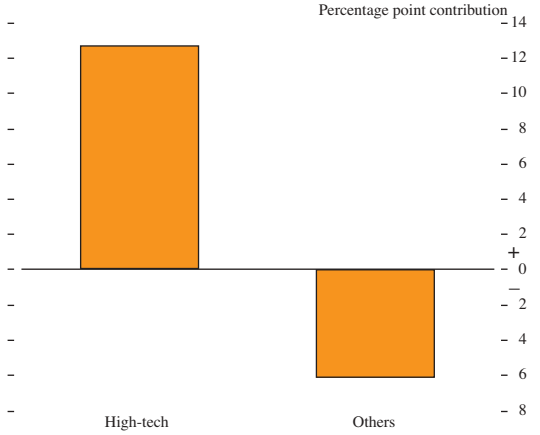
3 The empirical importance of the Internet for UK inflation

3.1 The current size and the prospective growth of e-commerce

The Internet has clearly penetrated popular consciousness. It now appears regularly in the media; the *Financial Times* has christened itself 'the newspaper of the e-conomy'.

World stock markets certainly appear to have become much more optimistic about the prospects for the 'hi-tech' sectors in recent months—'hi-tech' sectors more than account for the rise in the FTSE All-Share index(2) since last October (see Chart 1), ie the other sectors have actually fallen. Similarly, in the United States, the technology sector can more than account for the rise in the S&P 500, despite comprising around only 30% of the index (see Chart 2). Given the implied optimism of the financial markets about the 'hi-tech' sectors, it would be complacent of us to not take this phenomenon seriously.

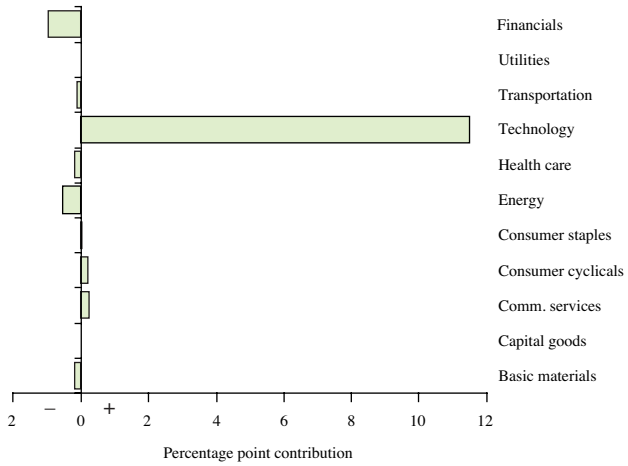
Chart 1
Percentage point contribution of key sectors to the rise in the FTSE All-Share since 25 October 1999(a)



Note: High-tech includes telecoms, information technology, media and Marconi.

(a) Up to 9 February 2000.

Chart 2
Percentage point sectoral contributions to the rise in the S&P 500 since 25 October 1999(a)



(a) Up to 9 February 2000.

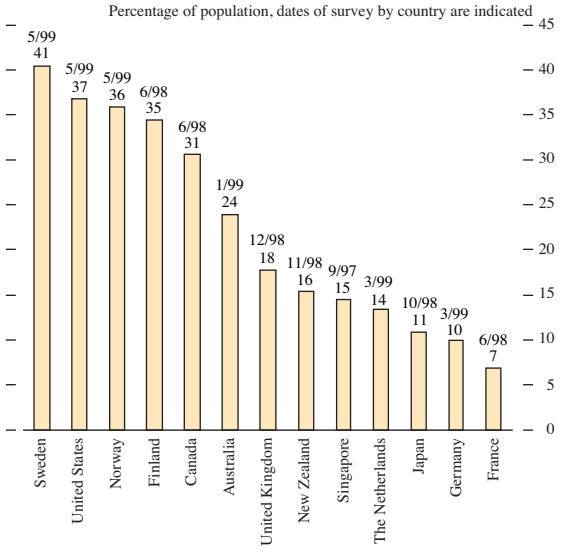
Estimates produced by the University of Texas suggest that the Internet economy is growing fast in the United States (see Table A). Chart 3 suggests that the United Kingdom still lags several countries in terms of Internet use, though the chart is based on a survey in December 1998, and anecdotal evidence suggests a significant increase in Internet penetration since then.

Table A
Internet economy indicators

	1998	1999	Growth (per cent)
Annual revenues ($ billions)	301.4	507.0	68
Employment (millions)	1.57	2.3	46

Source: Center for Research in Electronic Commerce, Graduate School of Business, University of Texas at Austin.

Chart 3
Benchmarking UK Internet users—world



Source: NUA, drawing on multiple published studies.

(1) Note, though, that the higher expected productivity growth should lead to higher share prices and therefore to higher demand as well, so, in principle, inflation might not fall.
(2) 'Hi-tech' sectors in this context include telecoms, information technology and media.

Indeed, a recent survey of online purchasing (which will, of course, be less than Internet usage) suggested that 10% of the population had already made an online purchase, with a further 6% (of those who had not made an online purchase) expecting to do so in the next three months (see Table B). Moreover, among those who have made an online purchase, the level of satisfaction does seem high, with 58% saying that the level of service received was better than from a traditional High Street retailer, and only 3% believing the service to be worse. This is a significant finding because it casts doubt on the view that the reason why Internet prices are lower than those on the High Street on a like-for-like comparison is the lower quality of service.

Table B
Online purchasing survey, January 2000

	Proportion saying 'yes' (per cent)
Have you ever made a purchase online?	10
Do you expect to make a purchase online in the next three months? (of those who have *not* purchased in the past three months)	6
What was the level of service you received?	
Better than you usually receive from a traditional High Street store	58
Same	39
Worse	3

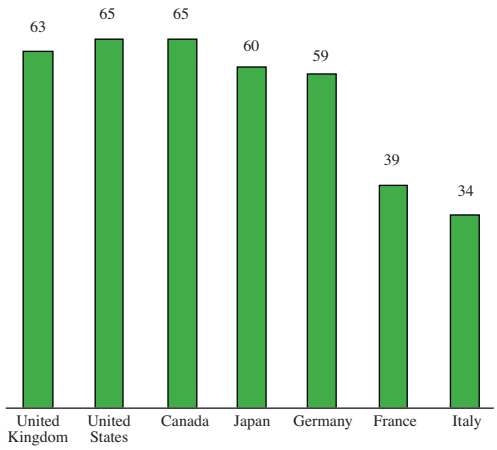
Source: Consumers' Association.

If Internet access were restricted to personal computers, it would be reasonable to expect the progress in Internet penetration to be low. However, the availability of the Internet through digital TV and the mobile phone can reasonably be expected to accelerate the degree of penetration among UK households.

The United Kingdom does well in terms of business usage of information technology (web sites, external e-mail or EDI), in that the level of penetration is one of the highest in the G7 countries (see Chart 4). However, just one in ten UK companies actually sells online, and only one in four makes online purchases.

Chart 4
Basic IT penetration of businesses—major economies

Stated percentage of companies that have their own web sites, or make frequent use of EDI or external e-mail



Source: Spectrum International Benchmarking study, 1999.

More encouragingly, a recent survey of global businesses suggested that the importance companies place on e-business is set to increase significantly (see Charts 5A and 5B). 23% of businesses think that e-business will be essential for the sector in which they operate within the next one to two years compared with 7% now, and a third believe that it will be very important compared with only 17% now. The proportion who think it will be unimportant is set to fall from 52% to 14% in one to two years' time.

Chart 5A
Current importance of e-business

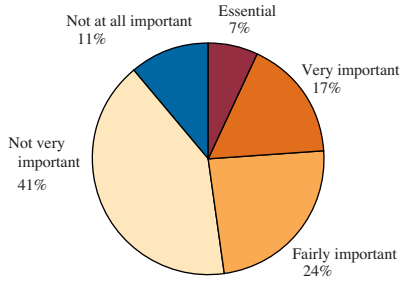
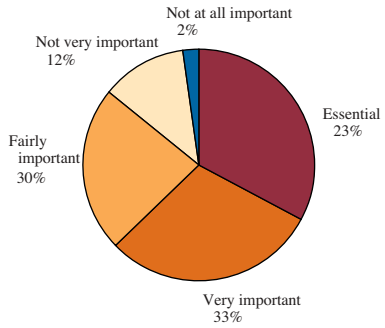


Chart 5B
Future importance of e-business



Source: Intentia International/MORI, August-October 1999.

Table C suggests that the expected returns on an investment made in e-business are high—around 22% per annum for the sample as a whole, with the expected return in the United Kingdom being broadly in line with the sample average (23%), but anticipated returns in the United States a little higher (27%). Across the board, companies are, on average, expecting 13% of sales to be generated by

Table C
Expectations associated with e-business

Per cent per annum

Expectations for returns on investment in e-business	
Total sample	22
UK sample	23
US sample	27
Expectations for sales generated by e-business	
Total sample	13
UK sample	15
US sample	15

Source: Intentia International/MORI.

e-business in one to two years' time, with expectations being a little higher than average in both the United Kingdom and the United States (at 15%).

Table D presents some related evidence from a recent survey carried out for Andersen Consulting. Around one half of UK respondents agree to the question of whether e-commerce is creating more intense competition now, with the fraction rising to around four fifths over the next five years. However, the fraction of those who 'strongly agree' with the statement rises from a puny 3% now, to around 60% over the next five years—so among those who feel strongly about it, the intensification of competition is yet to come. Turning to the other key question of changes in the role of intermediaries, a similar pattern emerges. Only 9% of UK respondents strongly agree with the proposition that e-commerce is already bringing fundamental changes to intermediaries, but this proportion rises to 44% for the prospective five-year period. The proportion rises from 59% to 81% over the next five years for those who agree with the basic proposition. It is also encouraging that the Government is adopting a variety of measures to accelerate the adoption of e-commerce in the United Kingdom.(1)

Table D
Business survey evidence regarding the Internet

Question	Percentage who agree strongly			Percentage who agree		
	United Kingdom	United States	Europe	United Kingdom	United States	Europe
Do you agree that e-commerce is currently creating more intense competition in your industry?	3	25	17	56	52	44
Do you agree that e-commerce will create more intense competition in your industry within the next five years?	59	48	38	81	78	64
Do you agree that e-commerce is bringing fundamental changes for the intermediaries in your industry today?	9	22	18	59	67	46
Do you envisage e-commerce bringing about changes for intermediaries within your industry sector within the next five years?	44	55	41	81	85	72

Source: Andersen Consulting. Survey undertaken in May-June 1999.

Hence, to summarise, the stock market's optimism about the 'hi-tech' sector does appear to be associated with significant expected growth in online activity amongst businesses and consumers alike, although, at this point, the former do seem more enthusiastic.

3.2 Microeconomic evidence for the potential benefits

For most people, the more visible aspect of e-commerce is of the business-to-consumer variety. In the United States, Brynjolfsson and Smith (1999) found that the prices for books and CDs sold through the Internet were 9%–16% lower than in conventional outlets, even after accounting for the costs of shipping and handling, delivery and local sales taxes. In a UK study carried out in December 1999 (summarised in Table E), Barclays Capital suggested that Internet prices were significantly lower than High Street prices for a variety of goods (with discounts of up to 22% for books), though there were some exceptions where the Internet was more expensive (eg for cassette tapes).

Table E
Estimated High Street vs Internet prices

Item	Percentage difference
Fridge-freezers	-12
Washer-dryers	-11
Microwaves	-10
Vacuum cleaners	-15
Televisions: portable	-14
large-screen	-13
wide-screen	-14
Video	-14
Discman	-10
Compact discs	-8
Cassette tapes	+10
Toys	0
Books: general paperback	-22
fiction paperback	-22

Note: A negative number signifies that the Internet price is lower.

Source: Barclays Capital.

Given the small size of the sample and the use of list prices, more research is needed in this area. Note that the existence of this differential suggests that the RPIX might be modestly overstating inflation, though the ONS is already working on incorporating online commerce into the RPIX. Moreover, anecdotal evidence suggests that some High Street retailers are beginning to respond to the Internet-based competition by lowering their in-store prices, so the bias in the RPIX might remain small.

It is widely accepted that B2C commerce is likely to be dwarfed by B2B commerce. There is much anecdotal evidence of the potential benefits of B2B commerce—for example, British Telecommunications (BT) claims that the average cost of processing each transaction it undertakes will fall by 90%, and, moreover, it forecasts a fall of around 11% in the direct cost of goods and services that it procures. Table F displays some estimates (produced by equity analysts at Goldman Sachs) of the potential cost savings from B2B *vis-à-vis* procurement costs. The estimates of the savings range from 2% to almost 40% across different sectors.

The sectors listed in Table F account for about 30% of the UK economy.(2) Of course, many companies produce both intermediate inputs into other industries and final outputs for consumers, and the estimates in Table F fail to allow for these second-round effects. Brookes and Wahhaj (2000) compute an estimate of the overall effect of such cost savings on the GDP deflator—they argue that it could be around 4% in the United Kingdom. This is a potentially significant effect, but note that this assumes that other things

(1) See for example the speech by the Chancellor of the Exchequer, 'Britain and the knowledge economy', 16 February 2000.
(2) We need to be careful here, as the numbers are based on expected US savings—though there is no reason to expect UK experience to be materially different over the medium term. The 30% figure also adds the car industry to the sectors listed in Table F—recall that Ford and GM have announced large B2B schemes.

Table F
Initial B2B cost savings by industry

Industry	Cost savings (per cent)
Aerospace	11
Chemicals	10
Coal	2
Communications	5–15
Computing	11–20
Electronic components	29–39
Food ingredients	3–5
Forest products	15–25
Freight transport	15–20
Healthcare	5
Life science	12–19
Machinings (metals)	22
Media and advertising	10–15
MRO	10
Oil and gas	5–15
Paper	10
Steel	11

Source: Goldman Sachs e-commerce/Internet.

are equal and does not allow for further macro effects.(1) Further, this effect would be spread over several years, though, in this case, it is interesting to note the views of Lamming and Elliott (1999, page 41) that:

'The UK and Germany are now reaching the point of 'commercial threshold' where most large companies are starting to use B2B. By 2002, it is expected that there will be wide-scale usage of e-markets.'

Also, the Brookes-Wahhaj estimates (as they acknowledge) are likely to underestimate the benefits of B2B commerce in that they do not allow for savings due to lower inventories or fewer intermediaries.

So there is a considerable amount of microeconomic evidence that the Internet could have significant effects, though we defer a consideration of the macroeconomic effects until later. Before doing so, some consideration of a historical analogue might prove useful.

3.3 The beneficial effects of the telegraph

Tom Standage (1998) has persuasively argued that, in the nineteenth century, the electric telegraph was, in effect, the Victorian Internet.

A textbook on American history (Atack and Passell (1994)) describes the economic benefits of the telegraph in ways that are reminiscent of contemporary descriptions of the Internet.

'Not only was the telegraph essential for the safe operation of the nation's single-track rail system, but it also provided a real-time link between producers and consumers. These new transportation and communications systems generated almost instantaneous flows of information, increased the speed and regularity of the flow of goods, and reduced the number of transactions involved in the transfer of goods. The costs of distribution fell and productivity rose … The telegraph was absolutely essential to the success of the Chicago meat-packing industry, enabling firms to respond quickly to changing levels of demand in different markets.' (pages 469–70)

or

'The new means of transportation and communication also revolutionised the distribution of manufactured goods. Wholesalers became increasingly centralised …' (page 470)

or

'The railroad and telegraph provided the means for market co-ordination. For the first time, manufacturers were assured of a smooth and continual inflow of raw materials at the back door and outflow of finished goods through the front gate with almost instantaneous updates on demand conditions. Inventories were sharply reduced, and cash flow increased. ... New machinery and new processes had to be developed to take full advantage of the opportunity. Increased flow made possible the subdivision of tasks and the development of highly specialised single-purpose machines. ... Wherever possible, production processes were made continuous ... The result was mass production that incorporated economies of speed and economies of scale.' (page 471)

Although the electric telegraph was, at the time of its introduction, much-hyped (see Standage (1998)), just as, perhaps, the Internet is, one can draw some encouragement from the fact that the Victorian Internet had important, tangible economic benefits, thereby giving some confidence that its modern-day successor could also have a profound economic impact. I now examine what we might learn from recent US experience.

3.4 Lessons from recent US experience

Since the Internet follows on from earlier advances in information and communications technology (ICT), and the United States has led the world in terms of introducing these new technologies, it might be reasonable to ask whether prior ICT advances have, in fact, led to a rise in productivity growth. Certainly, as early as 1996, the Chairman of the US Federal Reserve Board, Alan Greenspan (1996a)(2) argued that:

'The rapid acceleration of computer and telecommunication technologies can reasonably be expected to appreciably raise our productivity and standards of living in the 21st century, and quite possibly in some of the remaining years of this century.'

And:

'We are living through one of these rare, perhaps once-in-a-century events … the emergence of modern computer, telecommunication and satellite technologies have

(1) The authors go on to estimate such macro effects. Their estimates suggest a fall in the NAIRU of around 1 percentage point.
(2) As cited by David (1999).

fundamentally changed the structure of the American economy.' (Greenspan (1996b))

This was well before the aggregate data showed any acceleration in productivity growth, and Chairman Greenspan came in for much criticism (from both within the FOMC and outside) for pointing to a possible acceleration of productivity growth before it had occurred.

Now even the sceptics like Gordon (1999) have begun to concede that the growth rate of potential GDP has increased, although Gordon does claim that there is little evidence of any structural change in US non-farm business labour productivity outside the IT production sector. Specifically, he calculates that of the pick-up in labour productivity growth in the United States since 1995 Q4 of 107 basis points, more than half can be explained by cyclical factors (41 basis points) and improvements in price measurement (19 basis points), leaving a 'true structural acceleration' of 47 basis points (see Table G). However, when he excludes the computers and software sector, there is no evidence of any structural acceleration in productivity growth (it is estimated as minus 4 basis points—see Table G) suggesting that 'the new economy revolution consists simply of rapid productivity growth in the manufacture of electronic equipment itself with no spillover to the rest of the economy' (page 3). Even though Gordon's results would be disappointing to those 'new economy' enthusiasts who would have expected some spillover benefits into the rest of the economy, the central bank can nevertheless draw some comfort from the fact that potential real GDP growth has nevertheless risen (on his estimates, from 2.3% in 1987–95 to around 3.0% now).

Table G
Gordon's analysis of US non-farm business labour productivity growth 1995 Q4–1999 Q3

Percentage growth rates (annual)

	Non-farm private business (NFPB)	NFPB minus computers and software
Actual growth	2.54	1.81
Trend 1972–95 Q4	1.47	1.25
Contribution of cyclical effect	0.41	0.41
Contribution of price measurement	0.19	0.19
Contribution of 'true structural acceleration'	0.47	-0.04

Source: Gordon (1999).

Businesses outside the electronic sector that have invested a great deal in ICT might be surprised by Gordon's conclusion that it has made no difference to labour productivity growth. It is perhaps notable in this regard that in surveying firm-level studies, Brynjolfsson and Yang (1996, page 179) report that 'several researchers have found evidence that IT is associated …with improvement in productivity'.

Those who believe that ICT has had little effect on US productivity performance have also tended to rely on conventional growth accounting exercises and, since computers make up a relatively small share of the total capital stock (partly because they depreciate so fast), these studies have, until recently, shown computers as having a rather small effect on productivity. However, in this context, Sichel (1999) reports some intriguing results that are summarised in Table H. He shows that in the 1980s, computer hardware accounted for just over 0.2 percentage points of growth, while other capital contributed around five times more (around 1 percentage point). However, during 1996–98, the surge in the growth rate of computers has resulted in a significant increase in their contribution to growth—it is now estimated at 0.35 percentage points per year, with other capital now having a contribution that is only around twice as large. Moreover, it is also worth noting that Sichel's estimates suggest a significant pick-up in the rate of growth of multifactor productivity (MFP)—it is estimated to have risen back to around 1¼% per annum, having fallen to a paltry ¼% per annum earlier in the decade.

Table H
Contributions to growth of real gross output of private non-farm business 1970–98

Measure	1970–79	1980–89	1990–95	1996–98
Growth rate of output (a)	3.7	3.1	2.1	4.2
Contributions from: (b)				
Computer hardware	0.11	0.22	0.17	0.35
Other capital	1.23	1.03	0.57	0.72
Labour input	1.16	1.52	1.15	1.92
Multifactor productivity	1.25	0.32	0.26	1.25
Income shares (c)				
Computer hardware	0.4	0.8	0.9	0.9
Other capital	29.3	29.9	29.8	28.3
Labour input	70.3	69.2	60.3	70.8
Growth of inputs (a)				
Computer hardware	29.4	29.6	18.2	37.3
Other capital	4.2	3.5	1.9	2.5
Labour input	1.7	2.2	1.7	2.7

Source: Sichel (1999).

(a) Average annual log difference for years shown multiplied by 100.
(b) Percentage points per year.
(c) Per cent.

3.4.1 The role of measurement error

The work of Gordon (1999) and Sichel (1999) discussed above suggests that some rise in productivity growth is beginning to emerge in the data, though it is plausible that much clearer evidence of an acceleration would be obtained by allowing for the possibility that measurement errors have grown in significance. For example, Corrado and Slifman (1999) report that the data suggest the level of productivity has been falling, on average, over the past quarter-century in the non-farm, non-corporate sector. At the same time that this sector has experienced an above-average growth rate of unit labour costs, the unit profits and the sector's return to capital have been well maintained, which can be reconciled by the fact that the measured price deflator of the non-farm, non-corporate sector has been rising much faster. The main sub-sectors that display a fall in measured productivity growth are services and construction. It does seem implausible that those sectors of the economy could have maintained profitability despite poor productivity growth through higher price inflation for such a long time without attracting extra competition. So Corrado-Slifman carried out a simple experiment where they assumed that the level of productivity in all declining service-producing industries

was flat instead of falling. The net effect of adjusting the computations on this conservative basis would increase estimates of aggregate productivity growth by around 0.3 percentage points per year. Gullickson and Harper (1999) have carried out a similar exercise using multifactor productivity instead, and, as Table I suggests, can generate a significant increase in estimates of aggregate MFP growth. For example, if one assumes that the industries with negative MFP growth actually had MFP growth of 1% per annum, the estimate of aggregate MFP growth would rise by as much as around 0.85 percentage points.

Table I
Effect of measurement bias adjustments on aggregate US productivity growth

Assumption about industries with negative multifactor productivity growth	Effect on aggregate multifactor productivity growth (percentage points)
0%	0.41–0.44
1%	0.83–0.87

Source: Gullickson and Harper (1999).

So there appears to be some tentative evidence that US productivity growth may have been increasingly understated in recent years.(1)

3.4.2 The role of learning lags

The oft-cited Professor Paul David(2) has long argued that new technologies diffuse gradually because it takes a long time for companies to learn how to use the new resources effectively and one typically needs major reorganisations of production. He points out that although central generating stations for electric lighting systems were introduced first by Edison in 1881, electric motors constituted less than ½% of the mechanical horsepower capacity of the US manufacturing sector in 1890. Yet the electrified portion of total mechanical drive for US manufacturing was not to rise to 50% until the 1920s, when the US economy duly experienced a surge in MFP. Hence Sichel's (1999) findings of a rather recent surge in the contribution of computers to aggregate productivity growth can be seen to be consistent with David's hypothesis, in that although computerisation dates back to at least the 1970s, the significant productivity benefits might be coming through only now.

Recently, Kiley (1999) at the US Federal Reserve Board has argued that the contribution of computers to economic growth has been held down by the large adjustment costs required to incorporate a new investment good into the economy's capital stock. It is extremely difficult to infer accurately the role of adjustment costs, so any estimates should be regarded with particular care. Kiley's estimates suggest that adjustment costs have lowered US MFP growth by about ½ percentage point per year. Allowing for his adjustments, he suggests that trend output growth might have been boosted to around 3% per annum from around 2% per annum. While more work is clearly needed along these lines, it is notable that Kiley's arguments are not only consistent with much anecdotal evidence, but there is also evidence from a study of the market valuation of firms (see Brynjolfsson and Yang (1999)) that the stock market rewards firms for the investments in software, training and organisational transformations that accompany computer investments.

Hence, to summarise, recent US experience does suggest a pick-up in productivity growth during the last few years, and a significant rise in the contribution of computers to productivity growth. Moreover, these studies possibly understate the actual improvement in productivity growth because there is some evidence that the extent of measurement error might have been growing over time. There is also evidence that adjustment costs associated with the new technologies have held down MFP growth so far. Perhaps, most importantly, it is plausible that MFP growth will be higher in the future as the diffusion of the new technology increases. Note that Internet usage has only grown recently and is far from universal even in the United States. Moreover, just as the full productivity benefits of electricity were not seen until firms entirely reorganised production processes, one might argue that the Internet might be seen as the turning-point in firms' capturing the productivity potential of computers.

3.5 UK productivity

3.5.1 Recent performance

Over the last few years, measured UK productivity growth has been disappointing, in that it has been below its long-run average (see Chart 6). This is an unusually weak performance in that, typically, productivity growth tends to be above average when GDP growth is above average (see Chart 7). Although GDP growth has been above average for some of the years since 1995, measured productivity growth has remained stubbornly below average.

Table J suggests that a part of the explanation for the disappointing labour productivity performance might be a slower growth rate of the capital stock—measured MFP growth has not shown the same deceleration, but it has not risen either.

Those who believe that ICT advances should plausibly have contributed to an increase in productivity growth (as in the United States) would find the above numbers disappointing, though it is worth emphasising that the pick-up in measured US productivity growth has only become apparent in the past 18 months, and the diffusion of ICT has been slower in the United Kingdom than in the United States. Relative to the United States, there has been much less research in the

(1) Using a rather different methodology, McGuckin and Stiroh (1999) explore the hypothesis that ICT is generating output that is increasingly hard to measure in non-manufacturing industries. Their conclusion is that 'increasing measurement problems may understate aggregate productivity growth by an **additional** 0.32 to 0.50 percentage points per year in the 1990s'. Though their conclusion does depend on the assumption that increased computer usage is correlated with measurement error.
(2) See his 1999 article, and references to his earlier work.

United Kingdom into explaining the recent performance of productivity growth, so my comments are necessarily conjectural.

Chart 6
Growth in whole-economy productivity per head

Chart 7
'Detrended' growth in GDP and productivity

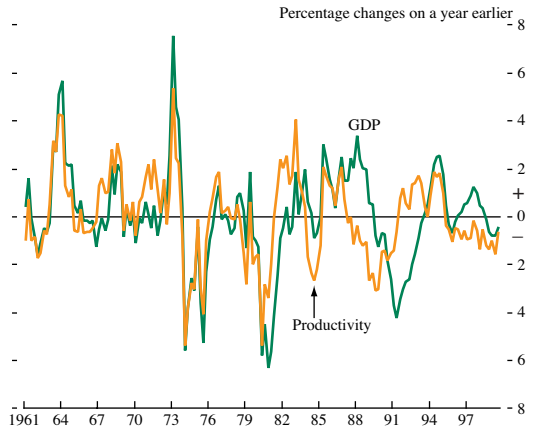


Table J
UK productivity growth

Per cent

	Labour productivity growth	Multifactor productivity growth (a)
1960–98	2.1	1.1 (b)
1973–98	1.6	1.0
1980–98	1.9	1.0
1995–98	1.3	1.2

Source: Own estimates, using ONS data.

(a) Defined relative to employment in heads, and using the non-housing capital stock.
(b) For 1966–98 instead.

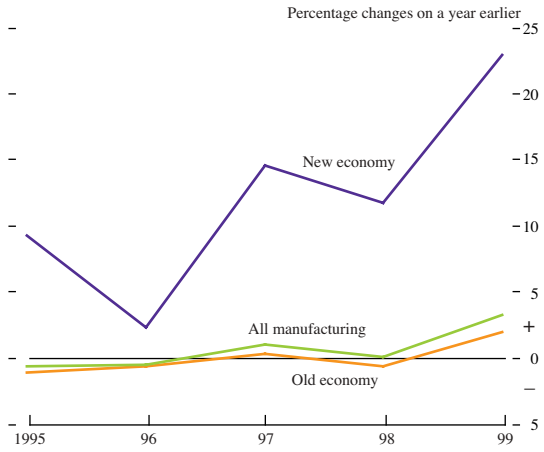
3.5.2 The significance of the IT sector in the United Kingdom

Note that, as in the United States, there has been an increase in investment in IT equipment in the United Kingdom. Specifically, UK investment in IT equipment increased at an average annual rate of 21.2% between 1992 and 1997,(1) while non-residential investment grew by an average of just 4.0%.

Investment in IT accounted for 10% of non-residential investment in 1997, compared with just 4% in 1991. Further, as in the United States, there is microeconometric evidence in the United Kingdom suggesting that ICT adoption does have the expected positive impact on productivity (see eg Kwon and Stoneman (1995)).

One reason for the upsurge in productivity growth in the United States is the superior performance of the ICT sector itself. Chart 8 suggests that, even in the United Kingdom, the so-called 'new economy' IT sectors(2) have, in recent years, experienced much faster productivity growth.(3)

Chart 8
'Old' vs 'new' (1995–99) sectoral productivity growth



Moreover, as Table K shows, these 'new economy' industries have accounted for a significant proportion of the growth rate in manufacturing, even though, in 1999, these sectors accounted for less than 5% of total manufacturing employment and around only 6% of manufacturing output. Indeed, in both 1998 and 1999, while output in these 'new economy' sectors rose, it fell in the rest of manufacturing. Of course, the IT sector defined in this way accounted for only 0.2% of UK GDP growth in 1999, while the comparably defined IT sector in the United States accounted

(1) At constant 1995 prices. Nominal IT investment is derived from input-output tables using product code 69 (office machinery and computers) and deflated by PPI for SIC 30.
(2) New economy sectors are: manufacture of office machinery; computers and other information processing equipment (SIC 30): manufacture of telegraph and telephone apparatus and equipment; radio and electronic capital goods; television and radio receivers, sound or video recording or reproducing apparatus and associated goods (SIC 32.2 and 32.3).
(3) Productivity is derived using output in SIC 30, 32.2 and 32.3. Separate employment data are not available for SIC 32.2 and 32.3, so the assumption made is that it grows in line with employment growth for SIC 32 as a whole (which includes 32.1). Since 32.2 and 32.3 together account for 60% of output in SIC 32, and 32.1 includes some hi-tech sub-sectors, eg electronic components, this is a reasonable assumption.

Table K
Contribution of UK 'new economy' industries to manufacturing output growth

Year	Percentage change in:		
	Manufacturing output	'New economy' industries	Rest of manufacturing
1995	1.52	0.83	0.69
1996	0.40	0.26	0.14
1997	1.29	0.56	0.73
1998	0.29	0.74	-0.44
1999	-0.18	0.84	-1.02

Source: Own estimates, using ONS data.

for about 1.2% of US GDP growth. Hence, in relative terms, the UK IT sector is much smaller, so it is perhaps less surprising that the growth of the IT sector has, of itself, not been associated with a rise in the aggregate productivity rate (yet).

3.5.3 The significance of measurement errors for UK productivity growth

In discussing the recent US experience, I noted that it was plausible that aggregate productivity growth had become increasingly understated, partly because the 'hard-to-measure' sectors (mainly services) had become an increasingly bigger fraction of GDP over time, and there was an additional bias arising from the fact that the implied service sector productivity growth rates were implausibly low.

In a UK context, it is also true that the hard-to-measure sectors have become an increasingly important fraction of output over time—so there may be a similar understatement of aggregate productivity growth.

However, the second reason for a plausible bias in US productivity numbers (implausibly low, ie negative growth rates in productivity in some service industries) does not carry over to the United Kingdom.

Table L attempts a sectoral decomposition of productivity growth per head between 1993–95 and 1995–98, when aggregate measured productivity growth slowed from 2.7% to 1.2%. The numbers suggest that manufacturing can account for around one fifth of the slowdown in measured aggregate productivity growth, which is at

Table L
Sectoral decomposition of productivity growth per head (average annual growth rates)

Per cent

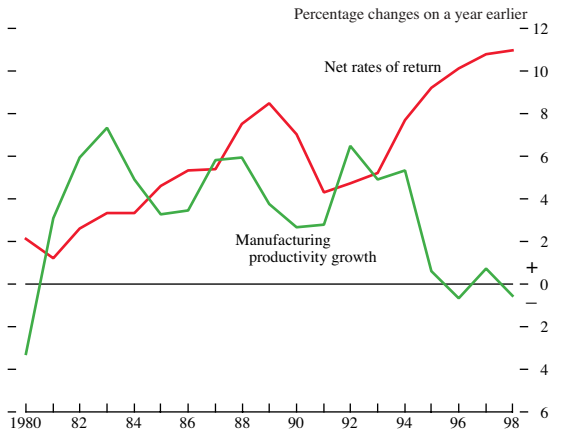
	Total sectoral contribution	
	1993–95	1995–99
Agriculture, construction and non-manufacturing production	0.46	0.16
Manufacturing	0.33	0.05
Distribution, hotels and catering	0.61	0.23
Transport and communications	0.43	0.27
Financial and business services	0.33	0.27
Other services	0.48	0.22
Whole economy	2.68	1.22

Source: Own estimates, using ONS data.

variance with recent US experience, where manufacturing productivity growth has been strong, and the hard-to-measure service sector growth rate has been rather weaker. Hence one needs to explain why, in the UK context, productivity growth has been weak in a sector that is supposed to be easier to measure accurately (ie manufacturing).

There are several reasons to be puzzled by the measured manufacturing productivity numbers. First, they do not accord with anecdotal experience. Several of the Bank's regional Agents have reported that their manufacturing contacts found the slowdown in measured manufacturing productivity growth hard to believe. A related question was asked in the CBI Pay Databank about past productivity growth. While the official data reported next to no productivity growth during the 1995–97 period, the answers to this question yielded 4.3% in 1995, 4.1% in 1996 and 3.4% in 1997, suggesting that a productivity boom was occurring. However, it appears that at least some respondents were answering this question in terms of sales per head (which is a gross output concept), so an increase in outsourcing implied an upward bias relative to the relevant, value-added concept.(1) So it is possible that a difference in the definitions of productivity used by businessmen versus economists explains the divergence between official statistics and anecdotal experience, but it still leaves me rather uneasy. Second, it is notable that the deceleration in measured manufacturing productivity growth has coincided with profitability (proxied by the net rate of return) continuing to rise, and the divergence is indeed, visually striking (see Chart 9).

Chart 9
Profitability vs productivity



Though this divergence could, in theory, be 'explained' by other factors, it is an issue that deserves further research.

Third, and rather more speculatively, there is other indirect survey evidence that manufacturing output might have been

(1) I am grateful to Kate Barker of the CBI for helpful correspondence in this matter. The response rate to this particular question has fallen in recent years, so we might not want to place much weight on the CBI data for this particular question.

understated over this period, in that the responses to a question about manufacturing volumes from a different CBI survey did suggest somewhat higher output. Indeed, using the historical relationship between the CBI survey and official manufacturing output until 1995 to infer an alternative estimate of manufacturing output from the CBI series thereafter yields an estimate of manufacturing productivity growth that is about ½% per annum higher.

Clearly more research in this area is needed, but I do suspect that manufacturing productivity growth might have been understated in recent years. Also, as in the United States, the 'hard-to-measure' sectors have become more important over time, so it is unwise for me, as a policy-maker, to automatically assume that the productivity growth numbers are broadly accurate.

3.5.4 Prospects for UK productivity growth

An assessment of the prospects for productivity growth should allow for the following:

Learning lags

As discussed above, it may take time before one sees the full benefits of a radical technological change in actual productivity growth. This is one explanation for why an improvement in US productivity growth only became apparent in the past 18 months; and with slower ICT diffusion in the United Kingdom, we may see the benefits here in the next two to three years too.

Adjustment costs

As noted above, work in the United States suggests that MFP growth has been depressed in recent years by the adjustment costs associated with the new technology, and so recent historical MFP growth underestimates the economy's future potential. Research on this is needed in this area in the United Kingdom—but it is plausible that a similar phenomenon has been at work here.

Likely growth in the IT sector

In the United States, the very high productivity growth in the IT sector has significantly increased the growth rate of potential output for the economy as a whole—as the IT sector expands in the United Kingdom, the economy here should benefit along similar lines.

The growth of performance-related pay

The greater individualisation of employment contracts and the growth of performance-related pay can be reasonably expected to stimulate productivity growth.

The Internet

As discussed in Section 2, there are good reasons for believing that B2B commerce should have a significant impact on measured productivity growth for some years.

3.6 What the Internet implies for policy

3.6.1 The role of the Internet in the current two-year ahead inflation forecast

The effects of the Internet were incorporated into the current (ie February 2000) inflation forecast in the following ways:

Effect on aggregate demand

Although no attempt was made to identify the Internet as a separate, independent influence, the fact that the euphoria surrounding e-commerce has boosted share prices was allowed to affect the forecast for inflation (mainly via higher consumption) in the normal way.

No additional adjustment relating to the Internet was made to the central projection for corporate investment. However, as business surveys are pointing to somewhat higher investment than is embodied in the central projection and the Bank's Agents are telling us that there is a significant surge in enthusiasm for investment in e-commerce activities, the MPC agreed that there was an upside risk to the central projection for investment.

The MPC has long built in an assumption that the stock-output ratio would, on trend, continue to decline for some years. The discussion in Section 2 suggested that the Internet would probably help the stock-output ratio to fall. The MPC saw this as another reason to justify the original assumption of a continuing trend decline, though, like all other assumptions, this will remain under review.

It is often asserted that the Internet will probably lead to a rise in aggregate demand before there is a corresponding rise in aggregate supply, and so inflation might even rise in the short run (see eg Brookes and Wahhaj (2000)). While this view is possibly valid, it is important to note that there is a potential offset from the continuing decline in the stock-output ratio. It is also at least possible that the stock markets have already more than anticipated the full benefits of the Internet phenomenon—eg Perkins and Perkins (1999) look at a sample of 133 Internet companies that have gone public since 1995 and argue that to justify their current market valuations, these companies would have to expand their revenues by more than 80% per year for the next five years; and they recall that Microsoft grew by 53% in the first five years, while Dell grew by 66%. So investors are implicitly betting that, on average, these Internet companies will be even more successful than Microsoft or Dell. If there is, indeed, a possibility that there is a significant correction in the equity markets, then it is possible that the current central projection for GDP growth is too high, though it should be noted that the MPC did explicitly allow for a downside risk to the central projection, arising from a fall in global equity prices, in the February fan charts.

Effect on profit margins, the NAIRU and productivity

It was noted in Section 2 that the Internet would put pressure on average profit margins on the economy. So the

price equation in the Bank's core medium-term macroeconometric model (MTMM) would need to be adjusted.(1) Of course, there are other pressures on profit margins which are unrelated to the Internet; these include the Competition Commission (especially with respect to cars), overseas entrants to some domestic markets (eg WalMart) and the increased tendency for the British consumer to shop around (perhaps encouraged by a low-inflation environment).

In its central projection, the MPC assumed that the effect of such margin adjustments (reflecting all the factors likely to affect profit margins, of which the Internet was only deemed to be one) would reduce inflation by 0.25 percentage points in the first year, and by 0.3 percentage points in the second. (This represents an implicit downward adjustment to the NAIRU.)

The potentially significant effects of the Internet on productivity growth were discussed above but, for its central projection, the MPC stuck to its previous estimate of the long-run trend of 2%.

3.6.2 Alternative treatment of the productivity and margins assumptions

Whether or not the MPC should adjust its estimate of the long-term trend rate of productivity growth is a necessarily complex issue. There are a number of reasons for considering it.

Potential B2B cost savings are large

As was noted in Section 2, the potential savings from B2B e-commerce are very large, and appear to be rather higher than would be expected from the normal process of innovation and improvements in work practices. It is worth noting that a recent Goldman Sachs study (Brookes and Wahhaj (*op cit*)) explicitly assumed that two thirds of the benefits of B2B would be in the form of higher productivity, and only one third would be in the form of lower margins (which contrasts sharply with the MPC assumption of no productivity effect and some margin effect).

Recent US experience

As discussed above, there is clear evidence of a pick-up in measured productivity growth in the United States, and there are good reasons for believing that the official data understate the extent of actual improvement that has occurred. To the extent that the take-up of the ICT/Internet has been slower in the United Kingdom, it would be reasonable to expect the US experience to be mirrored in the United Kingdom in the coming two to three years.

Other factors that might boost productivity growth in the United Kingdom

As discussed above, a combination of learning to absorb the new technology, the likely growth of the high-productivity IT sector, and the increased importance of performance-related pay are all likely to boost productivity growth.

Information in financial market prices

It is difficult to make sense of the valuation of ICT-related shares, or, indeed, the overall level of the equity market, unless one simultaneously believes that these companies will have a significant economic effect.

I have argued above that it is possible that the markets have overshot—nevertheless, it is rare to have so much smoke without fire. It would be arrogant of us to be completely dismissive of the possibility that the financial markets are telling us something.

There are, however, some arguments that favour the status quo assumption. These include:

Recent UK productivity growth has been disappointingly low

There is some validity to this argument, but there are also several reasons for believing that measured productivity growth probably understates actual underlying productivity growth, and by an amount that has plausibly increased over time. Moreover, it is possible that the adjustment costs associated with new technology have temporarily depressed recent productivity growth.

It is imprudent to count your chickens …

At one level it is difficult to argue with this sentiment, as it is indeed desirable that central bankers have their feet firmly planted. However, one cannot help but be impressed by the fact that Chairman Alan Greenspan publicly expressed optimistic views about US productivity growth as early as 1996, well before any academic studies detected a change in trend. Arguably, had he stuck to a conventional historical assumption about trend productivity growth in the United States, interest rates would have been raised more quickly and the associated slowdown in demand growth might have had an adverse effect on investment in the hi-tech sector.

My personal view is that there is a case for revisiting the assumption of unchanged prospective productivity growth, which may well turn out to be higher.

Turning to margins, as discussed above, the central projection builds in some effect—my personal judgment is that it needs to be a little larger, but it is exceptionally difficult to be confident about the actual size. However, it is

(1) The price equation should, at a conceptual level, include the 'average level of product market competition' as a variable—however, this is difficult to measure. Hence, with a potentially revolutionary event like the advent of the Internet, best practice would point to a judgmental adjustment to the residuals of the equation by the forecaster.

also my personal view that the size of the margin compression effect might get progressively larger over the next three to four years—as Internet penetration rises. At least in the United Kingdom, the growth of B2C e-commerce should plausibly accelerate with the spread of digital television and the arrival of third-generation mobile technology—with these factors likely to have a significant impact only after around 18 months. Also, as discussed in Section 2, one might reasonably expect the beneficial effects of B2B commerce to be spread out over at least the next five years. So I find implausible the assumption of temporary margin compression (lasting perhaps only a year) that some prefer.

3.6.3 Some other implications for policy

The likely economic effects of the Internet are necessarily uncertain, and it would be foolish to be dogmatic about it. Tom Standage (1998) reminds us that the consequences of a particular technological change are difficult to forecast—for example, one contemporary commentator thought that the age of aviation would be an 'age of peace' because aircraft would make armies obsolete on account of being vulnerable to an air attack. To take another example, Standage points to the early claims that nuclear power would usher in an age of electricity provision that would be 'too cheap to meter'. On the other hand, it is also worth reminding ourselves that the past 25 years have seen many well-known companies systematically underestimate the growth in demand for computers or the chips that are embedded in them. Moreover, the likely size of the economic effects of the Internet is also, as has been argued at great length, necessarily uncertain. In terms of policy, I believe that this has the following key implications.

- Do not rely on historical relationships

A variety of supposedly well-established historical econometric relationships have broken down in recent years (see eg Wadhwani (2000), where I discuss what befell the relationship between real wages and unemployment). For all the reasons discussed above, the Internet is likely to affect a variety of econometric relationships. Waiting for this to manifest itself in a statistically significant change in the pattern of residuals in the equations in the MTMM might leave it until it is too late—meanwhile, monetary policy that would, *ex post*, be seen to have been inappropriate might already have done damage.

Hence, I no longer rely in any way on 'rules of thumb' like 'the growth in real domestic demand needs to decelerate to $2^1/_4$%' or the 'rate of growth of average earnings must not average more than $4^1/_2$% per annum', as I am no longer confident about the implicit estimate of the underlying growth rate of productivity.(1) On the other hand, I am more than conscious of the simple rules of demand and supply and recognise that there are clearly limits to the degree to which domestic demand or average earnings can grow if they are not to jeopardise the inflation target.

- Keep one's sense of perspective

It is easy to be carried away by much of the current hype about e-commerce. One must remind oneself that although the Internet has important implications for inflation, it is just one of many factors that might affect inflation over the next two years.

To take a concrete example, if recent UK history were to repeat itself and we were to see the beginnings of a self-fulfilling frenzy in the housing market, which, as we have seen before, can have a very significant effect on inflation, then let there be no doubt that I would support pre-emptive rises in interest rates to attempt to prevent a housing market bubble induced rise in retail price inflation. This is because although I believe that the Internet will plausibly bring long-lasting disinflationary pressures to bear, in the short run these pressures can easily be more than offset by a housing market bubble. Similar considerations would apply to an acceleration in wage settlements that could not be justified by plausible increases in productivity. The Internet has important disinflationary effects without implying the death of inflation. In fact, my own preferred path for inflation is only a little below the central projection in the *Inflation Report*. Hence, it remains important to continue to monitor a host of other potential influences on inflation when setting policy.

4 Conclusions

I have tried to make the case for believing that the Internet will have a highly significant impact on productivity, margins, the NAIRU and inflation. It is my belief that one should rely less on historical relationships than before, and that, in particular, there is a case for revisiting the assumptions on productivity growth and margins in our inflation projections.

However, it is also important to preserve one's sense of balance. The Internet is only one of many factors that will influence the two-year ahead outlook for inflation. Tom Standage reminds us that many Victorians believed that the invention of the electric telegraph would usher in a new era of world peace as it would eliminate misunderstanding between nations; similar claims are being made now about the Internet. While recognising the undoubted benefits that e-commerce will bring, we must simultaneously avoid technological utopianism.

(1) Of course, in the case of the rule of thumb relating to the growth of domestic demand, one would not change one's mind about it for purely measurement error related reasons, as the likely errors might also simultaneously underestimate demand growth. However, in the case of average earnings, measurement errors in our estimates of productivity growth or a true acceleration in underlying productivity growth because of, say, ICT advances would both be equally legitimate reasons for modifying the rule of thumb.

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Monetary policy and the supply side

In this speech,[1] John Vickers, Executive Director and Chief Economist at the Bank, discusses some possible implications for inflation—and hence for monetary policy—of some current developments on the supply side, in particular the ongoing revolution in information and communications technology. He argues that, while prospects for a recovery in UK productivity growth are good, it does not follow that supply-side improvement necessarily implies lower inflation. Indeed demand might rise by more than supply initially. He concludes that, whatever the supply side may have in store, delivering low and stable inflation—and being expected to do so—is how monetary policy can give sustainable growth its best chance.

Introduction

To come from the Bank of England to speak to the Society of Business Economists is to be a nominal economist among real economists. Businesses like yours and those who work in them are the real economy—the supply side—the workings of which ultimately determine the paths of real economic variables such as output growth, employment and productivity. The Bank's paramount monetary policy objective of price stability, on the other hand, concerns (the rate of inflation of) a nominal variable—the general price level or, inversely, the purchasing power of money. The MPC pursues that objective by determining the terms of supply for money itself.

Interactions between the real and nominal sides of the economy are my subject this evening. I want to discuss some possible implications for inflation—and hence for monetary policy—of some current developments on the supply side, in particular the ongoing revolution in information and communications technology.

Views on the relationship between inflation and the real economy have shifted substantially over the years. Long ago, in the age of the Paleo Paradigm, it was believed that there was a trade-off, such that higher real activity could be sustained at the expense of higher inflation. That view having collapsed under the weight of both theory and facts—a rare and devastating combination—the current conventional (and correct) wisdom is that higher inflation cannot increase real activity sustainably. So the best that monetary policy can do for the real economy is to secure and maintain actual and expected price stability.

Recently, moreover, a view has gained ground that special supply-side developments can ease the task of monetary policy—in particular, that current technological and competitive developments are helping, or will very soon help, to suppress inflation. Then the prospect would be higher growth together with *lower* inflation. (And, indeed, in the Necro Paradigm inflation is dead.)

Assessing this view involves answering two questions:

1 What are the implications for growth of current and prospective supply-side developments?

2 What do these developments mean for inflation, and hence for monetary policy that targets inflation?

Information technology and economic growth

Twenty years ago I worked for IBM on a competition law case. The question was whether IBM possessed, and was abusing, a dominant position in the computer hardware industry. A similar antitrust case had been brought against IBM by the US government long before—when President Johnson's term of office was drawing to its close in January 1969. The fact that the computer industry was large enough to see major antitrust litigation more than 30 years ago shows that the large-scale commercial exploitation of information technology (IT) is far from new.

Since then the costs of computing power have gone on falling dramatically, the personal computer has become pervasive in home as well as office, the accessibility and capability of IT have been enormously enhanced by ever-improving user-friendly software, and, spurred by falling telecommunications costs, computer networking has exploded. And now there is the Internet.

These developments—the Internet above all—are self-evidently amazing. They hold out the prospect of substantial productivity gains in the years to come, just as IT has for many years past. Developments in IT might also help to sharpen competition, as new forms of business

(1) Given to the Society of Business Economists in London on 15 March 2000. I am very grateful for the help I received in preparing this paper from Andrew Bailey, Hasan Bakhshi, Ian Bond, Willem Buiter, Alec Chrystal, Roger Clews, Nick Crafts, Spencer Dale, Paul David, David England, Phil Evans, Nigel Jenkinson, Mervyn King, Jens Larsen, Ed Nelson, Peter Sinclair and Peter Westaway. Responsibility for the contents is, however, mine alone. This speech may be found on the Bank of England's web site at www.bankofengland.co.uk/speeches/speech75.pdf

organisation challenge older ones, and by improving price transparency generally. But what does all this add up to in macroeconomic terms?

Sources of US economic growth 1948–96

	Growth rate		
	1948–73	1973–90	1990–96
Outputs:			
Total output	4.020	2.857	2.363
Non-computer outputs	3.978	2.650	1.980
Computer outputs	0.042	0.207	0.384
Inputs:			
Capital services	1.073	0.954	0.632
Non-computers	1.049	0.845	0.510
Computers	0.025	0.109	0.123
Consumers' durable services	0.550	0.426	0.282
Non-computers	0.550	0.414	0.242
Computers	0.000	0.012	0.040
Labour input	1.006	1.145	1.219
Aggregate total factor productivity	1.391	0.335	0.231

Notes: Contribution of inputs and outputs are real growth rates weighted by average, nominal shares. All values are average annual percentages.
Based on data available prior to the comprehensive National Accounts revisions of October 1999.

Source: Jorgenson and Stiroh (1999).

Ironically, just as the IT revolution was getting under way, measured productivity growth in the United States and elsewhere slowed down. The table shows Jorgenson and Stiroh's (1999) analysis of US economic growth from 1948 to 1996. In the golden age from 1948 to 1973, estimated annual output growth was 4%, and labour productivity growth—the growth of output per unit of labour—was 3%. Total factor productivity (TFP) growth—ie allowing also for capital and consumer durable inputs, which grew strongly over the period—was, on these estimates, a little under 1½%. In the 1973 to 1996 period, by contrast, output growth slowed to about 2¾% despite a rise in labour input growth, productivity growth fell to around 1½% (less in the early 1990s), and TFP growth was less than ½%.

This slowdown, which forms the background to the late-1990s US growth spurt, is the Solow productivity paradox. Robert Solow quipped in 1987 that 'you can see the computer age everywhere but in the productivity statistics'. Various explanations have been put forward for the paradox of a productivity slowdown in the age of IT.

The first possibility is measurement problems (see Griliches (1994)). The balance of economic activity in developed economies has increasingly shifted towards service sectors whose output is hard to measure. If the under-recording of 'true' output has increased since the early 1970s—which is something we ultimately have to guess at—then the slowdown in productivity growth will have been overstated by the official figures. (Relatedly, inflation in the 'true' cost of living may have been overstated by available price indices. But inflation targets for monetary policy can be based only on available indices.)

Second, since it is only recently that computers have become a large part of the capital stock, perhaps one should not have expected a major IT contribution to growth much before now. On Jorgenson and Stiroh's estimates, computer outputs accounted for about 0.4% of annual US growth in 1990–96, and computer inputs contributed less than 0.2% to growth. Computers by then accounted for as much as a fifth of the contribution to growth of capital services, reflecting the vast shift towards IT investment prompted by the sharp declines in IT equipment prices that reflect the dramatic technological advances made by the computer industry. But the gains to IT investment have, on these figures, accrued to computer producers and their customers, rather than generating externalities in the form of TFP growth.

Third, it could be that an IT-based acceleration in productivity has just got under way in the United States and is just around the corner in other countries such as the United Kingdom. Ten years ago Paul David (1990) suggested, on the basis of the historical experience of electrification in the United States, that it was too soon to be disappointed that the computer revolution had not yet led to a discernible acceleration of economy-wide productivity. Commercial electricity generation began in the 1880s but did not have a substantial measurable impact on US productivity until the 1920s.

The diffusion of general-purpose technologies such as electricity and IT can take a long time and be arduous processes insofar as scarce resources are absorbed in the associated processes of economic restructuring. As David (2000) puts it:

'For these changes to be set in place typically requires decades, rather than years. Moreover, while they are underway there is no guarantee that their dominant effects upon macroeconomic performance will be positive ones.'

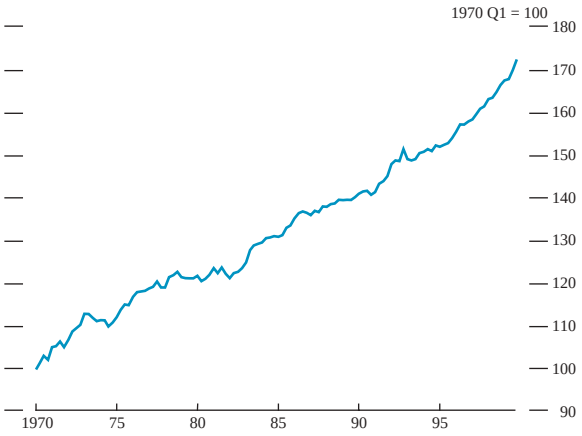
And he notes the limits to historical analogy. While history may teach that an instant productivity payoff is not to be expected and that its absence is not inconsistent with a large eventual payoff, it cannot foretell the time path of such gains. That said, David is cautiously optimistic that, relative to the experience of the past two decades, the future may well bring a resurgence of TFP growth resulting from the exploitation of IT.

Is that what we are seeing in the United States right now? Charts 1 and 2 show the level and growth rate of US non-farm business labour productivity since 1970. Since 1996, annual productivity growth has averaged about 2½%, 1 percentage point higher than over the 1973–96 period. This is undoubtedly impressive, but is it evidence at last of a substantial broad-based productivity impact of IT across the economy as a whole?

Robert Gordon (1999) is doubtful. His decomposition of the US productivity growth recovery accounts for all of it in terms of three factors:

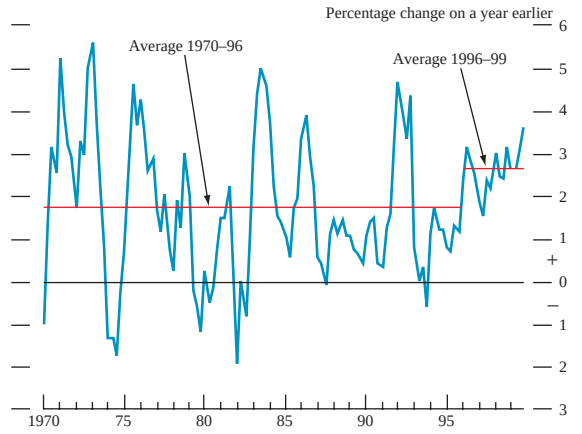
(i) The normal cyclical rise in productivity that typically occurs in economic upswings;

Chart 1
US non-farm business sector labour productivity



Source: Primark Datastream.

Chart 2
US non-farm business sector labour productivity



Source: Primark Datastream.

(ii) large productivity gains in the computer industry itself; and

(iii) improvements in inflation measures that have had the effect of increasing measured productivity growth.

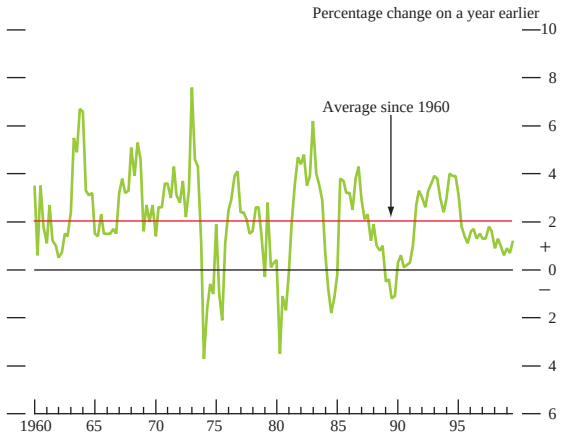
This is not to deny the good productivity news. Rather, it is to locate it, as far as (ii) is concerned, in the computer-producing sector of the US economy, and not generally across the economy.

Oliner and Sichel (2000), however, reach a somewhat different view from their analysis of the recent data. Unlike Gordon, they do not attempt to distinguish between cyclical and trend movements in productivity. Of the 1% rise in US labour productivity growth between the first and the second half of the 1990s, they attribute ½% to the increasing use of IT capital throughout the non-farm business sector, and another ¼% to advances in the technology for producing computers. On this view, IT is most of the story behind the recent acceleration in US productivity.

So far I have dwelt on the US evidence because it has been so extensively debated, because productivity there has recently picked up so sharply, and because the United States is the country that has been at the leading edge of the IT revolution since its commercial inception. (But let us not forget the intellectual forefathers of IT such as Charles Babbage and Alan Turing.) What are the implications for us in the United Kingdom?

Annual labour productivity growth in the United Kingdom over the past 40 years has been about 2% on average—see Chart 3. Since 1996, however, just as productivity growth in the United States picked up, it has been not much above 1% in the United Kingdom. It would be pessimistic to have as one's central expectation a persistence of 1% or so productivity growth in the period ahead, though uncertainty and volatility in the data mean that 1%, like 3%, is an entirely possible outcome. In good part because of the strength of business investment in the late 1990s (see Chart 4)—probably a growing share of which has been in IT—a more likely outcome would seem to be a rise in productivity growth, perhaps to around its longer-run trend rate of about 2%. (Together with annual labour force growth of near ½%, this would imply a central expectation for output growth of around 2½%.) Anyhow, that is what all the MPC members have assumed as the central case in recent projections. (We have also assumed a further decline in the stock-output ratio, which business-to-business e-commerce may help to bring about.)

Chart 3
UK labour productivity (GDP per person employed)

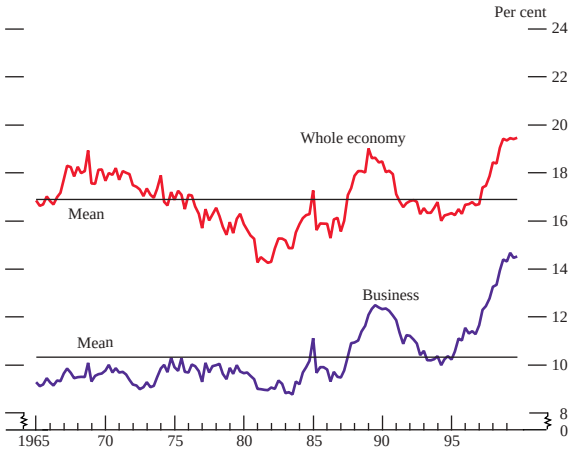


Sources: ONS and Bank of England.

Higher productivity growth than that is entirely possible—as is less—but 2% is not far short of the 2½% productivity growth that the United States has experienced in the remarkable recent years. And although it is growing rapidly in the United Kingdom, the IT sector, which appears to have experienced especially sharp productivity gains, is a larger part of the US economy.

Is 2% annual productivity growth large or small in broader historical terms? From a long-run perspective it is quite large. No historical knowledge is needed to show this. If it had grown at that rate since 1066, output per head would

Chart 4
Investment as a share of GDP



Note: At constant prices.

Sources: ONS and Bank of England.

then have been one hundred millionth of its current level. Even with 1% annual productivity growth, output per head would have been an impossible ten thousand times smaller then than now.

Estimates of the trend rate of growth of output in the British industrial revolution show a slow but steady rise from about 1% in the second half of the 18th century to around 2% in the early 19th century, then a peak of perhaps 2½% mid-century, before a significant slowing of growth (see Crafts (1998)). Allowing for labour force growth, productivity growth was much smaller than these figures, and, according to Crafts, 'total factor productivity growth was apparently very modest during the Industrial Revolution and was less than 1% per year throughout the nineteenth century'. This despite inventions such as the steam engine, railways, steel and the telegraph—the 'Victorian Internet' discussed in Wadhwani (2000).

But what about the more recent experiences of the post-war golden age of growth in Western Europe, and of the East Asian economies which at times grew at rates close to 10%? In the latter case, a good deal of the spectacular growth performance can be accounted for by demographics, fast capital accumulation, and the seizing of huge technological catch-up opportunities—see Young (1995). Some of those factors are also relevant to the experience of post-war Europe, which shows that high labour productivity growth over an extended period is by no means unprecedented, especially in the presence of strong capital investment. But it is historically rather unusual.

It is nevertheless quite possible that the IT revolution could at some point bring a period of historically unusual productivity growth. For example, it is plausible that the diffusion of Internet technology is and will be much faster than that of previous innovations. But some caveats must be kept in mind.

First, productivity growth does not happen by magic. Without continual innovation, growth would slow, and the main engine of innovation at present is IT. So while IT will no doubt add to productivity growth in the sense that it would be lower without IT, productivity growth without IT might have been lower than average past rates.

Second, other things being equal, the level of innovation must keep rising for productivity growth not to slow down. (The reference to 'other things being equal' is because innovation is by no means the only source of productivity growth. Others include exploitation of scale economies, gains from structural adjustment, and human capital investment.) Loosely speaking, steady growth requires innovation to grow as fast as output. So if the feeling is correct that there is more innovation now than there used to be, it does not necessarily follow that productivity growth will be higher than in the past, because 'a greater number of new things is not necessarily a greater rate of new things' (Triplett (1999)).

Third, strong capital accumulation is generally a prerequisite for high labour productivity growth. Gains from IT depend on investment in physical capital and in intangible, but nonetheless important, knowledge capital and human capital. Investment is one way in which the prospect of supply-side improvement may stimulate demand. This is a suitable point to turn to the monetary policy implications of IT.

Implications for monetary policy

Now let us *assume* that the IT revolution has created an unusual opportunity for a period of substantially higher productivity growth, and perhaps also for a structural intensification of competition. What then are the implications for inflation, and hence for monetary policy?

At first sight this might seem obvious. If costs are falling because of greater productivity, and if prices are if anything decreasing in relation to costs, then the pressure on prices would surely seem to be downwards.

But that is to confuse nominal (ie money-denominated) and real variables. Higher productivity means that more output can be produced from given inputs, so the price of output will tend to decrease relative to the prices of inputs. In particular, if competition does not weaken, output prices will fall relative to input prices such as wages. That is to say, wages will rise relative to prices—the real wage will increase. But this, by itself, says nothing about the effect on the level or rate of change of prices, or of nominal wages, or of nominal unit labour costs.

To put the point starkly, one could infer nothing about the path of inflation—movement in the value of money—from knowledge that oranges were getting cheaper in relation to lemons.

Shifts in productivity and competition can certainly affect inflation, but—as Willem Buiter (2000) has emphasised with his customary clarity—the links are by no means

straightforward. The simple argument above that rising productivity means downward pressure on prices is at best seriously incomplete.

A full argument must involve monetary variables. Inflation is after all a monetary phenomenon. In that spirit, suppose for a moment that monetary policy involved setting a path for the growth of some monetary aggregate *M*. Holding that path fixed, higher productivity growth would mean lower inflation if velocity—the ratio of nominal demand to *M*—did not shift. Inflation would then have to fall to keep the path of nominal demand the same.

But why would velocity stay the same? Velocity is notoriously variable, at least for most UK monetary aggregates. And it seems quite plausible that IT developments such as e-commerce should increase velocity, at least for narrower monetary aggregates, by facilitating economies in holdings of transactions balances. (Indeed, there has been some speculative discussion recently of a prospect of the ultimate demise of money, though it is interesting that the 1990s were the first decade since at least the 1940s that narrow money velocity *fell* in the United Kingdom, perhaps partly because of lower nominal interest rates.) If developments in IT increased both productivity growth and velocity in the thought experiment with a fixed money growth path, then the implications for inflation would be mixed.

However, although monetary quantities are valuable indicator variables, monetary policy in practice involves choosing the (inter-temporal) *price* of money—the short-term nominal interest rate—with the explicit aim in the United Kingdom of achieving the inflation target. The question then arises of whether, for a given nominal interest rate path, the arrival of a productivity-boosting supply-side opportunity will tend to increase or decrease inflation. And of whether, by implication, interest rates need to be increased or decreased to keep inflation on target.

In a range of simple macroeconomic models, the dynamics of inflation depend, among other things, on the output gap—actual output minus potential output. (See, for example, Clarida, Gali and Gertler (1999), McCallum and Nelson (1997), and Woodford (1999).) A positive output gap tends to go with rising inflation—as demand presses on capacity—and an increasing output gap tends to mean accelerating inflation. Conversely for negative and falling output gaps.

This sort of framework, which can be built up from microeconomic foundations, offers a simplified but coherent account of how supply-side developments can affect the paths of nominal variables. For example, a positive supply shock—such as unexpectedly higher (total factor) productivity growth, or a fall in the unemployment rate consistent with steady inflation—reduces the output gap and so lowers the path of inflation for a given path of nominal interest rates.

At first sight this might seem to justify the view that the IT revolution, as a positive supply shock, will moderate inflation. After all, we are assuming here that it will raise productivity growth unusually. (Moreover, as Sushil Wadhwani (2000) has stressed, it might also reduce the NAIRU via effects on product market competition and by improving the efficiency of matching people to jobs in the labour market.)

But supply 'shocks' are so called for a reason—they are *unexpected* changes in supply capacity. If the Internet, say, improves productivity (relative to a world without the Internet), that will now hardly be a surprise. An innovation such as the Internet is perhaps better described, when it arrives, as a shock to future productive potential. Once an improvement to the supply side has come to be anticipated—whether or not it has yet been realised—demand too may be boosted. Then the innovation imparts a demand shock as well as a supply shock. So depending on the links between the supply side and demand, a relevant question is whether the productivity improvement turns out to be more or less than expected. And timing is important, as an anticipated supply-side improvement could boost demand by more than supply in the short term.

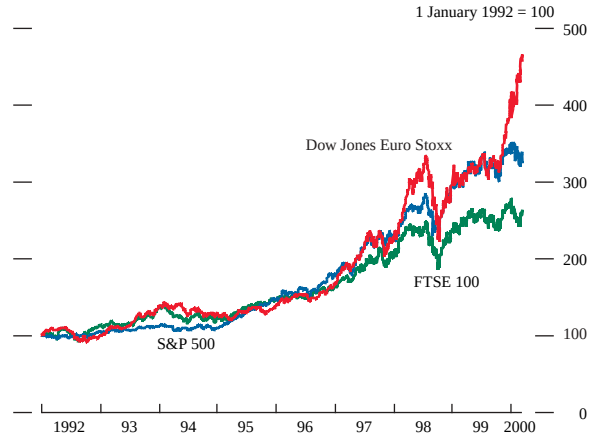
Two kinds of demand channel matter. The first, mentioned above, is direct investment demand, without which the supply-side improvement is unlikely to be realised. New technological opportunity creates a high marginal return on investment in new technology and so leads to a surge of investment in capital embodying it. Insofar as the new technology allows extra economies in inventory investment or reduces the marginal return on investment in 'old' technologies, there may be some offset to the expansion in investment demand, but the likely direction of the overall effect seems clear.

Moreover, new technological opportunity may encourage various other forms of investment in the broad economic sense, including training and restructuring of organisations and employment. Investment of this kind may temporarily reduce supply—for example because employees investing in training are not full-time in production activities—rather than being part of investment demand.

The second channel is via increases in consumer demand in anticipation of future income gains. The most prominent aspect of this mechanism concerns stock market wealth. Stock markets generally rose strongly in the past decade—see Chart 5. Especially striking over the past year or so has been the extraordinary rise of IT-sector stock prices—see Chart 6. (Some stellar performers have yet to make profits, suggesting that the hallmark of exceptional stock market valuation is no longer a very high price/earnings ratio, but an appropriately negative one.) As well as stimulating consumption, high stock market values may also further boost investment by lowering the cost of capital.

Stock market wealth gains related to IT have been very large in the United States. They have been large, but not as large,

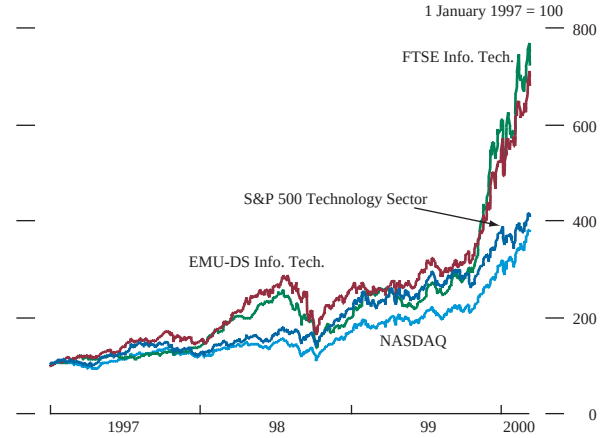
Chart 5
Worldwide equity indices[a]



Source: Primark Datastream.

(a) Measured in local currency.

Chart 6
Worldwide technology indices[a]



Source: Primark Datastream.

(a) Measured in local currency.

in the United Kingdom because the IT sector is proportionately smaller here—see the box on page 10 of the Bank's February 2000 *Inflation Report*. But of course rises in the United States and other overseas stock markets affect demand in the United Kingdom via external demand and wealth effects for domestic holders of international stocks.

Current market valuations of IT stocks, if interpreted as reasonable expectations of future dividend flows, imply enormous future profits for IT companies. This accords with the hypothesis that IT is about to bring substantial increases in productivity growth (a good part of which the IT companies will capture). But the general level of current stock prices, relative to the past, sits less easily with the proposition that competition in the economy as a whole, as distinct from particular sectors, is about to be greater than in the past.

Stock market wealth is the most visible but not the only source of demand stimulus in anticipation of productivity gains. Unusually high productivity growth would certainly be positive for real labour income growth—and hence for human capital wealth—especially if accompanied by a structural increase in competition. (In overall demand terms, a partial offset to the gain to labour income from greater competition would be the corresponding loss to profit income, but share prices should already reflect this in the case of quoted companies.) Once these labour income gains were expected, they would be a stimulus to consumer demand whether or not the expected gains had yet started to come through.

This does not presume that households spend freely out of expected 'permanent income'. Many households are near the limit of borrowing constraints, but many (including savers) are not, especially in an environment of financial liberalisation. And attitudes to risk and uncertainty may limit the spending even of the unconstrained. The point remains, however, that expectations of greater productivity growth and competition, if shared by households, could significantly increase consumer demand through effects on non-financial, as well as financial, wealth.

One way of drawing together these points is by reference to the concept of the *natural rate of interest*, which is defined as the short-term real rate of interest that would prevail in an economy with fully flexible prices (and hence always a zero output gap).

If a new technological opportunity appears unexpectedly, it would be normal in a wide and far-from-perverse range of circumstances for the natural rate of interest to *increase* for a period. The new opportunity increases the marginal return on investment—specifically, on investment to exploit the new technology. The marginal reward for saving—ie postponing consumption—must rise correspondingly in order to keep demand in line with potential supply (and the output gap equal to zero).

A standard economic relationship, which is derived from the inter-temporal optimisation behaviour of (unconstrained) consumers, links the real rate of interest positively to the growth rate of consumption. The real rate of interest is higher when consumption growth is higher because the richer I expect to be in the future than now, the more reward I will need to defer some consumption from now to the future. The arrival of a new technological opportunity seems likely to be doubly positive for consumption growth. If exploited it will raise output growth, and, in order to be exploited, it will require substantial investment, and hence saving, in the near term. In that event, in order to bring demand and supply into balance, the natural rate of interest will be higher than if the technological opportunity had not arisen.

This account has for simplicity glossed over open-economy aspects. If the new technological opportunity were country-specific and the country small in relation to the world economy, then the effect on the relevant natural rate of interest might be negligible. The happy country could consume ahead of the full realisation of the supply-side

improvement, run a trade deficit, and finance itself by borrowing from abroad. The technological opportunities offered by IT are not country-specific, though the rates of diffusion of their benefits are likely to vary, perhaps unpredictably, from place to place.

It is not just a theoretical or perverse possibility that the arrival of a new technological opportunity might, on unchanged real interest rates, increase demand by more than supply in the short term. In his Humphrey-Hawkins testimony to Congress last month, Federal Reserve Board Chairman Alan Greenspan (2000) stated that:

'Accelerating productivity growth entails a matching acceleration in the potential output of goods and services and a corresponding rise in the real incomes available to purchase the new output. The problem is that the pickup in productivity tends to create even greater increases in aggregate demand than in potential aggregate supply.'

The prospect of demand increasing by more than supply in the short term is also a feature of some recent analysis of business-to-business (B2B) e-commerce by Brookes and Wahhaj (2000). They estimate that annual growth could be higher by ¼% over the next decade on account of B2B. However, imparting a 'B2B shock' in simulations of the IMF's Multimod model of the world economy causes higher inflation and interest rates in a range of industrialised countries in the short run, but not in the long run. Demand boosts from anticipatory rises in equity markets are particularly emphasised by Brookes and Wahhaj, and they judge the United States to be the country most susceptible to this effect.

Suppose, then, that prospective productivity gains do tend to cause demand to increase by more than supply in the short term on unchanged real interest rates. Does it follow that actual real interest rates—and therefore nominal interest rates—need to be higher, in step with the higher natural interest rate, in order to keep inflation on target? This requires examination of how the sources of the productivity gains might also shift the relationship between the output gap and inflation.

This question is hard. A full attempt at it would involve analysis of the microeconomics of price-setting and is well beyond my scope. But here are some general comments.

First, if short-term nominal inertia is greater for costs than for prices, which I think is plausible in the case of wage costs, then a reduction in price-cost margins would tend temporarily to lower price inflation (for a given output gap path). But the quantitative importance of this point is hard to gauge. The existence, size and phasing of a prospective structural compression of price-cost margins on account of IT are unclear. And just as firms exploiting new technologies compete with others to win customers, so they compete—very evidently—for resources such as skilled employees and investment capital, and in the process put some upward pressure on costs generally.

Second, if the long-run consequence of e-commerce were ever more widespread real-time pricing, then the importance of nominal price stickiness would diminish over time. My bet is that the convenient underpinning institution of central bank money would still survive, but monetary policy would have ever less traction on the real economy. The job for monetary policy would be to set the nominal interest rate equal to the natural rate of interest plus the inflation target. Monetary policy errors would have less effect on the real economy, but with less price stickiness might lead to rather volatile inflation. I am unsure whether monetary policy would be more or less boring in these circumstances.

Conclusion

On the first question posed—the impact on economic growth potential of current and prospective technological advances—I am a cautious optimist. Prospects seem good for a sustained recovery in UK productivity growth from its subdued level of recent years. It is possible that there will be a leap to a historically high productivity growth rate over the next couple of years—the horizon that matters most in setting monetary policy—but that would be rash to presume. Past growth has stemmed from the exploitation of past innovations, which were no doubt spectacular in their day, just as computers were yesterday and the Internet is today. And history teaches that the lags from innovation to growth tend to be long and variable—more so than for monetary policy. Hence the caution with the optimism. We can but wait and see, so neither an ostrich nor a lemming be.

The second question concerned the implications for inflation. If IT is bringing a supply-side revolution, cannot monetary policy be eased for a while? That simply does not follow. Indeed, the arrival of an unusual supply-side opportunity could easily expand demand by more than supply initially, so that the natural real rate of interest goes up, not down, in the short term. That does not lead me to presume that the IT revolution has upward implications for inflation and nominal interest rates, because other, possibly offsetting, effects could also be at work, for example involving competition. But, equally, I see no strong grounds to presume that the overall effect on inflation is downward. This conclusion might seem like a classic case of 'on the one hand, on the other hand' economics. It is, and that should be no surprise. The supply side cannot be expected to take care of the value of money.

That is the task for monetary policy, and is the reason why monetary policy is aimed at price stability, not a growth target. No one knows how the supply-side potential of the economy will grow, or the trajectory of demand in relation to supply. Inflation targeting—especially with a symmetric target—is a framework for a flexible and forward-looking response from monetary policy to these and other uncertainties in the light of unfolding data. Whatever the supply side may have in store, delivering low and stable inflation—and being expected to do so—is how monetary policy can give sustainable growth its best chance.

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The financing of technology-based small firms
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The Bank of England's operations in the sterling money markets
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May 1998 (continued)
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106	Monetary policy surprises and the yield curve (*January 2000*)	Andrew G Haldane Vicky Read
107	Must the growth rate decline? Baumol's unbalanced growth revisited (*January 2000*)	Nicholas Oulton
108	The sensitivity of aggregate consumption to human wealth (*January 2000*)	Hasan Bakhshi
109	The effects of increased labour market flexibility in the United Kingdom: theory and practice (*February 2000*)	Stephen P Millard
110	Imperfect competition and the dynamics of mark-ups (*February 2000*)	Erik Britton Jens D J Larsen Ian Small
111	Liquidity traps: how to avoid them and how to escape them (*April 2000*)	Willem H Buiter Nikolaos Panigirtzoglou

Statistical Abstract

The annual *Statistical Abstract* comes in two parts: Part 1 contains a range of banking and other financial data; Part 2 provides longer runs of monetary statistics and related items. For 2000, each part is priced at £25.00 (including postage) in the United Kingdom. A concessionary price of £20.00 per part is available to academics in the United Kingdom and £15.00 per part to students and secondary schools in the United Kingdom.

Monetary and Financial Statistics

A monthly publication, *Bank of England: Monetary and Financial Statistics (Bankstats)*, was launched in January 1997. This comprehensive publication (priced at £90.00 per annum in the United Kingdom for 2000) contains detailed data on money and lending, bank and building society balance sheets, international positions of banks operating in the United Kingdom, government financing and the money markets (including gilt repo and stock lending), issues of securities and short-term paper, interest rates and exchange rates; it also contains occasional background articles. If you would like more information, please contact Daxa Khilosia, Monetary and Financial Statistics Division, HO-5, telephone 020–7601 5353.

The following articles have been published in recent issues of *Monetary and Financial Statistics*. They may also be found on the Bank of England web site at www.bankofengland.co.uk/mfsd/article

Title	Author	Month of issue	Page numbers
Statistics for European Monetary Union: a report of a half-day meeting of the Financial Statistics User Group	Jenny Dawuda and Neil Walker	January 2000	1–5
Derivative statistics: a report of a half-day meeting of the Financial Statistics Users' Group	Gillian Finbow and Mike Shemwell	November 1999	1–3

A strategy and work programme for official financial statistics	Bank of England and Office for National Statistics	November 1999	4–7
Financial market data for international financial stability	Robert Heath	August	1–3
Internationalisation of financial markets and implications for data collection and statistics	Robert Hamilton	August	4–7
Statistics for international financial markets	Michael Bollan and Robert Hamilton	August	8–11
Developments in international banking statistics in 1998	Michael Bollan	July	1–6
Monetary statistics and the monetary financial institutions consolidated balance sheet	Sue Docker and David Willoughby	July	7–12
New data on financial derivatives for the UK National Accounts and Balance of Payments	Andrew Grice	July	13–19
1998 gilt ownership survey	Jonathan Bailey	July	20–23

Targeting Inflation book

In March 1995, the Bank hosted a conference of central banks currently adhering to inflation targets. This book, edited by Andrew Haldane, draws together contributions from each of the eight countries represented at the conference. It details cross-country experiences of this monetary framework and the key operational and theoretical issues it raises. The book is suitable for both academics and practitioners. The price of the book is £20.00 plus postage and packaging.

Index-linked debt book

In September 1995, the Bank held a conference to discuss a broad range of theoretical and practical questions raised by index-linked debt in general, and the UK experience in particular. This book contains revised versions of the papers presented at the conference, as well as the papers that were circulated by the Bank ahead of the conference, setting out background information and key policy issues. The price of the book is £10.00 plus postage and packaging.

Openness and Growth book

The *Openness and Growth* book, published in October 1998, contains the proceedings of an academic conference held at the Bank of England in September 1997. The research described in the book investigates the link between productivity growth and the international openness of the UK economy. The price of the book is £10.00 plus postage and packaging.

Economic models at the Bank of England

The *Economic models at the Bank of England* book, published in April 1999, contains details of the economic modelling tools that help the Monetary Policy Committee in its work. The price of the book is £10.00 plus postage and packaging.

Government debt structure and monetary conditions

In June 1998 the Bank of England organised a conference to discuss the interactions between the size and structure of government debt and monetary conditions. This book published in December 1999, contains all but one of the papers presented at the conference, plus a background paper prepared within the Bank. The price of the book is £10.00 plus postage and packaging.

These publications are available from Publications Group, Bank of England, Threadneedle Street, London, EC2R 8AH; telephone 020–7601 4030; fax 020–7601 3298; e-mail mapublications@bankofengland.co.uk

General enquiries about the Bank of England should be made to 020–7601 4444.
The Bank of England's web site is at: http://www.bankofengland.co.uk
The web site gives details of job opportunities at the Bank, at http://www.bankofengland.co.uk/employment

Quarterly Bulletin and Inflation Report subscription details

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An index of the *Quarterly Bulletin* is also available to customers free of charge from Publications Group at the address given below. It is produced annually, and lists alphabetically terms used in the *Quarterly Bulletin* and articles written by named authors.

Bound volumes of the *Quarterly Bulletin* for the period 1960–85 (in reprint form for the period 1960–80) can be obtained from Schmidt Periodicals GmbH, Dettendorf, D-83075 Bad Feilnbach 2, Germany, at a price of DM190.00 per volume or DM4,380.00 per set.

The *Quarterly Bulletin* is available on the Bank's web site at www.bankofengland.co.uk/qb/index.htm

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