BANK OF ENGLAND

Speech

The Impact of the Internet on UK Inflation

Speech given by

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EXECUTIVE SUMMARY

1 Theoretical considerations

The internet lowers search costs, reduces barriers to entry and helps shorten the supply chain. These features should help boost productivity, lower profit margins and help cut the equilibrium rate of unemployment (NAIRU). Other things being equal, the fall in the NAIRU should lead to a fall in inflation in the short-run, until the central bank responds by lowering interest rates. However, if the internet is associated with very large wealth effects through higher share prices, it is then possible for aggregate demand to run ahead of aggregate supply, and for inflation to be higher in the short-run.

2 Prospective growth of e-commerce

The extraordinary performance of the 'hi-tech' stock market sectors in recent months is consistent with considerable optimism about the pace of growth of the e-commerce sector. Survey evidence suggests that businesses expect the importance of e-commerce to increase very significantly, and create more intense competition within their industry and also to lead to fundamental changes for intermediaries within their sector.

3 Microeconomic evidence for the potential benefits

There is evidence that the cost savings associated with business-to-business e-commerce could be very considerable. In terms of business-to-consumer e-commerce (which, in economic terms, is less important), internet prices, on average, appear to be lower than the High Street even after allowing for delivery charges.

4 The benefits of the electric telegraph

It has been argued that the electric telegraph was, in effect, the Victorian Internet. There is historical evidence suggesting that the telegraph had important, tangible economic

benefits, which suggest that its modern-day successor could also have a profound economic effect.

5 Lessons from recent US experience

Recent US experience does suggest a pick-up in productivity growth during the last few years, and a significant rise in the measured contribution of computers to productivity growth. Moreover, it is possible that these studies underestimate the true degree of improvement, both because of measurement biases and because of the adjustment costs associated with the new technologies.

Just as the full productivity benefits of electricity were not seen until firms entirely reorganised production processes (which took many years), one might argue that the significant productivity benefits of computerisation (which dates back to at least the 1970s) are only now beginning to come through, and that the internet may well be an important turning point in this process.

6 Prospects for productivity growth in the UK

The reasons for being optimistic about prospective productivity growth in the UK despite its disappointing performance in the post-1995 period include:

(i) Likely growth in the IT sector which, as in the US, is currently experiencing a very high rate of productivity growth.

(ii) One might reasonably expect the UK to mirror recent US experience (with a 2-3 year lag because of slower IT diffusion in the UK).

(iii) It is possible that the adjustment costs associated with a new technology, along with measurement error biases have depressed measured aggregate productivity growth in the UK in recent years.

(iv) Business-to-business e-commerce should have a significant cost-saving effect.

7 Implications for the MPC's inflation forecast

The current inflation forecast (Inflation Report, February 2000) does implicitly allow for internet-related demand effects (through higher equity prices, and a declining stock-output ratio), and a supply effect through assuming lower profit margins for only 2 years, but makes no change to the assumption that underlying productivity growth is likely to remain unchanged at its long-term average.

My personal view is that there is a case for revisiting the assumption regarding productivity growth, which may well come in higher. The margin compression effect may also be larger than is built into the central projection, and might become progressively larger over the next 3-4 years. Also, in terms of demand-side effects, current market valuations of internet-related stocks are so demanding that there is a case for putting the risk of a significant correction in equity prices in the central projection.

8 Other implications for policy-making

A significant innovation like the internet is a reason for being sceptical about the use of some historical econometric relationships in policy-making.

However, it is also important to recognise that the disinflationary effect of the internet could, in theory, be more than offset by a housing market bubble or a significant acceleration in unit labour cost growth (although, in terms of a central projection, I expect neither). The internet has important disinflationary effects but does not imply 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.

SECTION 1 THE INTERNET AND THE PROSPECTS FOR UK INFLATION

There is currently much popular 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."[1]

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

SECTION 2 SOME THEORETICAL CONSIDERATIONS

2.1 THE EFFECT ON PRODUCTIVITY AND PROFIT MARGINS

There are a variety of possible channels through which the internet might have significant economic effects, including:-

(i) Lower search costs

Conventional economic theory predicts that high search costs allow prices to be above marginal costs in equilibrium (see, e.g. Salop (1979)). The internet-associated lowering in search costs should lead to lower prices, and this should be true for both business-to-consumer (B2C, hereafter) and business-to-business (B2B, hereafter) commerce.

Hence, one might reasonably expect some product markets to more closely approximate the economists' conception of "perfect competition" than before.

[1] As cited in Standage (1998).

(ii) Lower barriers to entry

In several product areas, the internet lowers market entry costs, thereby limiting the price premiums sustainable by existing market participants (because of increasing actual or potential competition).

(iii) Greater product market competition should boost productivity and cap wage demands

Both, lower search costs and reduced barriers to entry, as discussed above, tend to induce greater product market competition.

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

At the level of the economy as a whole, an increase in the average degree of product market competition can, therefore, reasonably be expected to be associated with a reduction in the so-called non-accelerating inflation rate of unemployment (NAIRU, hereafter).

One might also plausibly expect an increase in productivity 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, e.g. Nickell, Wadhwani and Wall (1992)). Alternatively, one might expect to see less X-inefficiency in an organisation as a whole when competitive pressures increase.

(iv) A shortening of the supply chain

Currently, many retailers 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 is employing two major alternative distribution models – one where the end user orders products directly from a distributor bypassing the retailer, (e.g. 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 (e.g. Dell). Indeed, one would expect a reduction in the costs associated with 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, hereafter). But as pointed out by The Economist, (1999) EDI is very expensive to operate and 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. Also, the increased competition among suppliers that is induced by the internet should facilitate a reduction in the price of inputs.

(iv) Direct effects on unemployment

One would expect the internet to permit superior job matching between the unemployed and the available vacancies – this effect should lead to a fall in the NAIRU. On the other hand, the turbulence that would be potentially 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.

To summarise, it is reasonable to expect the initial impact of the internet to be to:

(a) Reduce profit margins (at least in some sectors).

(b) 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.

(c) A reduction in the NAIRU in response to the intensification of product market competition and superior job matching, though with some partially offsetting effects through an increase in skill and industrial mismatch.

2.2 THE EFFECT ON INFLATION

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

Specifically, suppose that we start in a position where inflation is running at 2½% and would , on unchanged interest rates, remain constant thereafter. Now, assume that the NAIRU falls for the internet-related reasons discussed above, then, other things being equal, inflation out-turns will start coming in below target. A central bank that, like the Bank of England (BoE hereafter), has a symmetric inflation target will respond to the expected 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 level.

Hence, in the short-run, the benign structural factors should enable inflation to come in 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.

In discussing the impact of these supply-side improvements, I have deliberately abstracted from the demand-side impact of these supply-side changes, which might also affect the short-run level of interest rates. Specifically, the expected benefits of the internet should be expected to boost share prices, and, hence, aggregate demand may rise in line with standard wealth effects. On the other hand, the restructuring activity that is typically associated with an intensification of product market competition usually leads to an increased sense of job insecurity, which hurts consumption. While these demand-side considerations 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 might sometimes be to boost 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 that therefore it cannot affect inflation, which is only determined by the level of the money supply. This view, though, 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 will start undershooting the 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 now to the internet-related effects on productivity, we would not expect this, in the long-run, to have any effect on the NAIRU. Recall that although we have experienced significant technical progress over the last century, the unemployment rate has been broadly trendless. However, we may see a short-run effect on the NAIRU. Specifically, if the 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 comes in below actual productivity growth, allowing, among other things, for lower prices.

In some respects, 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.[2]

An implication of the higher productivity growth is that rule-of-thumb based 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, and 2% productivity growth) might also need revision 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.

[2] Note, though, that the higher expected productivity growth should lead to higher share prices, and therefore, higher demand as well, so, in principle, inflation might not fall.

SECTION 3 THE EMPIRICAL IMPORTANCE OF THE INTERNET FOR UK INFLATION

3.1 CURRENT SIZE AND THE PROSPECTIVE GROWTH OF E-COMMERCE

The internet has clearly penetrated popular consciousness, in that the tabloid newspapers now regularly run stories on it. In terms of businessmen, the Financial Times has christened itself 'the newspaper of the e-conomy'.

The stock markets around the world certainly appear to have become much more optimistic about the prospects for the 'hi-tech' sectors in recent months – e.g. since last October, 'hi-tech' sectors can more than explain the rise in the FTSE All-Share[3] index (Figure 1), i.e. the other sectors have actually fallen. Similarly, in the US, the technology sector can more than account for the rise in the S&P500, despite accounting for only around 30% of the index (Figure 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.

Figure 1

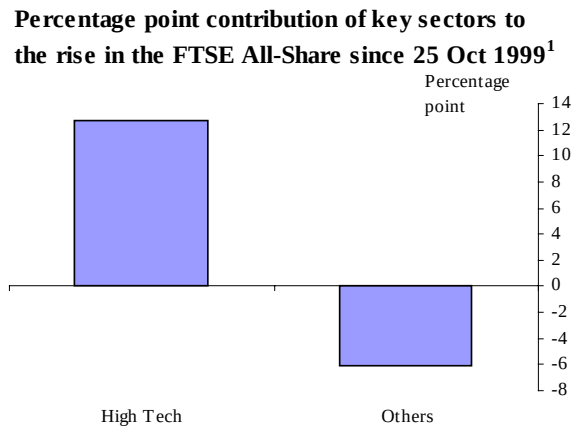
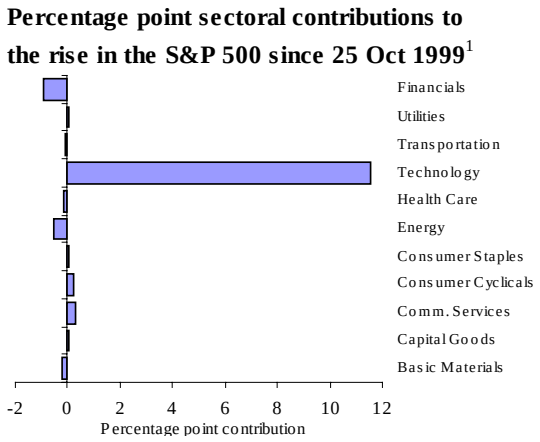


Figure 2



1. Until Feb 9

[3] 'Hi-tech' sectors in this context, includes Telecoms, Information Technology and Media.

In the US, estimates produced at the University of Texas suggest that the internet economy is growing fast (Table 1). In terms of internet users, the information in Figure 3 suggests that the UK still lags several countries, though it is based on information refers to a survey in December 1998, and anecdotal evidence suggests a significant increase in internet penetration since then.

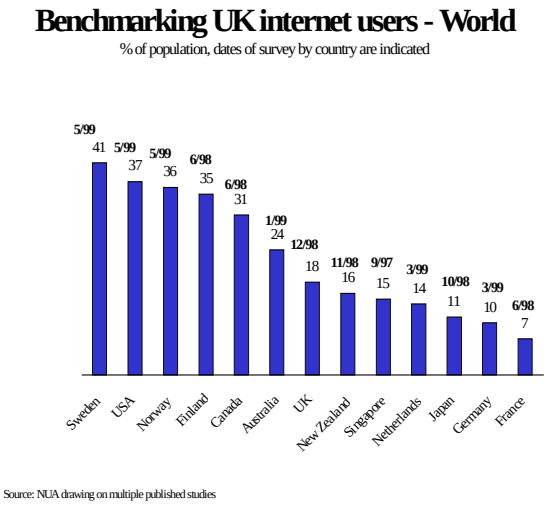
TABLE 1

INTERNET ECONOMY INDICATORS

	1998	**1999**	**GROWTH**
Annual Revenues	$301.4bn	$507bn	68%
Employment	1.57mn	2.3mn	46%

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

Figure 3



Indeed, a recent survey of online purchasing (which, of course, will 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 2). Moreover, amongst 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 that internet prices are lower than those on the High Street on a like-for-like comparison reflects a lower quality of service.

If one were restricted to internet access through a personal computer, 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 amongst UK households.

TABLE 2

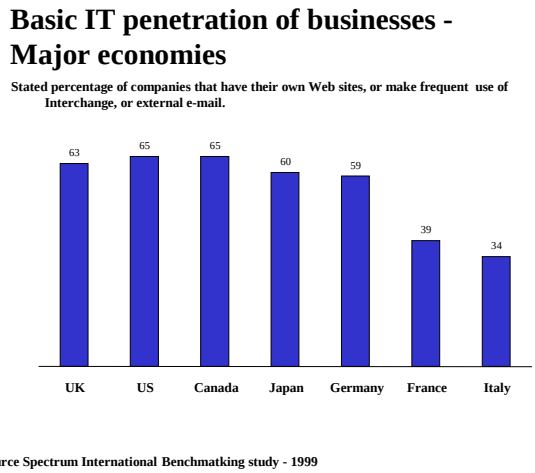
ONLINE PURCHASING SURVEY, JANUARY 2000

	Proportion saying 'Yes'
Have you ever made a purchase online?	10%
Do you expect to make a purchase online in the next 3 months? (of those who have NOT purchased in the last 3 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

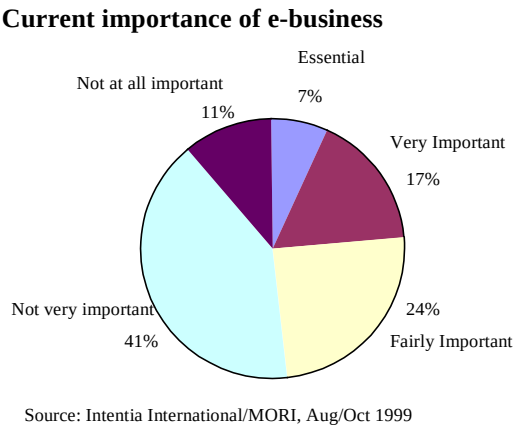
In terms of business usage of information technology (web sites, external e-mail or EDI), the UK does well, in that the level of penetration is amongst the highest in the G7 (Figure 4). However, just one in ten companies actually sell on-line, and only one in four make on-line purchases.

Figure 4



More encouragingly, a recent survey of global businesses suggested that the importance companies place on e-business is set to increase significantly (Figures 5A and 5B). Within 1-2 years, 23% of businesses think that e-business will be essential for the sector in which they operate (as compared to 7% currently), and a third believe that it will be very important (vs only 17% now). The proportion who think it will be unimportant is set to fall from 52% to 14% in 1-2 years' time.

Figure 5A



Source: Intentia International/MORI, Aug/Oct 1999

Figure 5B

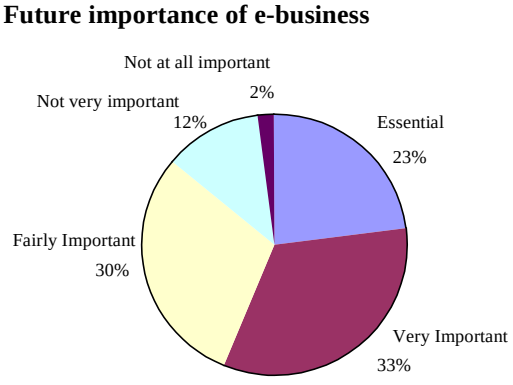


Table 3 suggests that the expected returns on an investment made on e-business are high – around 22% pa for the sample as a whole, with the expected return in the UK being broadly in line with the sample average (23%), but anticipated returns in the US are a little higher (27%). Across the board, companies are, on average, expecting 13% of sales to be generated by e-business in 1 to 2 years' time, with expectations being a little higher than average in both, the UK and the US (at 15%).

TABLE 3

EXPECTATIONS ASSOCIATED WITH E-BUSINESS

EXPECTATIONS FOR RETURNS On investment on 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 Intl./MORI

TABLE 4

BUSINESS SURVEY EVIDENCE REGARDING THE INTERNET

ISSUE	% who agree strongly			% who agree		
	UK	US	Europe	UK	US	Europe
1 Do you agree that e-commerce is currently creating more intense competition in your industry?	3%	25%	17%	56%	52%	44%
2 Do you agree that e-commerce will create more intense competition in your industry within the next 5 years?	59%	48%	38%	81%	78%	64%
3 Do you agree that e-commerce is bringing fundamental changes for the intermediaries in your industry today?	9%	22%	18%	59%	67%	46%
4 Do you envisage e-commerce bringing about changes for intermediaries within your industry sector within the next 5 years?	44%	55%	41%	81%	85%	72%

Source: Andersen Consulting – survey undertaken in May-June 1999.

Table 4 presents some related evidence from a recent survey carried out for Andersen Consulting. In response to a question of whether e-commerce is currently creating more intense competition now, around one-half of UK respondents agree, with the fraction rising to around four-fifths over 5 years. However, the fraction of those who 'strongly agree' with the statement rises from a puny 3% now, to around 60% over the next 5 years – so among those who feel strongly about it, the intensification of competition is yet to come. Turning to the other key issue 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 5 year period. In terms of those who agree with the basic proposition, the relevant percentage rises from 59% to 81% over the next 5 years.

In terms of the future of e-commerce in the UK, it is also encouraging that the Government is adopting a variety of measures to accelerate the process.[4]

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 US, 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 costs from shipping and handling, delivery and local sales taxes. In a UK study carried out in December 1999 (summarised in Table 5), Barclays Capital suggested that internet prices were significantly lower (with discounts ranging up to 22% for books) than High Street prices for a variety of goods, though there were some exceptions where the internet was more expensive (e.g., cassette tapes).

[4] See, e.g. the speech by the Chancellor of the Exchequer, "Britain and the Knowledge Economy", 16 February 2000.

TABLE 5

ESTIMATED HIGH STREET VS INTERNET PRICES

ITEM	**% DIFFERENCE[1]**
Fridge-freezers	-12
Washer-Dryers	-11
Microwaves	-10
Vacuum Cleaners	-15
Televisions: portable	-14
large screen	-13
Widescreen	-14
Video	-14
Discman	-10
Compact Discs	- 8
Cassette tapes	+10
Toys	0
Books: general paperback	-22
Fiction paperback	-22

1 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 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.

TABLE 6

INITIAL B2B COST SAVINGS BY INDUSTRIES

INDUSTRY	**COST SAVINGS**
Aerospace	11%
Chemicals	10%
Coal	2%
Communications/Bandwidth	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 & Advertising	10-15%
MRO	10%
Oil & Gas	5-15%
Paper	10%
Steel	11%

Source: Goldman Sachs E-Commerce/Internet

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 Telecommunciations (BT) claims that the average cost of processing each transaction it undertakes will fall by 90%, and, moreover, it forecasts a fall in the direct cost of goods and services that it procures of around 11%. Table 6 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 6 account for about 30% of the UK economy.[5] Of course, many companies produce, both, intermediate inputs into other industries and final outputs for consumers, and the estimates in Table 6 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, in the UK, it could lower it by around 4%. This is a potentially significant effect, but note that this assumes that other things are equal and does not allow for further macro effects.[6] 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) 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." (page 41)

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.

To summarise, 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.

[5] We need to be careful here, as the numbers are based on what savings Goldman Sachs equity analysts foresee in the US – 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 6 – recall that Ford and GM have announced large B2B schemes.

[6] The authors do go on to estimate such macro effects. Their estimates suggest a fall in the NAIRU of around one percentage point.

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.

It is notable that a textbook on American history (Atack and Passell (1994)) describes the economic benefits of the telegraph in ways that are uncannily reminiscent of contemporary descriptions of the internet, e.g.

"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." (pp 469-470)

or

"The new means of transportation and communication also revolutionised the distribution of manufactured goods. Wholesalers became increasingly centralised … ." (p 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." (p 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 one some confidence that its modern-day successor could also have a profound economic impact. I next turn to examine what one 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, hereafter), and the US 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)[7] argued

"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 again,

"We are living through one of these rare, perhaps once-in-a-century events ….. the emergence of modern computer, telecommunication and satellite technologies have 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 (both within the FOMC and outside) for pointing to a possible acceleration of productivity growth before it had occurred.

[7] As cited by David (1999).

Now, even the sceptics like Gordon (1999) have begun to concede that the growth rate of potential GDP has increased, although he 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 US since 1995 Q4 of 107 bps, more than half can be explained by cyclical factors (41 bp) and improvements in price measurement (19 bp), leaving a 'true structural acceleration' of 47 bp (see Table 7). 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 bp – see Table 7) 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" (p 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 per cent in 1987-95 to around 3.0 per cent now).

TABLE 7

GORDON'S ANALYSIS OF US NON FARM BUSINESS LABOUR PRODUCTIVITY GROWTH 1995 Q4-1999 Q3

PERCENTAGE GROWTH RATES AT ANNUAL RATES	**NON-FARM PRIVATE BUSINESS (NFPB)**	**NFPB LESS COMPUTERS AND SOFTWARE**
Actual growth	2.54	1.81
Trend 1972-1995 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).

Further, 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) report that "several researchers have found evidence that IT is associated … . with improvement in productivity". (p 179)

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 (in part, because they depreciate so fast), these studies have, until recently, shown computers having a rather small effect on productivity. However, in this context, Sichel (1999) reports some intriguing results that are summarised in Table 8. He shows that in the 1980s, computer hardware accounted for just over 0.2 percentage point 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 point 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, hereafter) – it is estimated to have risen back to around 1¼% pa, having fallen to a paltry ¼% pa earlier in the decade.

TABLE 8

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	.11	.22	.17	.35
Other Capital	1.23	1.03	.57	.72
Labor Input	1.16	1.52	1.15	1.92
Multifactor Productivity	1.25	.32	.26	1.25
Income Shares[c]				
Computer Hardware	.4	.8	.9	.9
Other Capital	29.3	29.9	29.8	28.3
Labor 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
Labor Input	1.7	2.2	1.7	2.7

a Average annual log difference for years shown multiplied by 100

b Percentage points per year.

c Per cent

Source: Sichel (1999)

3.4.2 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 one would see much clearer evidence of an acceleration if one allowed for the possibility that measurement errors have grown in significance. For example, Corrado and Slifman (1999) report that the data suggests that 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. Therefore, Corrado-Slifman carry 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 multi-factor productivity instead, and, as Table 9 suggests, can generate a significant increase in estimates of aggregate MFP growth. For example, if one assumes that the industries with negative MFP growth truly had MFP growth of 1% pa, the estimate of aggregate MFP growth would rise by as much as around 0.85 percentage points.

TABLE 9

EFFECT OF MEASUREMENT BIAS ADJUSTMENTS ON AGGREGATE PRODUCTIVITY GROWH IN THE US

ASSUMPTION ABOUT INDUSTRIES WITH NEGATIVE MULTIFACTOR PRODUCTIVITY GROWTH	EFFECT ON AGGREGATE MULTIFACTOR PRODUCTIVITY GROWTH
0%	0.41-0.44
1%	0.83-0.87

Source: Gullickson and Harper (1999)

Hence, there appears to be some tentative evidence that US productivity growth may have been increasingly understated in recent years.[8]

3.4.3 THE ROLE OF LEARNING LAGS

The oft-cited Professor Paul David[9] 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 under ½ per cent 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 per cent until the decade of the 1920s, when the US economy duly experienced a surge in

[8] 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 (emphasis added) 0.32 to 0.50 percentage points per year in the 1990s". Their conclusion does, though, depend on the assumption that increased computer usage is correlated with measurement error.
[9] See his 1999 article, and references to his earlier work.

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 only be coming through 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 accurately infer the role of adjustment costs, so any estimates should be regarded with particular care. Kiley's estimates suggest that adjustment costs have lowered MFP growth in the US by about ½ percentage point per year. Allowing for his adjustments, he suggests that trend output growth might have been boosted to around 3% pa from around 2% pa. 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 Young (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 suggesting that the extent of measurement error might have been growing over time. Also, there is 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 US. Moreover, just as the full productivity benefits of electricity were not seen until firms entirely reorganised production processes, one might argue that is the internet that might be seen as a 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 productivity growth in the UK has been disappointing, in that it has been below its long-run average (Figure 6). This is an unusually weak performance in that, typically, productivity growth tends to be above average when GDP growth is above average (Figure 7). Although GDP growth has been above average for some of the years since 1995, measured productivity growth has remained stubbornly below average.

Figure 6

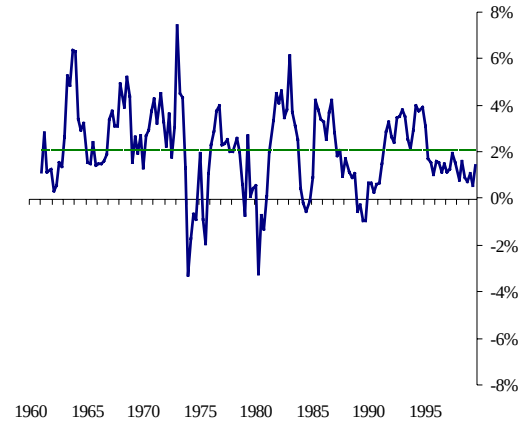


Figure 7

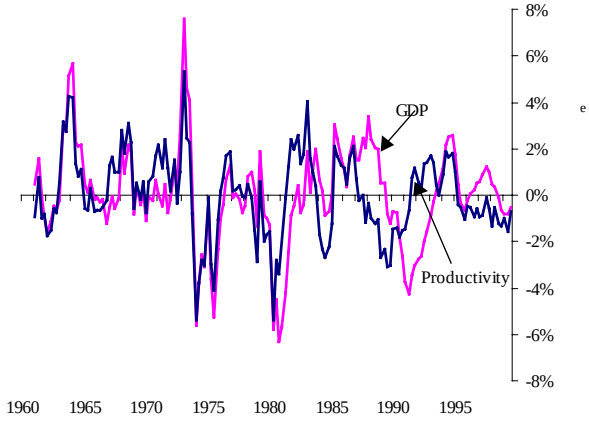


Table 10 suggests that a part of the explanation for the disappointing labour productivity performance might be a slower growth rate of the capital stock – measured MFP growth has not shown the same deceleration, but it has not risen either.

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

into explaining the recent performance of productivity growth, so what I say about it is necessarily conjectural.

TABLE 10

PRODUCTIVITY GROWTH IN THE UNITED KINGDOM

	LABOUR PRODUCTIVITY GROWTH	**MULTIFACTOR PRODUCTIVITY GROWTH[2]**
1960-98	2.1%	1.1%[1]
1973-98	1.6%	1.0%
1980-98	1.9%	1.0%
1995-98	1.3%	1.2%

Notes:

1 For 1966-98 instead

2 Defined relative to employment in heads, and uses the non-housing capital stock.

Source: Our estimates using ONS data.

3.5.2 THE SIGNIFICANCE OF THE IT SECTOR IN THE UK

Note that, as in the US, there has been an increase in investment in IT equipment in the UK. Specifically, UK investment in IT equipment increased at an average annual rate of 21.2% between 1992 and 1997,[10] whilst non-residential investment grew by an average of just 4.0%.

In 1997, investment in IT accounted for 10% of non-residential investment compared to just 4% in 1991. Further, as in the US, there is micro-econometric evidence in the UK

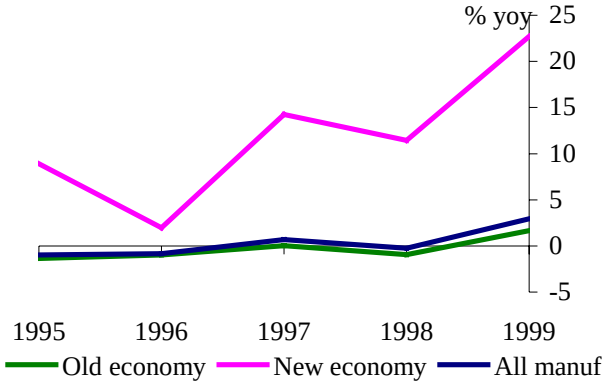
[10] At constant 1995 prices. Nominal IT investment is derived from input-output tables using product code 69 (office machinery and computers) and deflated by PPI for SIC 30.

suggesting that ICT adoption does have the expected positive impact on productivity (see e.g. Kwon and Stoneman (1995)).

In the US, one reason for the upsurge in productivity growth is the superior performance of the ICT sector itself. Figure 8 suggests that, even in the UK, the so-called 'new economy' IT sectors[11] have, in recent years, experienced much faster productivity growth.[12]

Figure 8

"Old" vs "new" sectoral productivity growth (1995-99)



Moreover, as Table 11 shows, these 'new economy' industries have accounted for a significant proportion of the growth rate in manufacturing, even though, in 1999, these sectors only accounted for under 5% of total manufacturing employment, and around 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 only accounted for 0.2% of UK GDP growth in 1999, while the

[11] 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).

[12] Productivity is derived using output in SIC 30, 32.2 and 32.3. Unfortunately, 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 e.g. electronic components, this is a reasonable assumption.

comparably defined IT sector in the US accounted 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, of itself, has not been associated with a rise in the aggregate productivity rate (as yet).

TABLE 11

CONTRIBUTION OF UK 'NEW ECONOMY' INDUSTRIES TO MANUFACTURING OUTPUT GROWTH

YEAR	% 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: Our estimates using ONS data.

3.5.3 THE SIGNIFICANCE OF MEASUREMENT ERRORS FOR UK PRODUCTIVITY GROWTH

In discussing the recent US experience above, I noted that it was plausible that aggregate productivity growth had become increasingly understated over time, in part because the "hard-to-measure" sectors (mainly services) had become an increasingly bigger fraction of GDP over time, and there was also 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 a similar understatement of aggregate productivity growth might also be present here.

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

Table 12 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 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 (i.e. manufacturing).

There are several possible reasons to be puzzled by the measured manufacturing productivity numbers. First, they do not accord with anecdotal experience. Several of the Bank's Agents have reported that their manufacturing contacts found the slowdown in measured manufacturing productivity growth hard to believe. Relatedly, one of the questions asked in the CBI Pay Databank relates to 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.[13] It is therefore possible that a difference in definitions of productivity used by some businessmen versus what economists look at explains the divergence between official statistics and anecdotal experience, but it still leaves me rather queasy. Second, it is notable that the deceleration in measured manufacturing productivity growth has coincided with profitability as proxied for by the net rate of return continuing to rise, and, indeed, the divergence is visually striking (Figure 9).

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

Figure 9

Profitability vs productivity

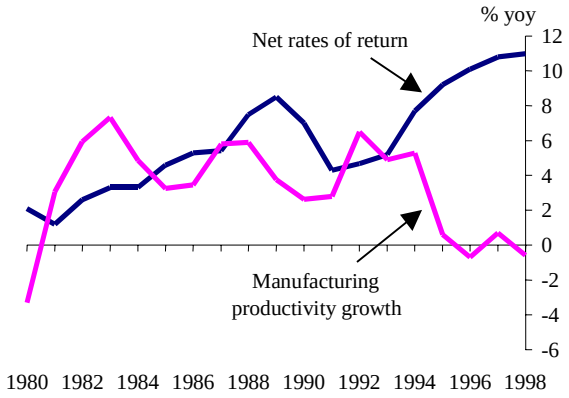


TABLE 12

SECTORAL DECOMPOSTION OF PRODUCTIVITY GROWTH PER HEAD (AVERAGE ANNUAL GROWTH RATES)

	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: Our estimates using ONS data

While 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 understated over this period, in that the responses to a question about manufacturing volumes from a different CBI survey did suggest somewhat higher output over this period. 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% pa higher.

It is clear to me that more research is required in this area, but one suspects that manufacturing productivity growth might have been understated in recent years. Further, just as in the US, the "hard-to-measure" sectors have become more important over time, so, at a minimum, it is unwise for me, as a policymaker, to automatically assume that the productivity growth numbers are broadly accurate.

3.5.4 PROSPECTS FOR UK PRODUCTIVITY GROWTH

In any case, in terms of assessing the prospects for productivity growth, one must allow for:

(i) 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 last 18 months – with slower ICT diffusion in the UK – we may well see the benefits here in the next 2-3 years too.

(ii) Adjustment costs

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

(iii) Likely growth in the IT sector

In the US, 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 here, the UK should benefit along similar lines.

(iv) The growth of performance-related pay

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

(v) The internet

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

SECTION 3.6 WHAT DOES THE INTERNET IMPLY FOR POLICY

3.6.1 THE ROLE OF THE INTERNET IN THE CURRENT 2-YEAR AHEAD INFLATION FORECAST

The effects of the internet were incorporated into the current (i.e. February 2000) inflation forecast in the following ways:

(a) 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 through higher consumption) in the normal way.

No additional adjustment relating to the internet was made to the central projection for corporate investment. However, since 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 into 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 cause a fall in the stock-output ratio. The MPC saw this factor as another reason to help 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 one gets a corresponding rise in aggregate supply and that, therefore, inflation might even rise in the short-run (see, e.g. 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 – e.g. 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 per cent in the first five years, while Dell grew by 66 per cent. Hence, 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 in the February fan charts arising from a fall in global equity prices.

(b) 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. In the context of the Bank's core medium-term macroeconometric model (MTMM, hereafter), this would require one to adjust the price equation.[14] Of course, there are other pressures on profit-margins which are unrelated to the internet including the Competition Commission (especially with respect to cars), new entrants from abroad in some of our markets (e.g. WalMart) and the increase in the tendency for the British consumer to shop around (perhaps encouraged by a low-inflation environment).

In its central projection, 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 have the effect of reducing 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%.

[14] 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.

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. The reasons for considering it include:

(i) 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 what one expects 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 in the form of lower margins (which contrasts sharply with the MPC assumption of no productivity effect and some margin effect).

(ii) Recent US experience

As discussed above, there is clear evidence of a pick-up in measured productivity growth in the US, and there are good reasons for believing that the official data understates the extent of actual improvement that has occurred. To the extent that the take-up of the ICT/internet has been slower in the UK, it would be reasonable to expect the US experience to be mirrored in the UK in the coming 2-3 years.

(iii) Other factors that might boost productivity growth in the UK

As discussed in greater detail in section 3.5.4, a combination of learning to absorb the new technology, the likely growth of the high productivity-growth IT sector, and the increased importance of performance-related pay are all likely to boost productivity growth.

(iv) 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 in these companies having a significant economic effect.

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

There are, though, some arguments which favour the status quo assumption. These include:

(a) Recent UK productivity growth has been disappointingly low

There is some validity to this argument, but there are also several reasons for believing (as discussed above in Section 3.5.3 above) 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.

(b) 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 US, 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 come in 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 also my personal view that the size of the margin compression effect might get progressively larger over the next 3-4 years – as internet penetration rises. At least in the UK, 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 only likely to have a significant impact 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 5 years. Hence, I think it implausible to believe in an assumption of only 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 last 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 are also, as has been argued at great length, necessarily uncertain. In terms of policy, I believe that this has the following key implications.

(i) Do not rely on historical relationships

A variety of supposedly well-established historical econometric relationships have broken down in recent years (see, e.g. 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 have effects on a variety of econometric relationships. Waiting for this to manifest itself in a statistically significant change in the residual pattern of 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 2¼%" or the "rate of growth of average earnings must not average more than 4½% pa", as I am no longer confident about the implicit estimate of the underlying growth rate of productivity.[15] 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.

(ii) 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 one of many factors that might affect inflation over the next 2 years.

[15] 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 simultaneously underestimate demand growth as well. 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.

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.

SECTION 4 CONCLUSIONS

I have already gone on too long – so I will be brief.

I have tried to make a case of believing that the internet will have a highly significant impact on productivity, margins, the NAIRU and inflation. It is, therefore, 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. As I noted at the beginning of this lecture, similar

claims are being made about the internet now. While recognising the undoubted benefits that e-commerce will bring us, we must simultaneously avoid technological utopianism.

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