A survey of the new economy
Elementary, my dear Watson
How information technology can boost economic growth

Sep 21st 2000 | From the print edition

IN THE 1940s Thomas Watson, then chairman of IBM, predicted that the world market for computers would add up to five; he simply could not foresee any commercial possibilities. Today there are around 300m active computers in the world, so the economic impact of IT will turn out to be somewhat bigger than Mr Watson might have guessed. But how big?

People nowadays take it for granted that they will grow richer year by year. Yet for most of human history, growth in world output per head averaged little more than 0.1% a year. It was not until the late 18th century that growth accelerated, to an average of 1.2% a year over the past 200 years (see chart 3), thanks to a spurt in technological innovation. Since then, the world has seen four main waves of innovation. The first, from the 1780s to the 1840s, was the industrial revolution in Britain, fuelled by steam power; the second, from the 1840s to the 1890s, was the railway age; the third, from the 1890s to the 1950s, was driven by electric power and the car. Now we are in the information age.

People are often frightened of technological change. Yet the world would be much more frightening without innovation. Economies have limited resources of capital and labour. So without better ways to use these resources, growth would soon run out of steam.

Traditional models of growth developed in the 1950s concentrated largely on inputs of capital and labour, and had nothing to say about technological change. It was seen as exogenous, something that rained down from heaven. But a new theory, developed in the 1980s by Paul Romer and others, put technological change at centre stage. This “new growth theory” regards knowledge creation as endogenous, responding to market incentives such as improved profit opportunities or better education. Rather than raining down at a steady rate, the pace of technological change depends partly on governments and firms. Mr Romer argues that the economic incentives for innovation have strengthened in recent years. Raising finance for innovation has become easier, and a bigger global market has increased the likely return. Global R&D as a share of GDP has increased. It is claimed, strikingly, that about 90% of all the scientists who have ever lived are alive today. The pace of innovation does not just seem to be faster: it really has increased.

Taking the plunge

A good gauge of the pace of technological change is the rate of decline in the cost of a new technology. Over the past three decades, the real price of computer processing power has fallen by 99.999%, an average decline of 35% a year. The cost of telephone calls has declined more slowly, but over a longer period. In 1930, a three-minute call from New York to London cost more than $300 in today's prices; the same call now costs less than 20 cents—an annual decline of around 10%.

These price plunges are much bigger than those in previous technological revolutions. The first steam engines were little cheaper than water power. By 1850 the real cost of steam power had fallen by only 50% from its level in 1790. The building of the railways reduced freight rates across America by 40% in real terms between 1870 and 1913, an annual decline of only 3%. The introduction of the telegraph hugely reduced the time it took to send information over long distances, but the service remained expensive. In the 1860s, a transatlantic telegram cost $70 a word in today's prices. Over the next decade the cost fell, but a 20-word message still cost the equivalent of around $200 to send. Today a 20-page
document can be e-mailed for a mere cent. Electricity prices fell more steeply, but still by an average of only 6% a year in real terms between 1890 and 1920.

Thanks to rapidly falling prices, computers and the Internet are being adopted more quickly than previous general-purpose technologies, such as steam and electricity. It took more than a century after its invention before steam became the dominant source of power in Britain. Electricity achieved a 50% share of the power used by America's manufacturing industry 90 years after the discovery of electromagnetic induction, and 40 years after the first power station was built. By contrast, half of all Americans already use a personal computer, 50 years after the invention of computers and only 30 years after the microprocessor was invented. The Internet is approaching 50% penetration in America 30 years after it was invented and only seven years since it was launched commercially in 1993.

In addition to plunging prices, computers and the Internet have four other noteworthy features:

• IT is pervasive: it can boost efficiency in almost everything a firm does, from design to marketing to accounting, and in every sector of the economy. The productivity gains of steam, electricity and railways were mainly concentrated in the manufacture and distribution of goods. This could be the first technological revolution to boost productivity in services, from health care and education to finance and government. That would be no small matter: services account for nearly three-fifths of America's GDP.

• By increasing access to information, IT helps to make markets work more efficiently. Economists at UBS Warburg suggest that the “new economy” should really be called the “nude economy” because the Internet makes it more exposed and transparent. The Internet allows consumers to seek the lowest price, and firms to get quotes from more suppliers; it also reduces transaction costs and barriers to entry. In other words, it moves the economy closer to the textbook model of perfect competition, which assumes abundant information, many buyers and sellers, zero transaction costs and no barriers to entry. IT makes these assumptions a bit less far-fetched. (However, it also seems to increase monopoly power in some industries, which will be discussed in a later section of this survey.)

Better-informed markets should ensure that resources are allocated to their most productive use. Farmers can get instant information on weather, prices and crop conditions in other regions. Manufacturers can track changes in demand more closely via direct links to electronic scanners in shops.

• IT is truly global. More and more knowledge can be stored as a string of zeros and ones and sent anywhere in the world at negligible cost. Information technology and globalisation are intimately linked. By reducing the cost of communications, IT has helped to globalise production and capital markets. In turn, globalisation spurs competition and hence innovation, and speeds up the diffusion of new technology through trade and investment.

• IT speeds up innovation itself, by making it easier and cheaper to process large amounts of data and reducing the time it takes to design new products. Thanks to ever more powerful computers, the mapping of the human genome, completed earlier this year, took much less time than first expected.

Net gains

Many economists believe that although computers are undoubtedly useful on their own, it will take the Internet to unlock their full economic potential. E-commerce still accounts for only 1% of total sales in America, but it is growing rapidly. Dot.com firms, such as Amazon and eBay, have become household names, but far more important from an economic point of view will be business-to-business (B2B) e-commerce, linking buyers and sellers electronically along the supply chain. The Gartner Group, a consultancy, forecasts that global B2B e-commerce will reach $4 trillion by 2003, compared with less than $400 billion of online sales to consumers.

The best way to analyse the impact of the Internet on the economy is as a fall in the cost of an input, in this case information. Expressed diagrammatically, this pushes the aggregate supply curve (an economy's productive potential) out to the right (see chart 4), in exactly the same way as the invention of the wheel
or electricity did in the past. Assuming no change in aggregate demand (D1), the equilibrium level of production rises from Q1 to Q2, and the price level falls from P1 to P2.

B2B e-commerce can cut firms' costs in several ways. First, it reduces procurement costs, both by making it easier to find the cheapest supplier and through efficiency gains. It is much cheaper to place an order online, and there are likely to be fewer errors in orders and invoicing. That may seem trivial, but Cisco reports that a quarter of its orders used to have to be reworked because of errors in its phone and fax ordering system. When it switched to online ordering, the error rate fell to 2%, saving the company $500m. British Telecom claims that buying goods and services online reduces the cost of processing a transaction by 90% and cuts the direct costs of goods and services it buys by 11%.

A second possible saving is from much lower distribution costs for goods and services that can be delivered electronically, such as financial services, software and music. The marginal cost to a bank of a transaction over the Internet is a mere cent, compared with 27 cents via a cash machine, 52 cents by telephone and $1.14 by bank teller. Online commerce also allows more efficient supply-chain management, cutting out layers of middlemen. And lastly, better information reduces the need for firms to keep large stocks. Dell Computer's build-to-order model completely eliminates inventories, and is being widely copied.

The B2B exchanges being set up by car, steel, construction and aerospace firms will provide a more efficient marketplace for buyers and sellers to exchange products. Such exchanges are likely to spring up in most industries. GM, Ford, Daimler-Chrysler and Renault-Nissan plan to move all their business to a joint electronic exchange with a turnover of $250 billion and 60,000 suppliers. According to one estimate, dealing with suppliers online could reduce the cost of making a car by 14%.

The biggest savings are likely to come in procurement. A report by Goldman Sachs, an investment bank, estimates that online purchasing could save firms anything from 2% in the coal industry to perhaps 40% in electronic components. As a result of such cost savings, Goldman Sachs reckons, B2B e-commerce could boost the level of output in the rich economies by an average of 5% over time. More than half of that would come through within ten years, an increase of 0.25% a year in the rate of growth over the next decade. Add in the potential indirect cost savings from the Internet as firms reorganise the way they do business, and the total gains could be considerably bigger.

The popular distinction between the old and the new economy completely misses the point. The most important aspect of the new economy is not the shift to high-tech industries, but the way that IT will improve the efficiency of all parts of the economy, especially old-economy firms. This distinction will be examined further in a later section of this survey. But first those productivity gains have to materialise—and economists find it impossible to agree on how far IT has already started to lift America's productivity growth.

*From the print edition: Special report*