OXFORD REVIEW OF ECONOMIC POLICY, VOL. 17, NO. 2

THE ASSESSMENT: ECONOMICS OF THE INTERNET

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Seen from the perspective of economics, the Internet has been widely regarded as a major force likely to raise productivity. However, at least so far, the identifiable effects on productivity appear small and largely confined to the USA. Similar scepticism is expressed about the view that the Internet would be naturally highly competitive. On the contrary, economies of scale and scope plus advertising-intensive reputations create the threat of concentration. As a result, a pro-competitive stance for policy is required—and in taking such a stance policy must look over the full range of the value chain. Such a pro-competitive stance is, however, not sufficient. Because of other market failures and because of the need to protect democratic rights, a wider view of policy is essential. The fundamental policy issues facing the Internet are, therefore, whether it can remain open, competitive, and pluralistic in a context increasingly dominated by large corporations.

I. INTRODUCTION

The Internet is the largest man-made system in the universe. It is in every country in the world, there are well over 100m subscribers and perhaps as many as 400m people using it.

The Internet is extraordinarily pervasive. In addition to the ubiquitous e-mail, it is already possible using the World Wide Web (WWW) to shop, bank, vote, debate, consult a doctor, a teacher, or a priest, and study for a degree. Moreover, its growth has been extremely rapid. A decade ago nobody beyond a small number of people in universities had even heard of the Internet. Today it is a major form of advertising, an important tool in election campaigns and for a growing number of people their first port of call for information about their health, their holidays and their children's schools. As the television and the personal computer (PC) move closer together, the Internet will become ever more integrated with the traditional mass media. But the

[1] I owe particular thanks to Andrew Glyn. He has not only taken much of the brunt of the work in editing this issue, but has also provided perceptive comments on an early version of this assessment as well as writing most of the section on productivity. I would also like to thank Elizabeth Prescott for research assistance.

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Internet is mass media with a difference. In the past we had individualized communication (most obviously in letters and telephone calls). This was followed by mass communication (first radio and then television). What the Internet brings is mass individualized communication.

These developments have produced an explosion of literature concerned with the Internet's effects. The articles in this issue illustrate something of the range of these concerns, seen from the perspective of economics and concentrating on the longer-term structural questions rather than the rise and fall of enthusiasm for 'dot-com' stocks in the financial markets (the 'Internet bubble'). However, before proceeding, some clarification of terms may be helpful.

First, a broad-brush, but useful distinction can be drawn between *carriage* and *content*. Carriage, or the communications infrastructure, includes the computers, cables, satellites, etc., plus all the digital traffic they carry. Content is that digital traffic reassembled in the form of text, pictures, and sound. Content includes also a range of services provided in the form of advice, instruction, education, banking, games, chat-rooms, etc.

Second, the term *portal* is used to describe a site that you visit in order to find your way elsewhere. Search engines, such as Altavista or Google, are therefore portals. However, portals may also be thought of as entrances to an integrated website, such as Amazon.com. Such portals are effectively the retail outlets of the Internet.

Third, the term *gateway*, though it is sometimes used to *include* search engines, is restricted here to the way in which you first get on to the Net. This will usually be via firms calling themselves Internet service providers (ISPs), but, as digital television expands, the provision of the Internet service could just as easily be coming from companies thought of as traditional broadcasters.

In the articles that follow, those by Paul David and by Martin Cave and Robin Mason analyse the carriage part of the Internet and how this has evolved. In the early days it was primarily a tool for academics, but once its commercial potential was recognized there were high hopes that Internet shopping would increase competition and reduce prices. These questions of pricing and of commercial behaviour are examined in the articles by Arup Daripa and Sandeep Kapur and by Howard Smith and Simon Latcovich, while William Wilhelm's article examines how the new technologies are affecting the structure of the financial sector. Bruce Kogut and Anca Metiu describe how the Internet has spawned collaborative communities of software developers, who, without obvious economic incentives, continue to develop programs. Steven Casper and Henrik Glimstedt examine the institutional requirements, in terms of the structure of financial and labour markets, which underpin successful firms in different segments of the Internet industry. Finally, Robin Mansell considers whether the new technologies offer opportunities for less developed countries radically to improve their position in the world division of labour.

This assessment concentrates on a broad overview of some of the key economic issues and on policy. As with most of economics it is concerned primarily with the effects of the Internet on the production, consumption, and distribution of goods and services—though when we turn to policy it will be essential to consider wider questions. Section II focuses on *carriage*. Section III deals with *content* and the sources from which it is available, particularly with the role in content availability of *portals* and *gateways*. A key question here is whether the Internet is competitive. Section IV is a brief reminder of some of the ways in which information goods may exhibit market failure, even when markets are competitive. Section V considers some of the other major economic effects of the Internet on the structure of the economy, especially whether this new revolution is raising the overall level of productivity of the economy. Section VI summarizes the complex policy problems that are being created and suggests some guidelines for policy. Section VII concludes.

(i) The Digital Revolution

One final word of introduction: underlying both the Internet and its wider effects is the digital revolution. This has three components (two technological and one economic)—each reinforcing the others. First, there is computing power. Different parts of computing (storage, transmission, etc.) have advanced at different speeds at different times, but, taken

overall, computer power has grown persistently at between 15 and 30 per cent *per annum*. The implications are astounding. Growth of just over 25 per cent each year implies a tenfold increase in 10 years and a hundredfold in 20 years. Over a lifetime of, say, 70 years, the growth is by a factor of no less than 10m!

Second, there is the digitization of information. This consists of the ability to represent not just letters but also colours and sounds in numbers and thus to be able to process everything in terms of '0s' and '1s'. As far as the computer is concerned, the result is that text, music, and pictures are equivalent. Each one can therefore be processed (edited, combined, copied, erased, etc.) as well as mixed with one another. This is truly multi-media. In addition, provided that standards are agreed so that the digital signals can move freely from machine to machine, this information can be transmitted anywhere in the world. Indeed, in one important sense the Internet is no more than the standards that govern all these exchanges.

Third, there is the underlying economics of the Internet. Many aspects of the digital revolution imply high fixed costs combined with marginal costs that are close to zero. Once installed, fibre-optic cables have near infinite capacity and so cost, literally, nothing to use, while to make a digital copy of a book or a piece of music requires no more than the click of mouse. As a result, *average* costs fall persistently as demand increases—and as costs and prices fall, so demand rises again.

The ultimate effect of these changes, taken in combination, is still hard to assess, but it is already clear that the Internet, as a new means of communication, is having profound effects on society. Indeed, it seems likely that the changes will be as profound as those brought about by the development of the printing press in the sixteenth century.

II. CARRIAGE

How the carriage part of the Internet works is described in the paper by Cave and Mason. The two most essential points are:

(i) It is a packet switched system. This means that each message is broken into separate packets and each of these packets is moved through the system (i.e. switched) by whatever route is free at the time, all the packets being recombined at the end. There is therefore *no permanent connection*.

(ii) It is a 'best effort' system. There is never any guarantee that a message will be carried, let alone how fast it will go.

These points are corollaries of one another. It is *because* there is no permanent connection that the system can rely on using spare capacity and so be effectively free at the point of use. It is *because* it relies on spare capacity that it cannot be more than a 'best effort' system. Moreover, as anyone who has ever used the Internet will know, these characteristics are both its boon and its bugbear. As economic analysis predicts, the system is brilliant so long as there is spare capacity. But, once full, any system that is free carries the price of congestion (queues, frustration, etc.).

How 'free' the Internet is in practice varies from country to country, depending primarily on the way in which the telephone system has been regulated. On the one hand, there is the United States, where all local calls, including connections to the nearest ISP, are free and revenue comes from subscriptions to the ISPs. On the other hand, there is the UK, where the revenue from local calls has been sufficiently above the marginal cost to make it worthwhile for ISPs, such as Freeserve,[2] to move in to capture the rent generated. Many other European countries regulate their local calls in a similar manner to that of the UK, often with a larger gap between revenue and costs, so the innovation of the 'free' ISP model has been widely imitated.

Although the Internet is free at the point of use, the fixed costs (the wires, cables, routers, etc.) still have to be covered both at the retail end (the final link to the user) and at the wholesale level (the backbone). The revenue for this comes from the charges made to the ISPs by the telecoms companies, from the subscription and advertising income

[2] Freeserve was set up by Dixons in the autumn of 1998 and, within a year, was the largest ISP in Britain. After going public in July 1999, it was swallowed by Wanadoo, a spin-off of France Telecom, in 2001.

earned by the ISPs, and, outside the USA, from the charges for the local calls that connect many users to their ISP.

The economics of *carriage* thus present two primary policy issues. First, the structure of telecoms regulation has a major influence on whether there is an encouragement to be connected (e.g. the UK Freeserve model) or to use once connected (e.g. the US model). In addition, as Cave and Mason show, the UK model encourages more (and smaller) ISPs to exist than would otherwise be the case. Second, because there is no price that rations demand once capacity is reached, there is the problem of congestion. Clearly the two issues are inter-related since the US system intensifies the tendency towards congestion.

So far the solution to the congestion problem has lain primarily with the engineers in the form of ever-higher capacity. The difficulty, however, is that once speed increases so does usage, and congestion returns. Cave and Mason discuss possible economic solutions and favour the proposal by Odlyzko (1997). This would effectively separate the Internet into 'sub-nets' with higher prices charged by those 'sub-nets' which offered, on average, a faster service (but still with no guarantee).

Whether the Odlyzko scheme would work in practice and whether, if it did, it would be either efficient or stable to have several sub-Internets co-existing, is implicitly challenged in the paper by David, where he questions whether most economists have understood the particular form of congestion that happens on the Internet.

The core of David's argument rests on three propositions. First, he emphasizes that the Internet is successful because it is a 'network of networks' and because the way it works requires very little computing intelligence along the way. All the computing power is at the ends of the system and its strength is that it does not require a permanent connection. David's concern is that most of the proposals to tackle congestion by attaching different prices to traffic that is differentiated in some way either risk recreating the permanent connections of the telephone system (and all their associated costs) and/or require more computing intelligence in the system than is compatible with the open protocols of the Internet. It would, for example, be easy to imagine that once there were 'sub-nets', with some faster than others, programmes would be developed that would transfer successfully only across a 'fast net', but once this occurred the openness of the Net would be gone.

Second, he points out that the congestion is not ubiquitous. It is thought to be rare *within* the backbone networks of North American ISPs. Instead it appears to occur primarily at the public Network Access Points (NAPs) to the backbone.

Third, he argues that the way in which the Net evolved historically meant that, in the past, congestion was, in part, avoided by a combination of moral codes and implicit pressures. As a result he suggests that, instead of relying just on technological solutions, the private operators of these access points could be put under greater regulatory pressure (e.g. by performance targets) to improve the service they provide.

To David's argument it could be added that, whereas an engineering solution (i.e. more physical capacity and more technical advance) for the *whole* of the Internet is almost certainly unrealistic because the scale of the investment required would be too large, regulatory pressure in conjunction with engineering advances which focused just on these bottlenecks might well be capable of producing a solution. Unlike the road system, where the installation of more capacity never provides a permanent solution, in the case of digital traffic a focused engineering solution might work (*a*) because the scale of technical advance is so rapid, (*b*) because costs keep falling, and (*c*) because, unlike roads, there are no physical limitations on the capacity that can be installed.

A further possibility, and one that would be complementary to adding more physical capacity, would be the re-introduction of a local call charge (but at a low level) in those countries where these are currently free. Even a small disincentive to remaining online 24 hours a day or to transmitting full motion video, whenever the mood takes, could make a significant difference. However, this latter proposal faces two considerable problems. First, the political opposition to charging for local calls once they have been free could be significant. Second, consumers, when faced

with a choice between a fixed charge and one that varies with usage, appear on average to prefer the fixed charge, even when this is the more expensive option.[3]

III. CONTENT, PORTALS, AND GATEWAYS

During the 1990s the Internet was passing through a phase somewhat analogous to the early days of cars, when enthusiasts were as fascinated by what went on under the bonnet as by their real purpose of carrying people and goods. But the point of the Internet, as with cars, is that it is *useful*—it carries information. This information is either available direct from the creator of the content (e.g. as a home page or an e-mail), or from where it has been gathered together into an integrated website or 'portal', such as Amazon.com, and is reached via an ISP or 'gateway'.

In examining these flows of information two assumptions have frequently been made. One is that the existence of the Net would significantly increase competitive pressures on *other markets* by (*a*) being a close and more efficient substitute for existing activities (e.g. for mail order) and (*b*) by allowing participants in *all* markets to be much better informed. This assumption is discussed below when considering the effects of the Net on the rest of the economy.

The other assumption is that the Net itself would be highly competitive. It is easy to see why so many have jumped to this position. Millions of people are participating in e-mail, there are multiple ISPs, and the cost of entry by, for example, establishing a website, is both low and falling. To this, two further factors may be added. First, the whole philosophy of the Internet has been that of open standards[4] and inter-operable equipment. Second, the openness of the Net, added to the ability for anyone to connect to anyone, made it seem likely that buyers, in all their multiplicity, could and would communicate directly with sellers, who would be equally numerous. To many, therefore, the Internet seemed like the ideal world of perfect competition made real.

There are four reasons for thinking that such a conclusion may have been reached too hastily. First, the multiplicity of websites and home pages is, in large part, an irrelevance. Many are little more than self-publicity and so their labour costs are zero. They are not, therefore, a typical part of economic activity. Moreover, given the astonishing mass of information that now exists on the Net, there must be considerable doubt as to whether they are even an effective form of publicity. Of course there are exceptions. For example, industries that have large numbers of small firms, such as parts of tourism, do find the Net a useful marketing device. However, in general, while this plethora of home pages is an interesting social phenomenon and may well have important social implications, it is unlikely that it is of great economic significance.

Second, as has already been noted, the digital revolution is characterized by significant economies of scale. In addition, in the case of content, the digitization of information generates economies of scope. Material created for one purpose can be repackaged and recombined with other material so that one set of fixed costs is spread over several uses. Indeed this is what multimedia and convergence is all about. In general, economies of scale and scope lead not to competition but to concentration.

Third, as is well known, the sale of 'information' as such faces a problem of potential market failure. For the market to work well, consumers have to be well informed about what they are buying, but if they are well informed about the information they are buying they would not need to buy it! As is also well known, this form of market failure is typically solved in one of two ways. One is via repeated sales of closely similar products, such as daily newspapers. The other is via reputation: for example, the high fees earned by the major consulting firms. However, new entrants can achieve neither of these. For example, in the case of reputation, either it already

[3] See the evidence summarized in Cairncross (2001, pp. 91–3). This behaviour may be similar to that found in consumers' resistance to micro payments (i.e. to paying very small sums per web page viewed). In both cases they appear to want to avoid the hassle of having to decide whether to pay or not.

[4] The fundamental standard of the Internet, TCP/IP (Transmission Control Protocol/Internet Protocol), has been in the public domain from the outset, available for all to use and without charge.

exists and can be transferred to the Internet or it has to be built. This is one important reason why BBC Online has become one of the most visited sites in Europe while many dot-com companies have bombed.

Fourth, despite the massive technological improvements, the *fixed* costs of producing content for the Internet are not falling as fast as might be supposed. This is because a major component of these fixed costs is not equipment, but people—and not just individual people, but *teams* of people. Of course many other industries are in the same position, and this is the point. The existence of the Internet has not suspended the normal ways in which organizations operate. Moreover, in the complex world of multimedia and global competition these fixed costs may even be rising. Lawyers have to clear complicated property rights, designers have to be state-of-the-art, and, in a world of global competition, writers and producers have to be the best in the business. The stars of stage and screen have always been able to earn a rent for scarcity, but globalization is dramatically increasing such rent. This can already be seen in the world of television, where the old monopoly of spectrum scarcity is being replaced by a new monopoly of available talent as seen in the rapidly escalating fees paid for sports rights. A world in which the winner takes all is not a world of free competition.

These analytical points, first made several years ago (Graham, 1995), find support in the papers in this issue. Latcovich and Smith examine the online book market. Far from finding perfect price competition, they show that Amazon.com has engaged in massive advertising and that, as the market size expanded from 1995 to 2000, these endogenous sunk costs escalated and there was no major new entry to the market. In addition, both advertising-to-sales ratios and market-concentration ratios were far higher than for traditional booksellers. Following a close examination of pricing on the Internet, Daripa and Kapur reach very similar conclusions. In particular they argue that far from the Internet having brought about the 'law of one price', the market in information goods is likely to have discriminatory pricing as its norm.

In addition, Cave and Mason show that the great number of ISPs in Europe, which makes the Internet appear so competitive, is no more than a regulatory artefact—individually, each one is just seeking the economic rent which is generated by local call charges in excess of costs. And, even in the UK, ISPs have been merging to form larger units.

Recent evidence reinforces these conclusions, especially for portals and gateways. A survey by Jupiter Media shows that, whereas in March 1999 11 sites accounted for 50 per cent of the time people spent online, by May 2001 this had dropped to only four and over the same time period the number of sites that attract 60 per cent of web visits has dropped from 110 to 14. Gateways also show an increase in concentration. AOL/Time Warner, in particular, is by far the largest. By 2001 it had over 23m subscribers and is responsible for almost a third of the time American citizens are spending online.[5]

It is also interesting that the portals and gateways that have flourished are either those that have been able to transfer reputations from elsewhere (e.g. the BBC) or where there has been a major effort to build it afresh (e.g. Amazon.com or Lastminute.com) or both (e.g. AOL/Time Warner). What might be an appropriate policy response to this potential lack of competition is discussed below.

The question of whether there needs to be a policy response to the price discrimination predicted by Daripa and Kapur can be dealt with here. It is true that consumers may resent different prices for what seem to them to be essentially similar commodities, but there is no fundamental reason why price discrimination is harmful to welfare. On the contrary, in an industry with high fixed costs and near zero marginal costs, and in the absence of dominance, it can be the best solution available. The price discrimination allows the entire consumer surplus to be captured and total costs are just covered. Moreover, while there is no guarantee that those with high wants will be those on high incomes, when it comes to payment there is likely to be some correlation, so on balance price discrimination will improve the equality of consumption opportunities. There is, therefore, no *prima-facie* need for policy intervention.

[5] Report on BBC News Online, 6 June 2001.

IV. INFORMATION GOODS AND MARKET FAILURE

In the case of many goods and services, all that needs to be known from a policy point of view is whether markets are competitive. However, in the case of information goods the position is more complex. There are the following main sources of additional difficulty.

First, in the case of many information goods, society wishes both for there to be an incentive for the good to be produced (e.g. knowledge about the human genome) and for that knowledge, once produced, to be disseminated as widely and rapidly as possible. Strong property rights are good for the first, but frequently poor for the second. Weak property rights produce the opposite effects.

One solution to this conflict of objectives has been the public funding of research, either directly or indirectly via the funding of various not-for-profit organizations such as universities. Another solution, explored in this issue by Kogut and Metiu, is voluntary cooperation. As they bring out, the public good aspect of information on the Internet, plus the community of interest that it has generated, appears to have been particularly effective in inducing the writers of software to share their results in the interest of the common good.

Second, there is the problem of asymmetric information. The consumer, even when he or she has the information, may not know enough to judge how trustworthy it is. Particularly difficult areas are those in which there is a long gap between purchase and consumption (e.g. buying a pension) and/or where this is specialized knowledge in the hands of the producer (e.g. health care).

Third, citizens have positive rights. These include the right to certain core information about the society in which they live, such as its laws, its political procedures, and how to participate in its democratic process. Such information must therefore be available to all and not be dependent on income or wealth.

Fourth, democratic societies have long recognized that information is a form of power and that for democracy to flourish there must be freedom of expression. The spread of opinion represented in the mass media must, therefore, meet the test of plurality.

At present, the mass media are still dominated by television, radio, and newspapers. However, as the Internet expands and as the PC and the television merge, it would not be difficult to imagine a world in which the Internet becomes for many people the primary source of information about their own society. In this case, policy for the Internet would have to address the same democratic concerns that complicate policy-making for the mass media.

Three areas, in particular, would need to be watched. First, there are potential issues arising from dominance over content. At the moment this may seem unlikely, but, given the global nature of the Internet and the possibility that, where there is star talent, the winner takes all, it cannot be ruled out. For example, Samuelson's economic textbook has sold worldwide, but it has been used by a multitude of teachers, each able to add their own interpretation. Suppose an interactive multimedia package (combining the reputations of both Samuelson and Microsoft) were now to be launched, complete with frequently asked questions (FAQs), continuous up-dates, built-in teaching aids, online testing, and global marketing. Entry by others would certainly be difficult and, in the absence both of competitors and interpreters, there would be a potential hegemony of ideas.

Another example is Microsoft's Encarta, the 'encyclopaedia on a disk', given away as a free CD-ROM with many PCs. It is undoubtedly more efficient, especially for fast searching, than book-based versions and, being free, it virtually drove the *Encyclopaedia Britannica* out of business. But is it more reliable? The early versions only recognized one Civil War, that of the USA, and contained no entry at all for Christian Democracy, the largest political movement in Europe (and, more parochially, displayed as its picture of a typical Oxford College, All Souls, a college that has no students).

Second, there are the issues arising from the 'gateway'. The problem with the gateway is that the great majority of consumers are unlikely to subscribe to more than one ISP. This is all the more likely once the hidden subsidy that has encouraged the 'Freeserve' model disappears. If a gateway is just that—no more than a way on to the Net—then

there is no problem. However, if some gateways themselves run as large integrated websites, with a wide range of content and services directly available, covering banking, news, leisure, education, health, etc., then, in these cases, there must be democratic concerns about dominance.

Third, and interacting with the problem of the gateway, is that of the browser. The potential abuse of market power that can occur when this comes bundled with the PC is well displayed in the Microsoft court case. Similar abuses could equally occur if the browser comes as part of the package of services offered by the gateway.

From an economic point of view the primary concern is the cost of switching (since this cost determines the extent to which the supplier can raise price in excess of cost and not lose the customer). If the supplier were also the cable company or the telecoms company that provided the physical wiring, such switching costs might be considerable. It is therefore important that other providers should be allowed to use the same wires and on competitive terms.

From the viewpoint of society as a whole there is a more important point. The browser has the capacity to set the agenda. It determines what is found and what is not. Yet large numbers of consumers may not understand this and, unaware of this agenda-setting capacity, could remain dependent for their knowledge of the world on a single supplier. Browsers must not, therefore, be bundled with gateways.

V. THE EFFECTS OF THE INTERNET ON THE ECONOMY

So far we have concentrated directly on the Internet. However, there has been an equally lively debate on the extent to which the Internet is transforming *other parts of the economy*. Two effects especially have been emphasized. One is the extent to which the Internet will increase competition. The other is the way in which the Internet may produce structural transformation and, related to this, bring about a major boost to investment. If so, and if the effect is significant in aggregate, this would manifest itself in either a step change in productivity or in an acceleration in the growth of productivity. The broader macroeconomic impact of the new economy will be the subject of a forthcoming issue of this *Review*, so only a brief overview of these issues is included here.

(i) Competition

The Internet is still in its early days. Nevertheless research carried out so far[6] suggests that its impact on competition is strongest either where the good or service has very precise characteristics, as in the transactions in stock and shares, or where it is extremely simple, such as plastic cups or paper napkins, and that it is especially in business-to-business (B2B) markets that these effects are being felt. The Gartner Group estimated that in 1999 B2B sales were more than five times those of sales to consumers (Uchitelle, 2000). Other areas of potential competitive gain are where information between buyers and sellers was previously poorly matched, such as consumer durables (the market into which the online auction house, eBay, has moved) and in the labour market where online job posting has grown spectacularly. However, as Daripa and Kapur plus Latcovich and Smith (this issue) and Autor (2001) show, the effects both on competition and on the flows of information between buyers and sellers prove to be considerably more complex than a simple market model would predict.

(ii) Productivity

Given the interest in the Internet and the claims that have been made about the extent to which it and the digital revolution will transform the economy, the effects on productivity have been subjected to forensic scrutiny over the past few years. However, identifying these effects proves remarkably difficult, especially as there is a host of measurement problems involved in assessing the impact of the new technologies on output and productivity. One of these arises from the problem of measuring output when quality is rising and yet prices are falling—yesterday's £1,000 dot-matrix printer is today's £100 laser printer. The construction of indices to reflect quality improvements is not only problematic, but it also has a decisive effect on the output of the

[6] There is a useful set of articles in the *Journal of Economic Perspectives*, winter 2001.

information, communications, and technology (IT) sector, and thereby on the growth of the capital stock of the economy as a whole. Another is that software spending is now counted as investment rather than as current input and this change boosts both GDP and the capital stock.

Nevertheless, from the lively debate on these and other empirical issues[7] the following conclusions may be drawn.

(i) There has been an enormous build-up of the stock of IT capital—computers, software, and telecommunications equipment—resulting from a sharp rise in nominal investment expenditures and the headlong fall in the prices of items purchased. Jorgensen's calculations for the USA show a doubling of the IT stock between 1989 and 1999 in current prices, combined with a 39 per cent fall in the average price (computer prices are shown as falling by 87 per cent over this period, with a particularly rapid fall after 1994).

(ii) Labour productivity growth rose sharply in the USA after 1995. GDP per hour worked accelerated to 2.1 per cent per year over the period 1995–9 from around 1.25 per cent per year over the previous two decades (Jorgensen, 2001). The acceleration in labour productivity growth was about double (from 2.2 per cent to 4.6 per cent p.a.) if attention is confined to what Nordhaus calls the 'well measured business output sector', which excludes government, construction, finance, and other services where output measurement is especially problematic. Despite the acceleration, labour productivity growth in the US economy as a whole was slower after 1995 than in the period 1948–73.

(iii) A substantial part of the increase in labour productivity growth reflects capital-deepening as investment in IT equipment has built up the capital stock. Jorgensen's estimates, corroborated by Oliner and Sichel (2000), suggest that capital-deepening has contributed rather more than one-half to the rise in labour productivity growth after 1995, and that the overwhelming bulk of this derives from faster growth of IT capital.

(iv) Over and above the contribution of capital deepening, there has been an acceleration in the growth rate of multifactor productivity (MFP): often interpreted as reflecting underlying technical progress, but actually a catch-all term for any impact on output other than the conventional, growth-accounting contributions of capital and labour inputs. The main protagonists in the debate seem agreed that MFP growth *within the IT sector* (e.g. in the production of computers, etc.) has contributed around 0.3 per cent per year to the acceleration in productivity growth as a whole.[8]

(v) The main dispute concerns what is happening outside the IT sector itself. Has the build-up of IT capital elsewhere been associated with a faster rise in MFP there also, or may that even have fallen? As conventionally measured, there has been an increase in MFP outside the IT sector. Oliner and Sichel and Jorgensen rate this as about as important for overall growth as MFP growth within the IT sector itself. Gordon (2000), however, claims that all the apparent acceleration reflects the cyclical impact of greater labour and capital utilization and that outside of durable manufacturing the trend growth of MFP has actually declined by about 0.3 per cent per year. The onset of recession in the USA will make resolution of this dispute even more difficult (several more years of 'abnormal' productivity growth would have undermined Gordon's position, for example, whereas it will be much more difficult to judge whether the current decline in productivity growth is a cyclical movement to a higher or to an unchanged underlying trend). The dispute is an important one because at issue is the significance of the effects of the new technologies on the 'old economy': is investment in IT associated with the 'normal' increase in output that

[7] Important contributions to this debate include Jorgensen (2001), Gordon (2000), Oliner and Sichel (2000), and Nordhaus (2001), with parallel work on the UK by Oulton (2001) and on the broader OECD group of countries, reported in OECD (2000).

[8] Nordhaus (2001) calculates that labour productivity growth within the 'New Economy' (taken to mean machinery, electrical equipment, telephone and telegraph, and software) accelerated from 7.3 per cent p.a. in 1989–95 to 13.3 per cent p.a. 1995–9.

results from traditional investments, or is it associated with an additional growth bonus (faster growth of MFP)?

(vi) All the results reported above refer to the USA. Oulton's very detailed (2001) study for the UK, following the methodology of the US studies, shows the build-up of IT capital having an increasing impact on growth in the late 1990s, but a smaller effect (around two-thirds) of that in the USA. However, the growth of non-IT capital fell sharply in the UK and MFP growth in the economy as a whole actually halved in the late 1990s (while it was nearly doubling in the USA). So, contrary to the US experience, the build-up of IT capital appears to be at the expense of other capital and has been associated with deterioration in MFP and thus growth performance overall.

As noted above, the Internet is only a small subset of IT as a whole. On the 'optimistic' interpretation of the US data, underlying labour productivity growth has accelerated by about 1 per cent per year, and the great bulk of this can be linked to IT, either through direct investment in IT, MFP growth in the IT sector itself, or (more controversially) faster MFP growth in other sectors which might be linked to their use of IT. In turn, some part of this reflects the Internet, but probably not that much—at least according to Oliner and Sichel's broad estimates of orders of magnitude. If there were real resource savings of 10 per cent on e-commerce, then the cost savings would represent only 0.2 per cent of US output in 1999 and over the preceding few years 'the effect of e-commerce on MFP growth would be considerably less than 0.1 percentage point per year' (2000, p. 21).

Of course many of the effects of the Internet may not be captured in GDP measures at all (for example, consumers ordering over the Internet may save time spent shopping; working at home over the Internet saves travelling time, etc.). Nevertheless it is important to keep in mind: (*a*) its relatively limited effect on conventional growth measures—at least so far; (*b*) the different effects it may be having even within the industrialized world; and (*c*) the possibility that in some countries the effects elsewhere in the economy may be positive, while in other countries they may be neutral or even adverse.

If these technologies do turn out to have the radical effect on economic structures and thus performance that the enthusiasts expect, then differential impact across countries becomes a significant issue. Casper and Glimstedt argue that the IT industries themselves are quite diverse in their organizational forms, which implies that the Silicon Valley model is not the only route to success. North European countries with much more coordinated economies have proved very effective in certain segments of the market. Mansell warns against exaggerated hopes of what the Internet can do for third-world development, pointing to the institutional and infrastructural prerequisites for success.

VI. GUIDELINES FOR POLICY

To some, the Internet appears so anarchic, global, and impossible to regulate that the very idea of 'policy' for the Internet is a contradiction. However, such an argument is misconceived on three grounds.

First, many of those involved in the early days of the Internet held notably libertarian views, but libertarianism is not the same as anarchy. It is, itself, a policy position. This has been especially obvious in the disagreements that have occurred over the display of child pornography on the Net, with groups in the UK holding very different positions from one another, and with the USA, with freedom of expression written into its constitution, finding itself out of step with views taken in, for example, France or Germany.

Second, it is not true that the Internet has been anarchic. On the contrary, not only did the USA make the promotion of the Net a policy goal,[9] but also the emergence and continuance of the Internet protocols, none of which ever had any proprietary control, has only been possible as the result of a remarkable degree of collaboration and self-regulation—the very opposite of anarchy. This has been carried out primarily by the Internet Engineering Task Force (under the umbrella of the Internet Society) and by the World Wide Web consortium

[9] Vice-president Al Gore gave it particular backing, including promoting the National Information Infrastructure programme.

(W3C) that oversees the standards on the Web. Whether such voluntary consensus building and the associated self-regulation can survive the further growth of the Internet is, however, a large question.[10]

David's article (this issue) highlights some of the difficulties. The early designers of the Internet were mostly engineers and computing scientists and they had a set of shared understandings. As a result, the Internet developed more in some directions than others. For example, openness was a design priority, whereas considerations such as security and privacy, being, in part, met by the custom and practice of a predominantly academic and research community, were treated as less important. However, today's Internet is increasingly privatized and commercialized. As a result, it not only lacks the shared moral codes, but is also expected to deliver a rapidly expanding range of services and under ever more stringent conditions (fast, open, secure, private, authentic, etc.). It is most unlikely that all of these can be achieved simply by ever smarter engineering. The crucial implication of this line of argument is that rethinking the governance of the Net and putting in place more formal codes of conduct, plus the associated regulatory institutions, is now increasingly necessary.

Third, actions by national and international regulatory authorities, as well as the normal processes of law, have already affected the Net (e.g. the 1996 Communications Decency Act in the USA or the lawsuit which curtailed Napster's activities)[11] and will increasingly do so. Indeed, the European Union and the UK have recently been conducting major reviews of their communications policies, including the Internet.

That policy is both inevitable and desirable does not, however, make it easy. Policy-making never is, but five factors make it especially problematic for the Internet.

(i) It is global, whereas most regulatory bodies are national or, at most, regional (e.g. the European Union).

(ii) It is in a state of considerable flux—growing rapidly, undergoing massive technical change and facing large changes in industrial structure and ownership.[12]

(iii) Even from just an economic perspective, the picture is one of complex trade-offs (e.g. between encouraging or enforcing competition or allowing a degree of concentration in order to reap economies of scale and scope).

(iv) As already noted, information goods present an unusually wide array of potential market failures.

(v) The Net has important social, cultural, and political dimensions that can neither be ignored nor be wholly separated from the economic dimension.

Despite this complexity, or in some cases because of it, there remain some guidelines that any policy towards the Internet needs to bear in mind. As with almost all economic policy, it must be based on one or other of two principles: that of *market failure* or that of *rights*.

Consider, first, *industrial structure*. Here the primary market failure lies in the threat of dominance. As a result, it would make sense to have a general presumption in favour of (*a*) competition and (*b*) the unbundling of services (so that consumers may, if they wish, buy one service without being forced to accept a package). However, this general presumption will not be sufficient, nor must it be applied in too literal a manner. The Internet is part of a complex value chain and this creates at least three difficulties:

[10] At its most recent meeting, in June 2001, the Internet Society launched a major review of self-regulation.

[11] The Communications Decency Act was subsequently thrown out by the Supreme Court, but it has been followed by the Children's On-line Privacy Protection Act of 2000.

[12] Between 1993 and 2000 all the top seven multimedia firms in the world were buying, merging, or being bought. There were also multiple partnership and strategic alliances being created. These have involved both horizontal and vertical integration from within the multimedia and telecoms world, as well as from firms totally outside (e.g. Proctor and Gamble, best known as makers of detergents, developed links with Paramount Television, owned by Viacom-CBS, and Seagrams, the Canadian drinks firms, acquired MCA, which owns Universal Pictures).

(i) strong competition in one part of the chain, but not all of it, will simply transfer the economic rent elsewhere;

(ii) unequal degrees of competition will skew investment to where the competitive pressure is least (thus if the regulatory authorities wish to promote either content or carriage, they need to do so deliberately and not arrive at either merely by default); and

(iii) some parts of the Internet value chain will be complementary to other parts and in such cases large numbers of firms should not necessarily be equated with strong competitive pressures, or, putting the same point another way, whereas mergers between competitors will usually be harmful to consumers, mergers (or agreements) between complementary firms will often be helpful.[13]

Given these complexities it probably makes sense to have a single regulator surveying carriage and content (as is now proposed for the UK). The issue is not, however, a simple one. Regulation is normally better done the more precise the objectives and the more knowledgeable the regulators. Thus care should be taken not just to throw away the knowledge embedded in the old 'vertical' regulatory structures (radio, television, telephones).

Having a single regulator looking at both content and carriage, either at the national or international level, does *not* imply that the regulators should encourage similar vertical integration among firms. On the contrary, in most cases the regulators should favour separation, while, at the same time, bearing in mind the two points made above ('watch the rents' and 'think what you are doing to investment').

To talk of a single regulator in this way when the Internet is global may seem to be something of an irrelevance. However, outside Europe, for the foreseeable future national regulators are all we have. Moreover, such bodies *will* regulate within their national territories. The good way forward, therefore, would be to encourage these national regulators to meet frequently and to see how far they can establish common approaches. Moreover, within Europe, there can be a similar process, but reinforced by the substantial additional power that already resides in the European Commission.

Consider, second, the market failure that arises from *asymmetric information*. One way of dealing with this is legislation to protect consumers. While this possibility should not be disregarded, the difficulty in legislating for material that can come from anywhere in the world is obvious. As a result, instead of trying to stop things in this way, there may be a case either now or in the near future for a public policy that promotes *trusted* sources of information and of supporting a number of portals run with these objectives in mind. An added advantage of this approach is that individual countries, reflecting their different priorities and their different cultural and social contexts, can choose what they promote. The arguments here are similar to those that surround public service broadcasting and these, as well as the views of those who take a contrary position, have been well developed elsewhere.[14]

Consider, third, the *democratic dimension* grounded in the right of citizens to choose their representatives and to do so in an informed manner. The two fundamental points here are (*a*) that the concern here is about the plurality of editorial philosophy and (*b*) such concerns are *additional* to and *separate from* those about economic dominance. Given such points, as well as the earlier one about the need for a regulator with an overview, then the most appropriate structure may be a single regulator, but with two or more sub-divisions.

It may also make sense to regulate organizations differently according to different *purposes*. For example, those who wish to trade under the banner of 'public interest' could be given different rights and obligations from those trading purely commercially, or from those identified with a particular interest or viewpoint (such as a religious portal).

Consider, fourth, the *right of citizens to participate*. This, involving as it does concerns about the

[13] Yarrow (2000) develops the argument in detail in relation to the communications sector.

[14] See, for example, the first issue of the new online journal, *Opendemocracy*, to be found at www.opendemocracy.org

information-rich and the information-poor, is a particularly difficult area. Many countries are pushing ahead with trying to introduce 'e-government', with the primary goal of delivering public services via the Internet. This will be justified if, as is hoped, there are substantial efficiency gains, but whether this will prove to be possible remains, in many cases, as yet unknown. Moreover, there are at least two problems. First, many public services (social security being the most obvious) are most consumed by those with least access to the new technology. Second, the early evidence is that contact between the public and the public agencies via the Internet works best where it is additional to existing contact via traditional methods of communication, rather than supplanting those.[15]

Should governments, faced with the problem of the low take-up of the Internet among those they most need to reach, subsidize some form of universal service for the Internet? Perhaps. Once access to the Internet becomes a near essential facility for participation in society (e.g. in applying for a job), there would be a strong rights-based argument for doing so. There is also a market-failure argument. As is well known, networks display externalities (even a millionaire would not buy a phone if he or she were the only person to own one). These externalities will be especially large as the point is approached at which it becomes possible *not* to duplicate systems of communication. Or, to put it another way, as Internet penetration rises, there will come a point when it will pay the State to connect the remaining non-Internet users because of the savings that will be possible elsewhere in the system.

While a policy of promoting universal service can be justified, and while governments should keep this in mind, the ways in which such a policy would be applied in practice will inevitably vary substantially from country to country. As Mansell's paper makes all too clear, the discrepancies between countries in their take-up of the Internet are massive, reflecting as they do the equally massive inequalities in income and wealth that exist between different parts of the world. Only the most naïvely optimistic can suppose that the Internet, or policy towards it, will do much to improve this. Indeed, it is all too likely that the gap will grow.

VII. CONCLUSIONS

Despite its phenomenal growth, the Internet is still in its early days. As a result, the first results of academic research about its effects are only now beginning to appear. It is therefore too early to reach definitive conclusions. Nevertheless, the Internet is undoubtedly here and policy towards it is being made, by default as well as explicitly. A brief overview of some of the key guidelines for policy-makers has therefore been suggested above. Three final remarks remain.

First, the Internet appears to have been moving through phases that bear a resemblance to those of earlier technological revolutions (such as the discovery of electricity). In broad terms, the first phase is dominated by pure research (often taking place in universities or in research institutes with public funding). In the second phase, when the original discovery has been made, but no one knows how exactly to use it, all kinds of experiments are made. This second phase is particularly suited to small firms and venture capital. Many new firms are born, but a great many fall by the wayside. In the third phase the market consolidates and large firms with their superior marketing facilities and worldwide reach take the lion's share. Schumpeterian competition this may be. Neoclassical competition it is not.

Second, in the case of the Internet (and recalling the underlying technology of the digital revolution), the factors tending towards dominance seem especially powerful. Further, as has been noted, dominance in any of the systems of mass communication poses special problems. Suggesting that this may happen is not to deny that there will still be a multiplicity of small firms. The Internet will also undoubtedly continue to encourage the flow of ideas between individuals and between like-minded groups. Nevertheless, the likelihood is that this will take place within a context dominated by large corporations. Coming to terms with this is, therefore, likely to be the fundamental policy challenge facing the Inter-

[15] Evidence presented to a seminar on 'E-Government and Democratic Rights' at Balliol College, Oxford, March 2001.

net. Can it stay open and can competition and plurality of view be sustained?

Third, while policy-making for the Internet is difficult, it is also, for the reasons that have been indicated, particularly important. It will require new forms of research and new ways of thinking and working. Such research and policy formation must involve not just economists, but also computing scientists, sociologists, political scientists, civil servants, lawyers, medics, and, last but not least, consumers and citizens.

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