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The Economic Importance of Electronic Networks: Assessing the Micro-level Evidence Base

by

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Executive Summary

There is evidence to suggest that the UK economy may be failing to capture the full economic benefits of investment in information and communication technologies (ICTs). If this is occurring, the goal of becoming a world leader in the knowledge economy will be jeopardised. Results, based on macro-economic analysis, do not yield a clear picture. The additional evidence available from this study, at the micro-level, commissioned by the Prime Minister's Strategy Unit, sheds further light on the situation.

A review of UK case studies, and those conducted elsewhere in Europe, detects some of the factors that influence the diffusion pathways of ICTs and the efficiency and effectiveness of their use. The case study material is supplemented by information from the Office of the E-Envoy, the Office of National Statistics (ONS), and other online sources. The analysis of key factors focuses on the experiences of private sector firms, public sector organisations, and households and individuals.

Improving ability to take advantage of ICTs is expected to have a strong positive impact on economic growth. The micro-level evidence provides insight into whether ICT usage patterns are consistent with expanding network capacity. Building this capacity to enable all potential user groups to gain full economic advantage is not straightforward. The ICT diffusion process embodies many factors that are difficult to predict. These factors can accelerate or slow the ICT adoption process and influence whether or not it will produce expected economic gains.

A significant factor is the system features of ICTs. **If key components of the ICT system are relatively immature, positive economic impacts as a result of ICT investment are unlikely to occur, or to be as extensive, as expected**. The system features of ICTs, i.e. the interactions between the technical and social components of the system, are crucial in achieving 'take off'.

The learning process is another key differentiating factor in determining the speed and direction of ICT diffusion and whether it will yield positive economic impacts. Deficiencies in the skills and competency base for applying ICTs can slow the diffusion process and reduce the economic impact of investment. **A key issue for the UK is whether there is sufficient investment in the ICT skills and competency base across all user groups, and especially smaller firms.**

The benefits of ICT investment are mixed. Many reported experiences are below expectations. The firms that report positive impacts have invested considerably in learning new organisational processes and work practices. Likewise, for public sector organisations, the case study evidence points to the importance of breaking down organisational change barriers and of the time needed to achieve positive outcomes. The key message is that positive ICT impacts arise from: 1) concurrent investment in learning, 2) strategies to reduce organisational change costs, and 3) measures that enhance the perceived safety (privacy and security) of networks and online transactions. The extent to which ICT user groups move up their respective 'e-adoption ladders' very much depends on how these factors, in combination, are deployed.

Our assessment suggests that policy measures are needed to reinforce the demand side of the ICT market. Priority areas include:

- Learning for skills and competency development aimed at breaking down entrenched attitudes and modes of behaviour that lead to resistance to ICT use.
- Reducing constraints that inhibit development of a fair and efficient e-service delivery market. These constraints relate to access to learning as much as to access to technology and ability to pay.
- Monitoring and assessing economic impact as a result of ICT investment using methods that capture the micro-level experiences of users.

Learning opportunities are particularly important in the following areas:

- Encouraging the 'peer-to-peer' model of content creation and exchange alongside existing, and evolving, business models. The aim should be to widen user participation to improve baseline experience levels.
- Promoting measures to build trust in the use of ICTs, including measures to assure users about network privacy protection and security.
- Reducing barriers to effectively managing intellectual property rights in digital information, especially for smaller firms. Efforts should be made to balance intellectual property rights protection and the maintenance of open digital spaces on the Internet.

Reducing constraints on e-service delivery markets requires:

- Ongoing, targeted regulation to encourage further competitive entry into some market segments. Interconnection models for mobile and fixed networks, between Internet service suppliers, and between the Internet and broadcasters, are increasingly complex and may be better addressed through formal regulation rather than self-regulatory measures.

- OFCOM to operate as a regulatory agency that can offer comprehensive and informed views on changing supply and demand patterns. OFCOM is well-positioned to signal changes in ICT usage patterns for electronic networks (and content).

- ICT development to avoid system failures that hold back opportunities for some user groups to advance up the 'e-adoption ladder'. Co-ordinating the use of regulatory and non-regulatory measures to strengthen opportunities for learning, should assist in achieving this goal.

Monitoring ICT economic impacts is essential:

- More in-depth case studies could provide further insights into the learning process and the barriers and drivers of change in ICT consumption patterns. Existing case studies use inconsistent methodologies and only provide snapshots of current practice. The evidence base for understanding how ICTs are evolving with individual needs and with learning experiences is very weak.

- Undertake systematic and methodologically sound, micro-level time series studies of ICT use to monitor its economic and social impact.

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1 Introduction

No other technology, with the possible exception of biotechnology, displays the promise of information and communication technologies (ICTs). These technologies are distinguished by their ubiquity and by the varied aspirations for their use. It is crucial to consider how these technologies can most usefully be applied to achieve the expected economic benefits.

Investment in electronic networks that rely on digital ICTs is expected to have a major and positive impact on the UK economy. However, the evidence base that is needed to measure this impact is not very robust. In early 2002, the London Business School (LBS), commissioned by the Performance and Innovation Unit,[1] prepared a report reviewing existing evidence on the impact of ICTs on labour productivity and economic growth, and examined the applicability of these results to electronic infrastructure and broadband in particular.[2] The LBS report concluded that differences in the definitions of ICTs and in the theoretical and methodological approaches employed in existing macro-economic research, together with data deficiencies, make it difficult to ascertain whether the UK is failing to capture the full benefits of ICT investment.

The UK government is committed to ensuring that a favourable environment exists to promote the spread of electronic networks. The overall objective is to ensure that the UK is a world leader in the knowledge economy.[3] The challenge is to establish policy and regulation that encourage investment in electronic networks to meet the needs of all groups in society, including private sector firms, public sector organisations, and individuals. This report examines the micro-level evidence of ICT impacts, and electronic networks in particular, in order to inform developments in policy and regulation.

1.1 The Mico-level Evidence Base – Scope & Methodology

The micro-level evidence-base on ICT impacts can be examined to indicate whether policy or regulatory measures might help to create incentives for more effective and efficient use of electronic networks. The focus is on existing micro-level research that assesses how the expected benefits of ICTs may accrue to different user groups and filter through the economy as productivity gains.

Electronic networks are defined for the Strategy Unit's project to include:

> … all the different networks in the UK that offer connectivity, so that information (voice, data and video, etc.) can be transmitted to and from multiple points, including a return path from the end user to the originator.[4]

At the micro-level, it is difficult to separate electronic network developments (infrastructure) from the services that are delivered. The definition of ICT that is employed in most micro-level case studies encompasses varying combinations of computing and telecommunications hardware, applications software, and services. This study focuses mainly on those applications that involve the use of digital technologies and information.[5] In this report, we review selected case studies that assess ICT impacts in the UK and other European Union countries. Most of the case study material is drawn from research undertaken by researchers based in institutes across Europe. The

analysis complements insights gained from existing macro-economic studies. As far as possible, we emphasise impacts linked, directly or indirectly, to the expansion of electronic network capacity.

Most micro-level evidence is qualitative and few systematic European case studies exist. Even fewer studies are designed to obtain self-reports on whether electronic network use, and broadband in particular, gives rise to productivity gains.[6] However, the case study evidence does provide some insight into users' perceptions of economic impacts. This material is supplemented by information from the Office of the E-Envoy, the Office of National Statistics (ONS), and other reputable online sources.

The ICT impact assessment in this report is based on thematic coding. This procedure extracts common themes and factors from the literature that appear to influence the direction and speed of ICT use and network investment. The application of this technique provides insights into:

- factors that may account for differences in ICT usage patterns among firms, households and individuals, and public sector organisations;
- factors that may account for positive economic and social impacts from the spread and effective and efficient use of digital ICTs;
- the extent to which positive economic impacts can be attributed to investment in new generations of electronic networks, increased connectivity, and the achievement of a critical mass in the marketplace.

Future demand for high bandwidth networks will continue to be influenced by changing patterns of media and information consumption across different platforms.[7] One of the most influential of these is the Internet. Table 1 sets out some of the areas in which the spread of electronic networks, including the Internet, is expected to have an economic impact. The matrix is used as a framework for assessing ICT impacts in this study.

Table 1 Network Connectivity and New Services

	Government	Firms	Consumers
Government	G2G e.g. Coordination	G2B e.g. Information	G2C e.g. Information
Firms	B2G e.g. public markets	B2B e.g. e-commerce	B2C e.g. e-commerce
Consumers	C2G e.g. tax procedures	C2B e.g. Price comparison	C2C e.g. auctions

Source: Adapted from Coppel (2000), OECD Economics Department Working Paper.

1.2 Structure of the Report

The next section of this report introduces the contribution of micro-level analysis to the understanding of ICT use and alternative diffusion pathways. These pathways affect whether positive ICT impacts are experienced throughout the economy. The section also identifies some of the key issues that must be addressed as the e-society is developing. Section 3 assesses the empirical data for the user groups identified in Table 1. Section 4 considers the main policy and regulatory implications arising from the factors identified as influencing the economic impact of ICT investment. Section 5 provides a conclusion.

2 Key Determinants of the Knowledge-driven Economy

2.1 The Structure of ICT Investment

There are differences in the rates of ICT spending and investment between the European Union countries and the US. Throughout the 1990s, spending on hardware, software, communications equipment and other ICT services was less than 6 per cent of European Union GDP as compared to 8 per cent in the US. Similarly, investment in ICTs accounted for 2 per cent of European Union GDP and nearly 3.5 per cent in the US.[8] The spread in both spending and investment between the European Union and the US has increased over time.[9] These gaps in ICT spending and investment rates are not present in all European Union countries. The patterns in Sweden, the UK, and the Netherlands do not differ markedly from the US.[10]

Data comparing the penetration of network infrastructures in the US and western Europe, and data showing information technology and telecommunication market growth rates, are provided in Annex A. However, factors other than relative rates of spending, investment and penetration must to be taken into account to examine why the economic benefits of ICTs may not be fully captured in the UK.

There are many initiatives to benchmark progress towards the knowledge-driven economy in Europe.[11] The Statistical Indicators Benchmarking the Information Society (SIBIS) project, for example, has analysed European country performance in implementing the e-Europe action plan. This action plan is being integrated, with reasonable success, into the national plans of the UK, France, Germany, the Nordic countries, and the Netherlands. The UK has made greatest progress in actions to improve Internet access for schools and to encourage teachers to use new technologies. However, most countries, including the UK, show a lack of progress in promoting industry-led codes of conduct for e-commerce, measures for life-long learning, and ICT-related training. There are initiatives in the UK to address these issues, but continuing policy effort is need to create an environment that stimulates demand for ICT investment.

Nationally-based efforts to monitor ICT impacts are in place.[12] In the UK, the Office of National Statistics (ONS) is beginning to monitor micro-level impacts and to develop new indicators for the private sector, households and individuals. Together with data collected by the Office of Telecommunication (Oftel) and organisations such as Nielsen-Netratings, these data make it possible to develop profiles of usage patterns.[13] However, most existing indicators do not capture variations in the effectiveness and efficiency of ICT use. More work is needed to devise indicators that provide further understanding of ICT consumption patterns and related social and economic impacts.[14] This requires a focus on the perceived effectiveness and efficiency of use.

A study of the determinants of economic growth in Europe suggests that,

> … the problems that Europe faces in key areas such as growth, equality and employment are all related to its failure to take sufficient advantage of technological advances, particularly the ICT revolution.[15]

Improving capacity for taking advantage of the ICT revolution is expected to have a strong positive impact on economic growth. Micro-level evidence provides insights into whether patterns of ICT use are consistent with improvements in this capacity.

2.2 ICT System Features and the Diffusion Process

Building the capacity to enable all potential user groups to gain full economic advantage from ICT use (and investment in electronic networks) is difficult because of the unpredictability of the ICT innovation and diffusion process.

The pathways along which ICT demand develops are numerous.[16] Time is required for users to become accustomed to new ICTs and to develop a willingness to use them. This makes it difficult to specify precisely which ICTs (and electronic networks) will be needed in the future.[17] The diffusion pathway can be divided into three periods: the period of early adoption, the 'take-off' period, and the maturity phase. Various factors may accelerate or slow the ICT adoption process and whether or not it will produce expected economic gains.

A significant factor is the *system features* of ICTs. System features complicate the analysis of the likely diffusion pathway and its impact. [18] For example, the economic impact of asymmetric digital subscriber line (ADSL) technology will be weakened if some part of the ICT system on which ADSL's successful diffusion relies is immature. The other parts of the system include related technical and human, or social, components. Their maturity and their capacity to smooth the diffusion process are affected by users' experiences, skills, and the adaptability of existing organisational customs and practices. These factors and system features influence how ICT consumption patterns develop.

The relationships between the ICT system components are influenced by positive network externalities. Positive network externalities exist when the value of a technology increases as others decide to acquire the same, or a related, technology.[19] Rapidly falling costs in some technologies, and new methods of using networks, are potential drivers of investment in higher bandwidth networks. Market segments with a willingness and ability to pay will receive earlier access to new networks and services. One result is that the technical components of an ICT system will diffuse and be adopted unevenly. Important changes in the human or social components that facilitate adoption will also occur unevenly.

However, ICT diffusion and adoption pathways are not fixed. Government policy and regulation in a number of key areas can alter the speed and impact of ICT use. For example, encouraging investment in 'always on' networks is likely to boost demand for ICTs, and lead to the 'take off' and 'maturity' phases of diffusion. This positively reinforces the 'virtual circle' needed to build human and organisational abilities alongside technological capacity. If key components of the ICT system are relatively immature, the positive economic impacts are unlikely to be as extensive as expected.

2.3 Learning as a Key Factor in ICT Demand

Research on ICT diffusion and use often examines the impacts on different user groups. However, the system features of ICTs and their use, i.e. the *interactions* between the technical and social components of the system, are crucial in achieving 'take off'. The learning process is a key differentiating factor. The effectiveness and efficiency of ICT

diffusion pathways depend upon 'the interplay of technological potential, commercial exploitation and socio-economic acceptance'. [20]

Deficiencies in the skills and competency base for applying ICTs will slow the diffusion process and reduce the economic impact of investment. In Europe, there is a projected shortfall of qualified people with information technology, electronics and communication (ITEC) skills to fill a projected 3.8 million new ITEC occupations by 2003.[21] A key issue for the UK is whether there is sufficient investment in the skills and competency base that will be needed. [22]

In the UK, the skills and competency profile in ICT employment areas is mixed. Employers are concerned about skill shortages and about the quality of graduates available to meet demand. This is especially the case for smaller firms. The E-Skills National Training Organisation has developed a framework for measuring and benchmarking ICT capabilities within organisations. It also undertakes initiatives to encourage public and private sector training. Nevertheless, the Institute of Directors (IOD) is calling for an increased focus on vocational education and training to address skill shortages in the ICT area.[23]

Maximising opportunities for ICT-related learning has been associated with self-employed tele-working.[24] The UK is in the mid-range in this area. Of all self-employed individuals, 8.6 per cent are working as teleworkers. This contrasts with Sweden (22.2 per cent), Finland (26.4 per cent) and Germany (11.4 per cent).[25] All of these countries are leading the UK in their Internet usage intensity.[26] Outsourcing also has an impact on the speed of ICT take-up because a skilled workforce is needed to retain higher value added ICT jobs in the face of competition from lower wage earning countries.[27] The UK dominates in the European market for outsourced information processing services, and especially in higher value information processing work.

These are two areas that can encourage widespread skill and competency building for working in online environments. Both areas play a role in stimulating demand for electronic networks and in ensuring that their use is productive. Learning is also a key differentiating factor in other parts of the ICT system.

2.4 Evolving Digital Information Exchange Models

Business models for the supply of digital information impact on ICT demand patterns. During the Internet's initial growth period, it was assumed that 'peer to peer' networking would favour content and information production tailored to small groups and individuals. Under this model, everyone would become a content producer which would drive demand for higher bandwidth networks.

However, recent reassessments of the business models developing for the supply of digital content suggest that the point-to-multipoint content model will continue to predominate. For example, the Institute for Prospective Studies in Seville argues that, 'customisation of content may still be possible but it will be offered only if users are willing to pay extra for it'. [28] In the near term, a 'peer-to-peer' model of digital information supply is not likely to be the major driver of demand for ICTs. 'Peer to peer' sharing of music, films and other entertainment files via the Internet may stimulate demand for higher bandwidth networks, but mainly at the household level for leisure and

entertainment purposes. It is unlikely that this model will overtake the business model driving the major content producing companies.

Further growth in the 'peer-to-peer' model should be encouraged so that it continues to flourish in the open spaces of the Internet. These activities offer good opportunities for learning which will extend user participation. Encouraging production of smaller-scale online content by a variety of users, including small and medium-sized enterprises, will advance ICT take-up.

Changes in copyright legislation are aimed at increasing the scope of protecting ownership rights in digital information as ICTs proliferate.[29] Securing information stored and transmitted over networks is also a central issue for the development of digital content markets. The extension and strengthening of copyright protection creates markets for the sale of digital information goods and services. It also raises the user costs for developing non-commercial uses of ICTs, many of which lead to enhanced ICT skills and competencies. The balance between intellectual property rights protection and the development of open Internet spaces to encourage user learning is an important differentiating factor for the diffusion pathway.

Learning is also a key feature for managing intellectual property rights in the ICT domain. Legal advice is often needed to address issues in this area. This can create barriers for smaller firms seeking to produce or to use digital content. [30] In the UK small and medium-sized firms tend to be unaware of, or unconcerned about, the management of digital information.[31] Support for smaller firms in acquiring the necessary management skills could reduce this barrier and boost incentives to exploit network connectivity at both firm and individual levels.

Learning processes are essential for encouraging practices that safeguard the protection of personal privacy and enhance the security of digital information. Technical methods to manage the boundary between the private and public lives of ICT users cannot substitute for social and legal choices.[32] Advances in ICT use for storing and processing messages create the potential for using aggregated data to protect national security and secure commercial competitive advantage.

An overarching issue here is how learning progresses in a manner that encourages trust. Building trust in e-services within all ICT user groups is essential to stimulate demand. Trust in existing commercial models of information and content delivery, and in emerging 'peer to peer' models, continues to require learning experiences that are built up as a result of using e-services.

2.5 Learning as the Weak Link in the Diffusion Pathway

A wide range of factors can retard or stimulate the effective and efficient use of ICTs, especially when private sector firms, public sector organisations, and individuals are in a relatively early phase of the learning process. [33]

Learning which supports skill and competency building is a key factor in the ICT adoption process. Empirical evidence on ICT take-up often simply measures access levels. However, it is necessary to assess how ICT use varies in terms of its efficiency and effectiveness and its impact on the economy. To do so, we need to examine the

different contexts of use and the extent to which they encourage the accumulation of required skills and competencies.

The micro-level evidence from case studies provides insights into how ICT use is affected by the learning process. Assessing the strengths and weaknesses of these learning (skill and competency) processes and their impact on ICT use and demand patterns is not always straightforward. Although considerable amounts of case study data exist, many of these employ inconsistent methodologies. The results often involve local factors that confound the interpretation of causal links between learning processes and their impact on ICT use.[34]

The next section applies the framework set out in section 1 to examine the evidence on diffusion pathways and the economic impact of ICTs that emerges from an assessment of the case study evidence.

3 Diffusion Pathways and ICT Impacts

3.1 Introduction

Micro-level evidence provides a rich resource of information to examine the factors that give rise to alternative ICT pathways and differential impacts. These factors differ for private sector firms, public sector organisations, and households and individuals. Many case studies provide indirect evidence of ICT impacts. These sometimes report respondents' assessments of whether access to ICTs enables them to become more effective or efficient. This evidence provides some insight into how the main ICT user segments assess the impact of ICT use. It also provides an indication of how ICT use may change.

The analysis in this section reviews a reasonably large sample of case studies and other sources of micro-level data on the use of ICTs by private sector firms, public sector organisations, and households and individuals. The focus is on impacts and reported barriers to, and drivers of, more effective and efficient use. For each user segment (firms, government, households and individuals), key themes are extracted from the data.

By 2003, it is expected that western Europe's most active sectors in e-commerce and related ICT services, in order of importance, will be: financial services, discrete manufacturers, retail and wholesale traders, insurance, government, communications, transport, services, utilities, process manufacturers, health care and education.[35] Developments in business-to-business (B2B), business-to-consumer (B2C) and business-to-government (B2G) services, based on the public Internet and on private networks, will create demand for ICT investment and increased network capacity. Whether positive economic impacts are achieved depends upon how effectively and efficiently the new technologies are used.

In the following, we assess business use of ICTs (section 3.2). This is followed by an assessment of government use of ICTs (section 3.3) and household and individual use (section 3.4). Section 3.5 provides an overall assessment.

3.2 Business Use of ICTs

There are many studies of the way industrial value chains are being affected by electronic networks, and specifically, by the implementation of Internet-enabled services.[36] The majority of case study research on firms and ICT use in the UK and most of western Europe has been conducted at the sector level. The following accounts for over one hundred UK and European Union sector level case studies and a selection of firm level studies. Combined, these encompass the experiences of just over three thousand firms.[37]

3.2.1 Key Factors

In the UK, as in many OECD countries, most Internet sales are business-to-business (B2B) transactions, predominantly in the financial sector. Total e-commerce sales in the UK in 2000 amounted to £56.6 bn (2 per cent of total sales) of which the financial sector is estimated to have contributed £43.74 bn (77 per cent).[38] The remaining sectors were wholesale, retail, catering, and travel (£7.61 bn or 13 per cent), manufacturing (£3.99 bn or 7 per cent), and computing and other business services (£1.28 bn or 2 per cent). Less than one-fifth of e-commerce sales were made to households, the business-to-consumer (B2C) segment of the market. For 2000, an estimated £10 bn worth of goods was sold to households, falling to just over £1 bn once sales in the financial sector are removed.

E-commerce transactions are increasing in value, but they are a small proportion of total sales. Relative to the other OECD countries, Britain's retail e-commerce performance is strong.[39] The B2C segment of the e-commerce market is expected to remain substantially smaller than the B2B segment at least until 2005 in Europe.[40] In the UK, the B2C segment is forecast to grow by 65 per cent to 43.4 bn and the B2B segment by 68 per cent to 256 bn. This would establish the UK as the second largest European Union 'e-commerce' country after Germany.[41]

The growth of online transactions is influenced by the rate at which firms move along the diffusion curve. The 2001 e-commerce business survey for the UK shows that ICT usage intensity varies among firms according to their position on an 'e-adoption ladder'.[42] Large disparities exist in private sector firm ICT use.[43]

The majority of firms have adopted the basic uses of ICTs but very few have reached more sophisticated levels of usage. At the basic level of use, adequate learning to achieve effective and efficient outcomes seems to be occurring. However, to experience greater economic impacts, firms will need to move further on the 'e-adoption ladder'. The aim to get businesses 'online' in the UK was achieved by 2001 with 94 per cent of businesses having access to the Internet, but more effort is needed to build on this baseline.

The UK E-Commerce Awards Programme provides some indication that ICT take-up levels are increasing among firms with less than 250 employees. Applications to the Programme increased more than eightfold from 198 to 1,683 between 1998 and 2001. In 2001, most firms applying were micro-businesses (993 or 59 per cent) operating at the lower end of the 'e-adoption ladder'. Firms transacting via the Internet (201 or 12 per cent) and those involved in practices designed to 'improve or transform' their businesses (237 or 14 per cent) accounted for a relatively small proportion of applicants.[44] Although participation is small (0.5 per cent) in proportion to the total small and medium-sized business population (3.66 million[45]), these figures are impressive for their growth rate.

To encourage firms to move up the e-adoption ladder, policy measures are needed. Network capacity bottlenecks and prices that discourage use of higher capacity networks will slow the learning process. The business areas most likely to encourage more sophisticated use of electronic networks include purchasing, marketing and sales, and finance. The UK ranks third in Europe in the purchasing sector, second in marketing and sales, and fifth in finance for the take-up of e-commerce. ADSL rollout is expected to drive the further growth of e-business services.

3.2.2 Case Study Evidence

Sector level case studies in the UK indicate that the impact of ICTs on sectors and on firms is strongly influenced by industry specific dynamics. These include inter-firm operating practices and product characteristics. [46] European sector case studies also reveal mixed results in terms of reported impacts of ICT use. Firm level case studies provide greater detail on impacts, but there is even greater variation. Overall, the evidence confirms that technology *per se* is not the crucial factor in promoting more effective or efficient ICT use.

ICTs are tools that businesses can apply to achieve their aims. The most important drivers of firms' decisions about ICT use are the business benefits they expect to achieve. The main expected benefits reported by firms as a result of increased use include:

1. Cost reductions accruing to firms;
2. Increased transaction speed and reliability;
3. Improved management capabilities;
4. Improved collaboration capabilities;
5. Stronger interdependencies within upstream and downstream markets; and
6. Better customer relations management (CRM).

The case study evidence shows mixed results with respect to these benefits. Many firms report that they have yet to experience most of the benefits expected. Firms that report positive impacts generally have invested considerably in learning and organisational change strategies. The impact of the use of e-commerce,

> … does not seem to depend greatly on the availability of or access to e-commerce technologies. Rather, it depends on the important material and human investments needed as well as reorganisation and the amount of time required to generate and circulate knowledge about how the new technologies and systems work … hindrances and delays to entry are due more to the learning process, "second entry" strategies and investment in reorganisation than to the price of hardware and communications.[47]

The case study evidence emphasises the importance of human investments, organisational change, and time to achieve the benefits of ICT investment. These factors are particularly evident in the take-up of B2C e-commerce in the banking and financial services sector. There is a lengthy period of consumer learning to build trust in online services.[48] The research evidence highlights barriers internal to firms as well. Effective and efficient use of ICTs are not likely to be achieved in the face of negative senior management attitudes and a lack of appropriate in-house workforce skills. Pessimistic attitudes and negative experiences of some small and medium-sized enterprises also slow progress up the adoption ladder.[49] The role of 'change agents' in fostering trust and in

providing customised training is vital for improving ICT adoption rates, especially among micro-businesses.[50]

In the B2C segment, too few online customers and insufficient development of secure servers are inhibitors to the growth of ICT use. The UK trails behind eight OECD countries in the latter respect.[51] The B2C segment may only be viable for goods and services with high search costs and experience qualities. Generating trust through brand recognition and providing adequate consumer protection are key drivers in this area.[52] The need to build trust and confidence for e-commerce is emphasised in many case studies. There are frequent illustrations of how difficult it is to achieve trust even when a firm has a strong brand reputation.[53]

One European investigation of online shopping concluded that, 'the current problems on the supplier side relate largely not so much to technology, but rather to reliance on old infrastructure and business practices not designed and developed for trading in an electronic environment'.[54] Encouraging the spread of B2C e-commerce is an incremental process that builds on users' positive experiences. Some of the reported impacts of e-commerce in the case study literature for various sectors are highlighted in Annex B.

In some areas, e-commerce strategies may reduce opportunities for firms to participate in online trading. If ICTs are used to create closed e-commerce systems for members of buyer and supplier 'clubs', firms that are excluded from the business value chains have less incentive to use ICTs. In the transport and logistics industry large firms are implementing e-commerce for key clients, but their Internet sites are mainly closed to firms that are not members of their alliances or client base.[55] Studies have shown that, '…where there is an established basis of market power - i.e. where a dominant supplier and/or customer is in a position to motivate and control relationships in the value chain – e-commerce does not alter this arrangement significantly'.[56]

Firms that are not tightly linked into value chains often report that e-commerce participation is unlikely to have a positive impact on their businesses. ICT use to support e-commerce is more likely to lead to 'lock-in' for smaller firms operating in markets for tangibles. Smaller firms may be forced to participate in e-commerce by other firms that dominate the supply chain. In some cases they are forced into electronic trading as a condition of contract.[57] Firms that are not involved in these relatively closed networks are expected to benefit from the use of e-marketplaces. Recent evidence suggests, however, that it will be some years before these Internet sites reach the mature phase of development needed to serve as a strong stimulus for ICT investment.[58]

3.2.3 Overall Assessment

The most common factors reported in the sector and firm level studies accounting for differences in the impacts of ICT use, are clustered into the four themes as shown in Table 2.[59]

Table 2 Importance of Key Factors in ICT Use for Private Sector Firms

Factors	Firms	Households / Individuals	Government
Firms:	**B2B: E-Commerce**	**B2C: E-Commerce**	**B2G: Coordination**
Learning	High	High	Medium
Cost	Medium to Low	Medium	Medium
Safety	Medium	High	Low
Technology	Low	Medium	Low

Source: Adapted from Coppel (2000), OECD Economics Department Working Paper.

Positive impacts of ICT use in terms of gains in effectiveness or efficiency arise from: 1) investment in learning, 2) strategies to reduce the costs of organisational change, 3) measures that enhance the perceived safety (privacy, security) of networks and online transactions, and 4) the extent of advanced ICT use. The relative importance of these factors varies for firms, government, and household and individual users.

The positive impact of ICT use in the context of *B2B e-commerce* is extremely dependent upon whether learning occurs alongside the use of new technologies. The 'high' importance of learning is linked to: 1) the need to increase applications skills at the individual level, and 2) the need to encourage accepting attitudes to the use of ICTs. Smaller firms are more concerned about the cost of ICT implementation than with the cost of acquisition. Concerns about the type of technology may increase if B2B e-commerce develops without a parallel increase in the availability of bandwidth capacity. Safety issues are a 'medium' concern but could increase as businesses progress up the e-adoption ladder.

For *B2C e-commerce* the evidence suggests that learning is of 'high' importance. If learning is neglected and there is insufficient focus on user benefits, the economic impact of B2C e-commerce developments is reduced. The growth of B2C e-commerce has been slowed by relatively low penetration of Internet access and by uncertainty about how the 'shop window' can be translated online. Technology is relatively more important in this segment than in the B2B segment. In the B2C segment, concerns focus on developing effective user interfaces. Cost and safety factors generally are 'medium' and 'high' concerns, respectively, in this segment.

The case study evidence indicates that learning is a 'medium' concern for *B2G e-commerce.* However, substantial effort is needed to persuade firms, and especially smaller firms, to switch from paper-based to e-government services. Factors relating to safety and technology are 'low' concerns as compared to concerns about the cost of capital investment and business reorganisation. Firms also appear to be concerned about pressures on time if they move to new ways of transacting with government before the benefits are clear.

3.3 Government Use of ICTs

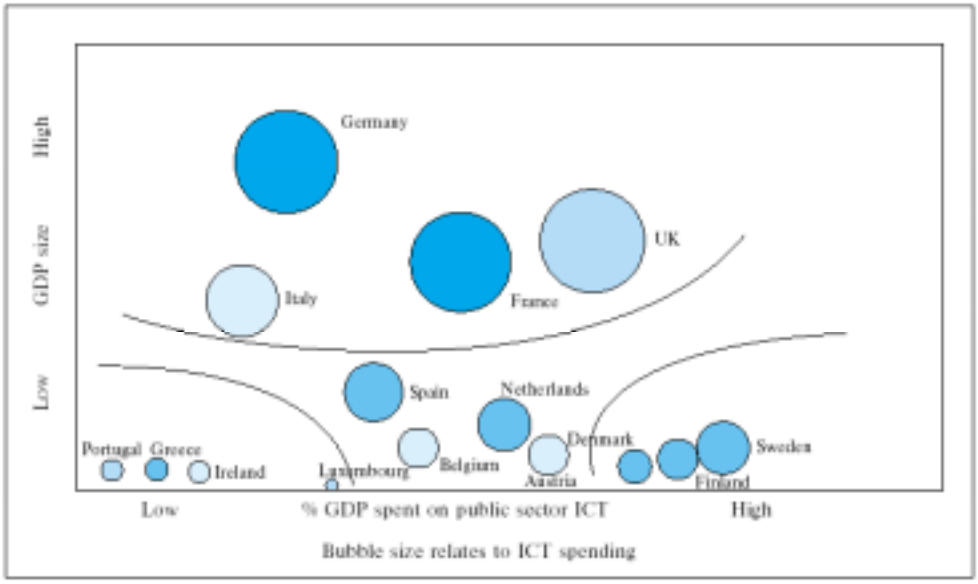
There are fewer case studies on e-government than on the development of e-business services. Even fewer studies focus on ICT use which encompasses all types of public sector organisations. Most studies focus on national, rather than regional or local, government initiatives. In addition, there is little clarity in the literature as to the definition of e-government services.

3.3.1 Key Factors

E-government participation rates vary less among the European Union countries than between these countries and the US. All European Union countries, except for Greece, are classified in the United Nations 2001 global benchmarking report as having 'High E-Government Capacity'. [60] The UK has the highest index rating (2.52) of all European Union countries, sixth from the US (3.11). The US is rated as the most e-enabled country of the 190 UN members. This index incorporates an assessment of a country's official online presence, its telecommunication infrastructure, and its human development capacity. Overall, 2001 saw a greater increase in e-government service provision than during the previous five years combined. [61]

The UK's strong performance in this area can be attributed to its national strategy and to its level of ICT spending. The UK was one of the first countries to dedicate resources to establishing a centralised, high-level government unit for advancing ICT use. This approach appears to be more effective than the fragmented or ad hoc approaches adopted elsewhere. ICT spending in the UK on public administration is strong, relative to its overall GDP size (see Figure 1).

Figure 1 ICT Spending on Public Administration in EU Member States, 2000



Source: (EITO) 2000

However, studies of ICT-based public services in Germany, Italy, Belgium, and Finland suggest that success is more likely in projects that begin from small-scale process

innovations and that are driven by the efforts of local administrations.[62] The more successful projects are implemented in parallel with regulatory and policy changes. The evidence does not provide a basis for assessing changes in the effectiveness or efficiency of service delivery. It does show that the learning curve to implement e-government services is extremely long. It is also difficult to transfer knowledge about service development from one locality to another.[63]

ICT use, in support of e-government services is expected to follow an e-adoption ladder. Benefits are expected to accrue to government and to users as progress is made to: 1) establish a basic official website, 2) extend the non-interactive website presence, 3) provide limited interactivity, 4) provide transaction capability, and 5) provide 'one stop' interactive services.

Most governments, including the UK, are on the first rungs of this e-adoption ladder. A census of all central government sites in the UK in 2001 for the National Audit Office shows [64]

> … some areas of considerable progress on basic features since 1999, and a few transactional capabilities developing. But there has been little progress yet on more sophisticated electronic publishing or interactive features. A second study undertaken of the usage of central departments' Web sites shows that there are marked variations between departments in the extent to which their Web traffic has grown, assessed against the background expansion of Internet usage in the UK. [65]

Patterns of e-government provision vary across government segments. Across western Europe, complete G2B transactional services are less widely available (20 per cent) than in the G2G (35 per cent) and G2C (31 per cent) segments. As of 2002, Germany, France, Denmark, and Portugal have the most developed G2B markets. According to a major survey, [66] European firms expect e-government services that will support their online transacting and improve their competitive strength. The most important G2B e-services identified were online tax return services, followed by e-procurement, employment-related e-services, and information services.

3.3.2 Case Study Evidence

The mechanisms that encourage or discourage the take-up of e-government services are varied. G2B use is expected to lower costs and increase transaction speeds. Increased ease of use and promotion of services by government are also expected to promote take-up. The main G2B inhibitors are the slow take-up of digital signatures (20 per cent), security (20 per cent), the costs of replacing existing information systems (15 per cent), lack of infrastructure (10 per cent) and lack of broadband access (5 per cent). High costs and organisational barriers are also reported problems. UK case studies on HM Customs and Excise and the Department of Transport, Local Government and the Regions (DTLR) illustrate how these concerns, particularly regarding security and replacement or upgrading costs,[67] apply to the G2B and G2C segments.

Developments in the G2C and G2G segments are expected to modernise government by enhancing the efficiency of service delivery and the effectiveness of government. ICT use in these two segments is also expected to reshape the democratic process and to enable direct public service delivery to citizens. [68]

The potential for e-government to re-engage citizens in the political process and to reduce inefficiency in government bureaucracy is discussed widely in the literature. Some evidence suggests that e-government service development is being driven mainly by technology rather than by the needs of firms and citizens. For instance, research on ICT implementation in local government in the UK suggests that too much emphasis is given to the functional application of service *delivery*. It is suggested that too little emphasis is given to the way that e-government services restructure the decision-making process. The design of e-services may be inconsistent with the aim of achieving increased transparency.[69] However, some local government initiatives are integrating e-commerce, e-work and tele-democracy by involving users and technology designers in a positive cycle of learning.[70] Overall, implementing ICTs in ways that involve users requires changes in policy that are relatively slow and incremental.[71]

Citizens can be encouraged to use government web sites when G2C services are up-to-date, easy to access, accurate, and reliable. Attitudinal barriers include low expectations of government and a lack of trust in government-based information. G2C use is also hampered by the costs incurred by users to transfer to an e-government service and a lack of clear evidence of user benefits. G2C e-services also need to be adapted so that they are integrated into citizens' daily routines.

Studies show that 'those who already use computers at home or at work are more likely to be prepared to use new technology to deal with government'.[72] 'The digital divide is not so much a question of access but of education'. A major driver of effective and efficient use of e-government services is skill and competency development.[73] For example, experience of developing virtual town halls in Germany shows the need to develop electronic signatures, standardised platforms for online transactions, and user-friendly services.[74]

The G2G case studies suggest a common barrier to the efficient and effective deployment of e-government services. There is strong resistance to changing organisational processes and work practices when ICTs are implemented. This is attributable to traditional organisational cultures and values and to weak demand and rivalry between service delivery channels.[75] Rivalry in the public sector can hold back the use of ICTs to support e-government services because of the perceived risk of job displacement. A review of ICT use in the UK's social security, health care and social services sectors suggests that 'conflict between different elements of the (policy) community has hampered the government's attempts to utilize ICTs in service management and delivery'.[76] Positive ICT impacts will be limited or absent if public service workers resist changes in the way services are delivered.

3.3.3 Overall Assessment

The importance of the four main themes - learning, cost, safety and technology – is indicated in Table 3 for each of the user groups. The impact of e-government services on the economy depends on whether efficiency gains are achieved in transactions and whether e-government services result in 'joined-up' government services.

Table 3 Importance of Key Factors in ICT Use for Government

Factors	Government	Firms	Household / Individuals
Government:	**G2G: Co-ordination**	**G2B: Information**	**G2C: Information**
Learning	High	High	High
Cost	Low	Medium	Medium
Safety	High	High	High
Technology	Low	Medium	Low

Source: Adapted from Coppel (2000), OECD Economics Department Working Paper.

For *G2G e-government services* there is evidence of substantial change in recent years aimed at introducing ICT support. However, there is also evidence of continuing resistant attitudes and behaviours. These attitudes and behaviours limit the spread of e-government services and the rate of movement up the 'adoption ladder'. Measures to break down organisational barriers are necessary for successful implementation. Local initiatives also tend to be evaluated more positively in terms of impacts. Cost is identified as a 'medium' concern. Devices to ensure secure services are considered to be of 'high' importance. Developments in this area could promote transacting online. Technology *per se* is considered to be of 'low' importance. However, if technology is defined to include software, it may be a more important concern because of the need to replace or upgrade existing information technology-based systems.

Studies of *G2B e-government services* indicate that substantial changes are underway and that resistant attitudes and behaviours also limit provision. Firms appear to be cost conscious but there are growing signs of a willingness to transact electronically. Cheaper, quicker and safer solutions for conducting routine transactions with government, especially in the e-procurement area, are likely to drive growth in this area.

The progress of *G2C e-government services* relies on fostering an organisational culture in government that is citizen-centred. Learning in this area is of 'high' importance and training for ICT use in government departments needs to reflect this. A lack of confidence and trust in government is a reported barrier to G2C e-services. Growth depends on building a sense among citizens that e-government services are relevant to their lives. E-government services must offer an efficient means of interacting with a wide range of public services. Reducing the costs to users of a shift from off- to online services and providing secure systems are more important for individuals than are the technology factors.

3.4 Household and Individual Use of ICTs

Case studies of the impact of ICTs at the household and individual levels are relatively rare as compared to other areas. Micro-level data are available which suggest how Internet usage is spreading but it is difficult to assess direct economic impacts. Research

is needed on changes in the patterns of individual and household consumption of digital services of all kinds.

The evidence base for understanding how ICTs are evolving with individual needs and with learning based on experiences with earlier technologies is very weak. The features of ICT use that are likely to be perceived as most effective or efficient from the citizen or consumer perspective, or from the supplier perspective, are uncertain. This deficiency in the evidence base needs to be addressed to reduce the risk of misdirecting investment into e-services that will not achieve a critical mass of users or bring the expected positive economic impacts.

3.4.1 Key Factors

In the UK, as of April 2002, 55 per cent of adults had accessed the Internet for personal use. Most adults access the Internet (99 per cent) via a personal computer (PC) in their homes. Internet access at multiple access points was evident (4 per cent) but infrequent. In February 2002, mobile phones (6 per cent) and digital television (5 per cent) were providing complementary access devices.[77] Nearly half of homes in the UK (46 per cent) were connected to the Internet and if a person owned a PC, it was very likely to be connected to the Internet.

A 'digital divide' continues to persist in the UK. The population that is most affected is over 55 years of age and has the lowest socio-economic standing in terms of education and income. In comparison to the average take-up for the population overall, this group lags behind in terms of the percentage of homes with Internet access by one half of the proportion of the population that it represents.

Table 4 Demographic Distribution of Homes with Internet Access

Demographic	% Homes with Internet Access	% of UK Population
55+	16	32
Lower Socio-economic groups D and E.	14	28
Income up to £17.5K	25	50

Source: Adapted from Oftel Residential Survey Q8Feb2002

Although adults in the UK over the age of 55 represent 32 per cent of the population, only 16 per cent have Internet access in their homes (see Table 4). This has not changed since August 2000. For home Internet access to better reflect the population distribution, a change will be needed.

By 2005 some 67 per cent of the UK population is expected to be accessing the Internet, [78] representing an 11 per cent growth rate from 27.3 m in 2002 to 40.8 m. This would rank UK Internet penetration as second highest in western Europe. However, Internet penetration in the UK is also forecast to grow at a relatively slow rate (11 per cent), but faster than the Nordic countries at 8 per cent. In 2001, the Nordic countries also had the highest penetration rates and are expected to maintain this position in 2005 (78.2 per cent).

Average Internet household usage time in the UK, as a measure of user intensity, is showing signs of increasing. A small group of heavy users (8 per cent > 30 hours per week) partly skewed average weekly usage upwards from 8 to 9 hours in February 2002. As user intensity increases, awareness of technologies that permit more advanced usage also appears to increase. The longer an individual is on the Internet, the more likely he or she is to transact online. Households are also moving towards using fully un-metered packages (May 2001 - 7 per cent to February 2002 - 32 per cent). Internet service provision in the UK residential market is becoming more concentrated, a development that may influence access costs in the future. By February 2002 Freeserve had a 21 per cent market share, BT a 20 per cent share, AOL a 17 per cent share, and NTL an 11 per cent share.

Demand for broadband services such as asymmetric digital subscriber lines (ADSL) and cable modems is strengthening. Between November 2001 and February 2002, there was a switch away from ISDN (9 to 3 per cent) towards ADSL/Cable Modems (7 to 8 per cent) and the use of ordinary telephone line access (83 to 88 per cent). Price is an important factor in stimulating broadband take-up. BT's price reductions for wholesale DSL products in April 2002 are filtering into the retail market. ADSL take-up by consumers and small and medium-sized enterprises rose from 136,000 to 290,000 subscribers over the six months to June 2002. Cable Modem subscribers increased from 196,000 to 419,000 over the same period.

Western Europe experienced a substantial increase in ADSL subscribers during 2001 to nearly five million, of which 40 per cent were in Germany. In the US, with 1.5 million new ADSL lines, growth was lower than expected. The total number of ADSL lines reached 3.8 m in 2001. In Asia the leader is South Korea with over 4 m lines.[79] Cable offers an alternative to ADSL to more American consumers than it does to western Europeans. In the US, cable services accounted for 60 per cent of broadband users (5 m) in 2001, but for only 28 per cent of western Europe's users (2 m). Developments in the cable sector are likely to make it easier to manage the quality of service and to increase bandwidth and this should strengthen the prospects for cable operators in the UK. [80]

The growth of demand for Internet access and use is affected by the regulatory treatment of wholesale and retail pricing. Studies comparing differences in Internet access pricing in the European Union and the US indicate that price is a key defining factor of consumer demand.[81]

The UK has been at the centre of the 'free' Internet. Unlimited local call flat rates for Internet access were introduced by BT in the UK in June 2000. According to the ONS Internet Connectivity Index,[82] as of April 2002, free access subscriptions were declining as a proportion of total subscriptions at a rate nearly identical to increases in fixed rate subscriptions for un-metered access. This indicates changing price sensitivities or differentiation in the access plans being offered, the later being a more likely explanation. Willingness to pay for Internet access coincides with a shift from dial-up towards permanent Internet connections.[83] This change is relatively new and the shift is small so far. But this may be an early indicator of readiness among some users to move to higher consumption levels that will drive demand for network capacity.[84]

Oftel research indicates that more intense Internet users seem to be willing to increase their spending in order to enjoy the added value of broadband. [85] The main added value

seems to be the ability to access the telephone and the Internet simultaneously. A July 2002 report commissioned by the Department of Trade and Industry and the Digital Content Forum (DCF) identifies price as the most important factor in driving broadband take-up. However, content development is also an important factor in significantly expanding broadband take-up beyond present levels.[86]

Incentives will be needed to stimulate broadband product and service delivery. There is uncertainty about how the advertising, pay, and public service fee paying revenue models will compete.[87] Increasingly 'real' interactivity, the use of personalisation tools and enhanced services for advertisers, and the growth of online banking and ordering, and interactive games are expected to stimulate the market.

Demand for mobile devices combining functions such as the telephone, Personal Data Assistants (PDAs), and Global Positioning Systems (GPS) is also expected to stimulate market growth. 'Always on' services are likely to change the balance between work and leisure time and influence people's mobility. The adoption of 'smart home' technologies is also expected to expand as costs decline and devices become modular, expandable and up-gradable.[88] Growing familiarity with electronic services will enhance skills and competencies. This should drive demand for new services and access to higher capacity electronic networks.

3.4.2 Case Study Evidence

Micro-level research in Europe suggests that mobile telephony users are incorporating this technology into their lives in many different ways. In the UK, in-depth research suggests that people associate the mobile phone with morality (with a moral economy where use is related to concepts of the self that heighten awareness of moral obligations), greater efficiency, productivity, and independence, and a desire to aspire to the upper-middle class.[89] In Finland, the rapid adoption of the mobile phone is perceived to be challenging Finnish linguistic culture, self-images, and the characteristics of the social environment.[90]

However, research on young people's assimilation of new media suggests that the use of multi-channel television, the PC, and the Internet rarely radically changes their lifestyles.[91] New media use does appear to affect the social environment by redefining private and public consumption patterns. The diversification of media forms and content also enables access to local and global experiences. Technology convergence seems to alter traditional social boundaries such as between home and work, entertainment and information, and education and leisure time. In some cases, the use of interactive technologies seems to blur the user's experience of the 'real' and the 'virtual'.[92] Developments of this kind are expected to combine to increase demand for access to electronic networks.

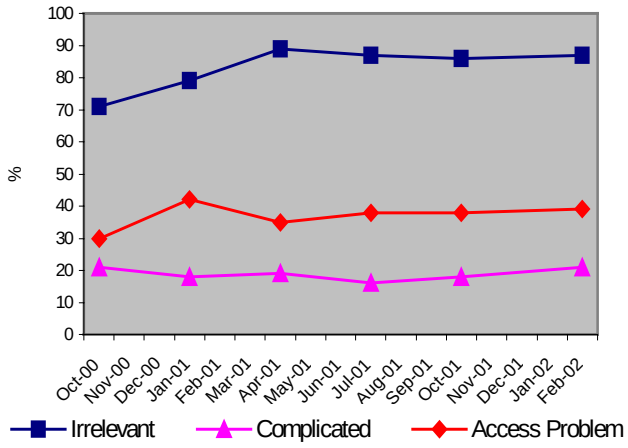
E-government and e-learning services are also expected to stimulate demand in the consumer marketplace. A study covering 27 countries, including the UK,[93] indicates that individuals follow a progressive adoption curve. The majority of Internet users are 'information seekers' (20 per cent). Another 9 per cent are 'downloaders' who print government forms, 7 per cent are personal information providers and a further 6 per cent are 'transactors' who are willing to make payments online. The UK is lagging behind other European countries in moving citizens along this adoption curve. Safety (with respect to providing government with personal information or making payments)

was a concern for 64 per cent of those included in the survey. But 'transactors' (63 per cent) and 'non-users' (62 per cent) had similar concerns for safety, suggesting that this factor may not continue to be a substantial barrier.

Evidence on barriers to the more extensive use of ICTs by individuals suggests that several factors are important. An absence of need and interest; preferences for shopping in person and seeing the product; security concerns about payments requiring credit card details; privacy concerns; and trust relating to receiving and returning goods bought online, are principal barriers to expanding use.[94]

In the UK, reasons for not accessing the Internet for personal use are shown in Figure 2.

Figure 2 Barriers to Personal Internet Use



Data Source: ONS StatBase

The biggest barrier for non-users is the perceived 'irrelevance' of the Internet. 'Irrelevance' is associated with non-users' lack of interest. Some report feeling too old, not wanting to use it, not having 'got round to it yet', and having a poor opinion of the Internet. A 'complicated' assessment is associated with a lack of confidence and skills. 'Access problems' are associated with lack of access to a computer, inability to afford access, lack of time, and with health problems that make access difficult.

The most frequent Internet user today is young, single, and in a higher socio-economic band. This user mainly accesses the Internet from a home PC to seek information and to use e-mail. This 'average' user is increasingly ordering or buying goods or services online and is as likely to be female as male. The least frequent Internet user is an older individual and from a lower socio-economic band.[95]

Current patterns of individual and household use of the Internet and other electronic networks illustrate that individual use is dynamic and fluid. However, some features of non-use seem likely to persist and to exclude some individuals from benefiting from e-services.

3.4.3 Overall Assessment

Table 5 provides a summary of the importance of the key factors – learning, cost, safety and technology – for ICT use by individuals and households.

Table 5 Importance of Key Factors in ICT Use for Households / Individuals

Factors	Government	Firms	Household / Individuals
Households / Individuals[1]	**C2G: Tax procedures**	**C2B: Price Comparison**	**C2C: Auctions**
Learning	High	Medium	High
Cost	Medium	Medium	Uncertain
Safety	High	High	Uncertain
Technology	Low	Medium	Uncertain

[1] Households / Individuals are denoted as 'C' referring to consumer in the OECD model.

Source: Adapted from Coppel (2000), OECD Economics Department Working Paper.

C2G e-commerce is becoming an option for individuals in the UK but citizens and consumers will need convincing that changing their mode of receiving government services will benefit them. Enticing individuals onto the web requires a reduction in the costs of learning new ways of accessing e-government services. Some evidence suggests that e-government service development is starting with services that add the least value from the individual's perspective. However, accumulating experience may persuade individuals to engage more intensely with these services. Citizen use of e-government services as a means of enhancing democracy is in the experimental stage. Safety, in terms of privacy and secure transactions, is a high priority concern. Once people begin to use online services, these concerns seem to decline. Individuals appear to be willing to experiment when costs are reduced and when attractive content is available.

The limited evidence on the impacts of *C2B e-commerce* suggests that learning efforts need to be supplemented by cost reductions and secure transacting environments to stimulate growth. Signals of security provided by respected brands are helpful, but a perceived lack of relevance of ICT use persists among some people. In addition, learning opportunities need to be tailored to the specific levels of skill in user groups if they are to be effective. A key difference in take-up between C2B and C2G services may be related to the voluntary versus involuntary nature of participation, but this requires further study.

C2C e-commerce is a relatively uncharted area. Further investigation is needed to understand how this segment will progress. There are some indications that consumers prefer to transact via intermediary firms rather than to enter into direct transactions with private individuals on line, at least for some goods and services.

3.5 The Potential of ICT and its Impact

There is a key message that applies across all three ICT user segments – firms, public sector organisations, and households and individuals. The impacts of ICT use in terms of effectiveness and efficiency depend on social, economic, political, cultural, organisational factors. This makes it difficult to make clear statements about the impact of ICT investment on the economy as a whole. A recent study observes that:

> The relationship between technological change and social transformation is now acknowledged to be a complex one, and the simple notion of technological changes having social [and economic] effects, which in turn can be simply controlled by appropriate policies, has now been shown to be false. [96]

Electronic networks are being used to reorganise time and space relationships. These networks offer greater data storage capacity, new opportunities for participation in the economy, and new types of interactions and uses of digital information.[97]

For *private sector firms*, ICT use (and access to electronic networks) enhances the relationships between firms with respect to products and services that they already produce. In some cases, firms can commercialise specific information assets by using the new technologies. A major impact of the growth of e-business is that firms need to put new learning processes in place. There are strong signs that investment in learning can enable firms to move more rapidly to higher rungs on the 'e-adoption ladder'.

Value chains for products with a relatively fixed degree of value-added – as in automobiles – are highly integrated and the scope for new forms of e-business is limited. But in sectors where there is scope for new products and services in the value chain – publishing and food – firms are moving more quickly to adopt e-business. This is likely to stimulate demand for electronic networks. Most businesses in the UK are using basic forms of e-commerce. But even with narrowband connectivity, firms are experimenting with new applications. Where firms invest in skills and competencies and introduce new e-business services, their assessments of the benefits in terms of effectiveness and efficiency tend to increase.

The biggest challenges for *government* are resistance to organisational change and the lack of perceived relevance of the new services. The cost of switching from off- to online services is a key barrier for users of ICTs. This will need to be addressed to promote faster progress on the 'e-adoption ladder'. Technology does not feature as a major barrier. But greater ease of access and lower cost access to electronic networks are likely to stimulate use of e-government services.

For *households* and *individual* users of ICTs, the adoption pathway is unclear. Very few micro-level studies (apart from the marketing field) examine ICT adoption and its impacts from the individual perspective. Most studies examine basic demographic information to indicate how ICT use impacts on people's lives. There are many hypotheses to investigate, but there is very little rigorous research so far.

4 Policy and Regulatory Priorities

4.1 Introduction

Multiple factors account for differences in ICT diffusion rates and usage patterns among private sector firms, public sector organisations, and households and individuals. The economic impact of the spread of digital ICTs is influenced by many intervening factors. The most significant of these is the length of the learning curve needed to optimise the benefits of ICT use. 'Learning by doing' to develop knowledge is essential. First hand experience is necessary to take full advantage of ICTs.[98] This applies to the use of electronic networks and to all segments of users.

The micro-level evidence shows that an indirect relationship exists between ICT investment, increased connectivity, and the achievement of a critical mass in the marketplace. Users who move along the 'e-adoption ladder' are more likely to report positive economic and other socially related impacts.

The intention at the outset of this project was to use the analysis of the case study evidence to highlight factors that appear to account for differences in the effective use made of electronic networks by different types of company by size and by household income. With respect to companies, those sector level studies that have sought to select a stratified sample of private sector firms, tend to reveal that size is not a key determinant of innovative capacity in the use of ICTs. Although there is some evidence that smaller firms have a weaker skills base and fewer resources to invest in technology and human resource development, there are illustrations of smaller firms that are moving as rapidly as larger firms along the e-adoption ladder. The differentiating factor consistently is willingness to invest in learning, awareness building and organisational change.

With respect to households, there are a few detailed case studies of household use of ICTs in the UK that were undertaken in the mid to late 1990s. These provide a complex picture of the varied social uses of ICTs within single parent, elderly, and other household types. However, this work did not attempt to assess the effectiveness or efficiency of ICT use.[99] More recently, surveys have been undertaken to examine the penetration of ICTs into households differentiated by income level and other socio-demographic indicators. It can be said that lower-income households appear statistically to be somewhat heavier users of Internet access once they are connected. However, the evidence is not sufficiently robust to draw conclusions about the factors that may explain observed differences in the aggregated data. While we are beginning to be able to monitor types of ICT use and the intensity of use, there are no sufficiently large or consistent samples of case studies that would provide explanations of key factors contributing to effective use or enable an assessment of differentiated impacts at the household level.

Our assessment of the evidence overall suggests that policy measures are needed to reinforce the demand side of the ICT market. Such measures are needed to underpin the UK government's ambition to achieve a strongly knowledge-driven economy. Priority areas include:

- Learning for skills and competency development aimed at breaking down entrenched attitudes and modes of behaviour that lead to resistance to ICT use.
- Reducing constraints inhibiting a fair and efficient e-service delivery market from evolving. These constraints relate to access to learning as much as to access to technology and ability to pay.
- Monitoring economic impact as a result of ICT investment using methods that capture the micro-level experiences of users.

4.2 Learning for Skills and Competency Development

The link between ICT investment and its impact on economic growth is indirect. Skills and competency development through learning are central to increasing the rate of ICT (and electronic network) adoption, and to their effective and efficient use. Policies aimed at promoting a broader distribution of the skills base are likely to strengthen ICT demand.

The *costs of transition* to a knowledge-driven economy are considerable. These costs are nearly always underestimated and they largely relate to learning. The costs of organisational change in the public and private sectors, and for individual users to change behaviour to adapt to online interactions, are significant. Micro-level research repeatedly shows that large numbers of potential ICT users resist these new opportunities. This is because of perceived threats to established routines and customs, and to existing preferences for work organisation and the use of leisure time. However, the evidence also suggests that, as skills and competencies develop, there is a reduction in these perceived threats.

Learning involves a complex process of knowledge accumulation. This leads to change that shapes the effectiveness and the efficiency of ICT use.[100] This is a key differentiator of the pathway towards greater ICT use and its positive economic impact. Understanding how new routines, skills, and competencies develop is essential to an explanation of variations in the effectiveness and efficiency of use of ICTs, including electronic networks.[101]

Research suggests that variations in ICT impacts across countries and sectors are associated with local learning opportunities, e.g. in the household, private sector firm or public sector organisation.[102] For example, an analysis of the economic impact of ICTs in Norway found that, '…insofar as ICTs are important aspects of innovation activities, the *distribution of ICT competencies is of crucial importance* to understand actual and future innovative capability' (emphasis added).[103] Another study shows that technologies, such as mobile telecommunications, are associated with 'learning regimes' that must be in place for the successful rollout and take-up of services.[104]

Investment in learning is crucial. Policy action is important because deficits in the skill and competency base relative to other countries will slow the use of ICTs in the UK and give rise to ineffective and inefficient usage patterns.

Learning opportunities are particularly important for::

- Encouraging the 'peer-to-peer' model of content creation and exchange, alongside the commercial media and digital information industry's development of content, in order to enable users to gain experience in the use of ICTs.
- Promoting measures to build trust in the use of ICTs including measures to assure users about privacy protection and the security of networks. This matter needs attention even as e-commerce legislation is introduced in the UK.[105]
- Reducing barriers to the effective management of intellectual property rights in digital information especially for smaller firms, and monitoring the balance between intellectual property rights protection and the maintenance of open digital spaces on the Internet.

4.3 Reducing Constraints on E-service Delivery Markets

To promote optimal access to ICTs, regulation is needed to encourage competitive entry in some segments of the market. Encouraging universal access to public networks and limiting discriminatory and unfair restrictions on network access and usage will continue to present issues for regulators.

An important role for policy is to monitor opportunities to move users onto new rungs on the 'e-adoption ladder'. The new Office of Communications (OFCOM) will be well-positioned to signal changes in ICT usage patterns on the basis of its research and its familiarity with consumer price sensitivities. OFCOM will have an overview of most segments of the market for electronic networks (and content). From its position, the regulatory agency can offer informed views of changing patterns of demand that are not influenced by vested interests in the segments of the market.

In addition, regulation continues to be needed to monitor interconnection costs between alternative networks. The growth of mobile data and multimedia service markets is likely to lead to more complex interconnection models that take account of increases in bandwidth usage.[106] Demand for high bandwidth services will be sensitive to the effects of interconnection models on retail prices.

Self-regulation by the Internet service providers may not be sufficient in the future. As an OECD report suggests, 'the Internet, by its nature, does not automatically lead to more openness and competition'.[107] There may be a role for formal regulation of Internet interconnection and peering arrangements and this is not a content regulation issue.

In addition, interconnectivity between the Internet and television is a feature of the future of commercial digital television in the UK.[108] Next generation set top boxes will be powerful and broadcasters are seeking additional revenue streams.[109] Emerging markets are likely to be highly price sensitive,[110] and further development of interactive television is likely to pose issues for regulation to ensure that public service broadcasting remains viable.

Citizens and consumers will be marginalised if they do not attract e-service providers because of their geographic location or socio-demographic position. Steps by government to require universal access to electronic (broadband) networks through regulation are not regarded as appropriate. However, expanding access to electronic networks is a means of providing opportunities for ICT-related learning. This is

important for those who will otherwise lag behind on the learning curve and, therefore, will be excluded from the benefits of e-services.

Policy action need not be justified by evidence of market failure. Micro-level evidence on ICT use indicates that *system failures* may be holding back movement of some ICT users on the 'e-adoption ladder'.[111] If a component of the ICT system (human and technological) is missing or is not interacting well with other components, the economic impact of ICT investment is likely to be reduced.

There is a need to examine system failures and to co-ordinate the use of regulatory and non-regulatory measures to strengthen opportunities for learning that will stimulate demand for ICTs. There are signs of system failure in the human and organisational parts of the ICT system in the UK. The micro-level evidence suggests that there are weaknesses in skills and competency building that are contributing to user resistance to greater and more effective ICT use.

4.4 Monitoring and Assessing ICT Economic Impacts

Improved indicators of ICT impacts are being developed partly through the work of the Office of the E-Envoy and ONS. But there is a gap in the evidence base at the micro-level. Systematic and methodologically rigorous case studies can reveal how people are responding to digital opportunities and the new e-services. They can provide insights into the learning process and the barriers and drivers of change in ICT consumption patterns, factors that are not captured by macro-level research techniques.

Detailed case studies of user perceptions and experiences can highlight key changes and promote greater awareness and responsiveness by ICT suppliers. Existing case studies use inconsistent methodologies. They provide snapshots of current practice. They are undertaken mainly at the industry sector level or at the functional level in government. Research has barely started to reveal how people are using ICTs in their homes and workplaces.

Encouraging and supporting new efforts to undertake systematic and methodologically sound micro-level studies over time of ICT use and its economic (and social) impact will enable this evidence gap to be addressed.

5 Conclusion

Government policy and regulation have roles to play in ensuring that investment in ICTs (and electronic networks) leads to the expected productivity gains in the UK economy.[112] The priorities – based on an assessment of the micro-level evidence are:[113]

1. Investment in learning for skill and competency development,
2. Initiatives to stimulate digital content and information production especially using a 'peer to peer' model, and
3. Building confidence in the security of networks.

There is evidence of a dynamic, self-reinforcing cycle where learning and experience stimulate demand for e-services. Because of the system characteristics of ICTs this can

encourage investment in the ICT infrastructure. As Greg Spencer, consultant to Broadband Futures in the UK puts it, 'just putting in wires and offering cheap rates isn't enough. People have to have skills to create and use content, not just the technology itself'.[114]

Research at the micro-level cannot address all the factors that impact on the effectiveness and efficiency of ICT use. However, it can complement and inform macro-economic analysis. Movement along the diffusion pathway involves choices by citizens, consumers, workers and their employers, and policy makers. These choices impact on the economy and, indirectly, on the take-up and use of ICTs.

Progress towards a knowledge-driven economy is the agreed goal. But the alternatives facing private sector firms, public sector organisations and individuals need to be kept under constant discussion. A shared vision of the knowledge-driven economy can help to forge better co-ordinated policy and regulatory action, consistent with the ICT diffusion pathway that is most highly socially and economically valued.

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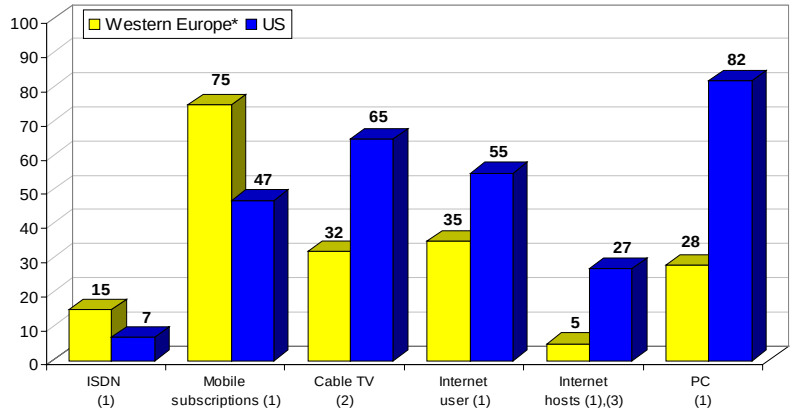
Annex A: ICT Diffusion and Growth Rates

Investment in network infrastructure and spending on information technology and telecommunication equipment in 2001 led to network infrastructure penetration in western Europe that was less pervasive than in the US, with the exception of mobile communications. Some of the differences in the patterns of diffusion between the network infrastructures in western Europe and the US are shown in Figure 3 as of 2001.[115]

Figure 3 Network Infrastructures in Western Europe vs. United States, 2001



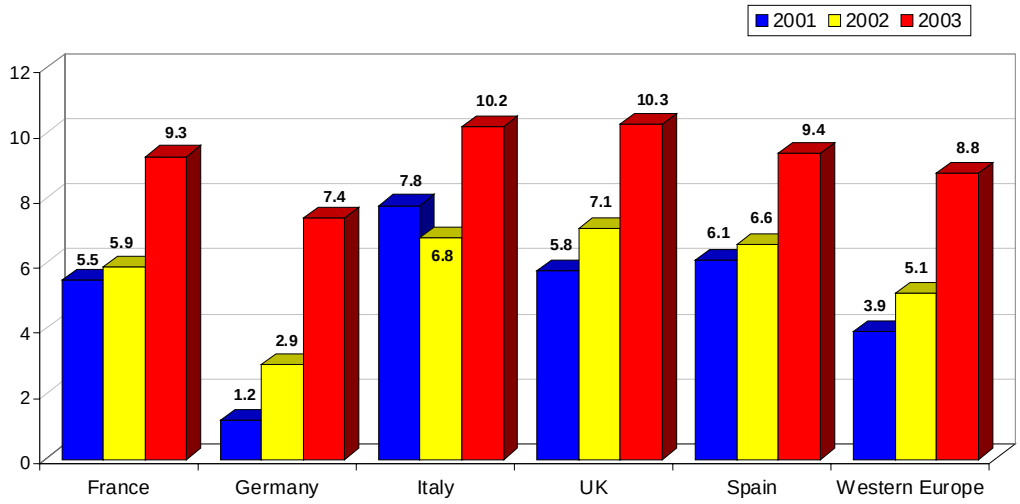
(1) per 100 inhabitants, (2) per 100 households, (3) July 2001; * EU 15, Switzerland and Norway

Source: EITO (2002).

Figure 4 below shows recent and projected growth in the European information technology market valued at 341 bn Euro in 2002. The growth rate projected for 2003 suggests that the UK will maintain its position.

Figure 5 below suggests that growth in the market in 2003 for the underlying telecommunication infrastructure in the UK is not likely to be as healthy as elsewhere in Europe. However, it is expected to grow faster than in the preceding year.

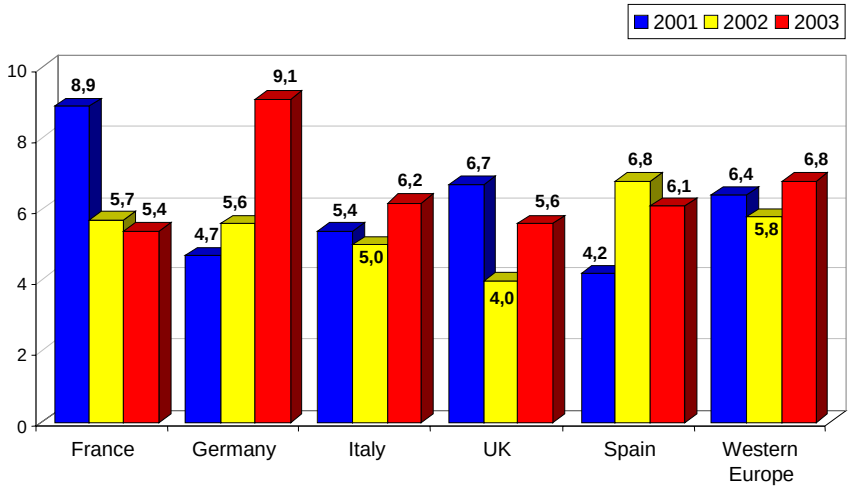
Figure 4 Western European IT Market Annual Growth, 2001-2003 (%)



Market value 2002: 341 billion Euro

Source: EITO (2002).

Figure 5 Western European Telecom Market Annual Growth, 2001-2003 (%)



Market value 2002: 337 billion Euro

Source: EITO (2002).

Annex B: Reported Impacts of E-Commerce at the Sector Level

Automobiles: ICTs are being used to provide car trade portals linked to dealers. The cost of selling through the Internet (including advertising costs) may amount to 20% of the cost of traditional selling but these potential benefits are not yet being experienced by customers.[116]

Banking Industry: Online banking is not yet displacing traditional banking and complex alliances of service providers are emerging with some restructuring of the relationships between wholesale and retail services.[117] For investment banks, there is a four stage process of ICT adoption which can enable banks to achieve the benefits of their investment through the 'interaction of the technical ability to produce at low unit cost, and the managerial ability to control and co-ordinate resources'. [118]

Book Publishing: ICT investment is enabling new business models for digital publishing and distribution. On-demand publishing is undermining the sector's traditional organisation and there are signs both of direct publisher to end-customer e-services that bypass retailers (disintermediation) and of new agents entering the value chain (reintermediation).[119]

Insurance Services: In this market in their search for efficiency gains ICT developers often fail to develop shared understandings of the use of ICT systems. This gives rise to conflicts and misunderstandings that can lead to failures of system implementation.[120]

Logistics: ICTs have been implemented in response to problems rather than as strategic tools. In the latter case, they can lead to improved performance monitoring, profit margin maintenance, and stronger quality control.[121]

Music Industry: The co-existence of off-line retailing, online retailing, and direct online distribution is occurring. Various service packaging companies (fulfilment companies) are negotiating with record companies to manage the ordering and delivery process.[122]

'*Non-Knowledge Based Services*' (construction, security services, cleaning services, retail and wholesale, transport, and hotels and restaurants). ICT use seems to break down old divisions between service categories helping to achieve coordination of different contractors to deliver on complex projects.[123]

Pharmaceuticals Distribution: ICTs are being used to bypass some established distribution services, but the major distributors see these as fragmented approaches with little effect on their established structures.[124]

Postal Services: E-commerce is impacting on volumes leading to smaller more frequent orders, decreasing volumes due to e-substitution of letters but increases in direct physical mail marketing and in heavy weight items. Post companies are expected to become integrated operators and this may lead to reduced competition.[125]

Retail Distribution: ICTs are being used to rationalise business processes and to shift towards a more demand driven organisation of supply.[126]

Textiles-Clothing: Strong management vision is leading to efficiency gains in e-procurement and product, process and relational innovations which benefit some sub-segments of the market depending on the location of suppliers and their previous use of electronic data interchange systems.[127]

Tourism: Virtual operators are complementary to consolidated physical companies that are packaging holidays. There are compatibility standards problems between systems and operators in the value chain which reduce the magnitude of the potential impacts.[128]

See also OECD (1999) and (2000) for additional sector level analysis of e-commerce impacts.

Notes

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1 Renamed the Prime Minister's Strategy Unit, July 2002.

2 See Affuso and Waverman (2002).

3 UK Online Strategy, available at http://www.e-envoy.gov.uk/ukonline/anreport2001/downloads/ar2sum.pdf accessed 3 July 2002.

4 This definition includes traditional telephone and cable networks, data networks for Internet traffic, mobile phone networks, wireless data networks and interactive television. It excludes traditional broadcast television, non-interactive digital television, and broadcast radio as these do not offer a direct return path for the end user, see PIU Review of Electronic Networks: Working Draft, July 2002, s. 1.1.3. This definition is consistent with the UK Draft Communications Bill of May 2002 which defines electronic communications networks, services and associated facilities. The draft legislation is being put in place for the Office of Communications which will also include content services within its remit.

5 The definition of ICT varies considerably. The OECD definition encompasses markets for hardware, packaged software and services as well as semiconductors. The ICT industry includes manufacturing (office, computing and accounting equipment); Radio, TV and communication equipment – and ICT services including communications services rendered to the public by post, wire or radio and services for the exchange or recording of messages, see OECD *Information Technology Outlook 2002*, Paris, summary at: http://www.oecd.org/pdf/M00030000/M00030907.pdf accessed 7 August 02.

6 In contrast, at least at the level of the firm in the US, there have been some attempts to measure productivity on a systematic basis, see Brynjolfsson and Hitt (1996); Brynjolfsson and Yang (1996); and Brynjolfsson and Kahin (2002).

7 Mansell and Steinmueller (2000).

8 ICT spending refers to revenues paid to primary vendors and distribution channels for office machines, data processing systems, software and services by the final customer. Final customers include corporations, households, schools and government agencies. ICT investment refers to business sector investment in hardware, software, and communications equipment. It is calculated by subtracting household and government spending from total spending, see Daveri (2001).

9 Daveri (2001).

10 Differences in ICT performance between the US and Europe may be attributable to the differences in the use of price index methodologies, see Wyckoff (1995) and Barbet and Coutinet (2001).

11 The European Commission funded IST Project SIBIS, IST–2000-26276 SIBIS-Workpackage 4: eEurope Evaluation & Benchmarking Report 2001, available at: http://www.sibis-en.org/sibis/files/report_eeae.pdf accessed 3 July 2002; and the European Commission funded TERRA-2000 project, at http://www.terra-2000.org/ accessed 16 July 2002.

12 For example, Selhofer and Mayringer (2001).

13 See relevant ONS articles at: http://www.statistics.gov.uk/themes/economy/articles/neweconomy.asp accessed 6 July 2002; ONS First Release Internet Access: Households and Individuals 2 July 2002 at: http://www.statistics.gov.uk/pdfdir/intacc0702.pdf accessed 7 July 2002; Oftel Consumers' use of Internet Q8 February 2002 at: http://www.oftel.gov.uk/consumer/research/con_int.htm

accessed 5 July 2002; Nielen/NetRatings European Newsletter at: http://www.nielsen-netratings.com/newsletter/newdesign/global/global.htm accessed 5 July 2002; and ONS Cross-Sectional Data at: http://www.statistics.gov.uk/statbase/esdataset.asp?More=Y accessed 10 June 2002.

14 This is supported by Coyle and Quah (2002) in their report.

15 Fagerberg et al. (1999), p. 235.

16 Mansell and Steinmueller (2000).

17 Technology diffusion studies draw upon sociological and economic analysis, see Rogers (1983) and Stoneman (1983).

18 Andersen et al. (2000).

19 Katz and Shapiro (1985).

20 OECD (2002a), p. 11.

21 Millar (2001).

22 Millar (2001).

23 See Fielding (2002); Neal and Bennett (2001).

24 The definitions are: self-employed (regular) teleworkers - either have a main workplace outside their home (e.g. at their client(s)) but spend at least one full working day at home; or are based in a SOHO (small office home office) at home and regularly use ICTs to collaborate with partners and stay in touch with customers. Supplementary teleworkers are all those who spend less than one full working day at home, Garies (2001).

25 ECaTT 1999 (n=727) cited in Gareis (2001) and Gareis and Mentrup (2001).

26 Internet usage intensity generally refers to numbers of Internet hosts as a proportion of the population or to other measures of the diffusion of PCs. Estimates of the actual time spent making use of the Internet and other ICTs and measures of how effective or efficient such use is are only beginning to be developed.

27 Millar (2002a, b).

28 Punie et al. (2002), p. 4.

29 These include the World Trade Organization TRIPS agreement and initiatives by World Intellectual Property Organization including the Copyright Treaty and the Performances and Phonograms Treaty.

30 European Commission (2001).

31 Tang (1998).

32 Mansell and Steinmueller (2000).

33 Steinmueller (2000).

34 For instance, Livingstone and Bovill's (1999) comparative study of children's changing media environment in Europe and Turow and Ribak's (2002) comparative work on the use of the Internet in the US and Israel.

35 EITO (2000), p. 230.

36 For instance, Hawkins (2001a, b); Hawkins and Verhoest (2002 forthcoming); Mansell and Nioras (2001).

37 The difficulties in explaining differences in diffusion and usage patterns at the sector level are documented in the literature. As far as possible our assessment of impacts is based on firm level studies, see also Boden and Miles (2000) for an analysis of key determinants of the growth of services in the knowledge-based economy.

38 See ONS, 'First e-commerce survey of business', 15 May 2001. A transaction is deemed to be an 'e-commerce' transaction if the order is placed on the Internet irrespective of the mode of payment or delivery. These figures exclude the value of intra-company transfers and transactions.

Much of the data and value associated with these flows is supported by private networks of corporations and their value is enormous, but is not accounted for in the official statistics on public electronic networks including the public Internet.

39 See OECD at: http://www.oecd.org/sti/consumer-policy accessed 10 June 2002.

40 See http://www.EITO.com accessed 8 July 2002.

41 By 2005, Germany's B2B market is forecast to grow 77 per cent to 389 m; the B2C market is forecast to grow 83 per cent to 58.5 m.

42 This survey is to be published during 2002. The 'e-adoption ladder' anticipates firms' progress through various development stages. See Chapter 2 in 'Business in the Information Age: International Benchmarking Report 2001' at: http://www.ukonlineforbusines.gov.uk/main/resources/publication-htm/bench2001/pdf/ch9.pdf accessed 4 July 2002.

43 Based on a discussion with ONS representatives in June 2002.

44 Acknowledgement to Stuart Hillston at Interforum for providing these figures.

45 Statistics available at: http://www.sbs.gov.uk/press/news90.asp accessed 5 August 2002.

46 The Department of Trade and Industry (DTI) is attempting to disaggregate sector level impacts across a number of studies undertaken with PriceWaterhouseCoopers (PWC). See also Clegg (2001); and Hawkins and Prencipe (2000).

47 OECD (2001a), pp, 6 and 33.

48 Mansell et al. (2000); Mansell (2001).

49 Nikolychuk (1995).

50 De Berranger et al. (2001).

51 OECD (STI/ICCP) at: http://www.oecd.org/sti/consumer-policy accessed 4 July 2002.

52 Asch (2001).

53 Charwdhry et al. (2002); Chaston (2001).

54 Raijas and Tuunainen (2001).

55 Mansell and Nioras (2001).

56 Hawkins and Verhoest (forthcoming 2002), Ch. 4, pp. 4.

57 Hawkins and Verhoest (forthcoming 2002).

58 Paré (2002 forthcoming).

59 These themes are derived by grouping common issues reported in the case studies as giving rise to positive or negative impacts of ICTs

60 United Nations (2001).

61 United Nations (2001), p. 5.

62 Siegried (2001).

63 Feindt et al. (2001).

64 NAO (2002a).

65 NAO (2002b), p. 3.

66 EITO (2002), number of respondents not provided.

67 NAO Report (2002), p.17-42.

68 Coleman and Gøtze (2000).

69 Pratchett (1999), p. 1.

70 Kinder (2002).

71 Hudson (1999).

72 Silcock (2001).

73 Silcock (2001).

74 Siegried (2001).

75 NAO (2002).

76 Hudson (1999), p. 330.

77 Oftel Consumers' use of Internet Q8 February 2002 at: http://www.oftel.gov.uk/consumer/research/con_int.htm accessed 5 July 2002Oftel (February 2002).

78 Web users defined as individuals who access the web at least once every three months at: IDATE, http://www.idate.fr accessed 1 July 2002.

79 IDATE (2002a).

80 IDATE (2002b).

81 One analysis of 'flat rates' at the retail and wholesale levels indicates that un-metered interconnection does not necessarily encourage the take-up of flat rate users, but that it encourages innovative pricing strategies that increase demand for access, see Bourreau (2001).

82 ONS Internet Connectivity Index: April 2002 at: http://www.statistics.gov.uk/themes/economy/articles/e_commerce.asp#internet accessed 5 July 2002.

83 Year on year growth for dial-up connections was 12 per cent versus 427.8 per cent for permanent connections. As of April 2002, 95.4 per cent of UK Internet connections were dial-up and 4.6 per cent were permanent.

84 The data do not distinguish between business and non-business Internet connections.

85 Oftel (2002) report on Consumer perceptions at: http://www.oftel.gov.uk/publications/research/2002/bban0102.pdf accessed 15 July 2002.

86 Report summary by Z. Trinder-Widdess (2002) 'Study finds content will drive broadband uptake' Periodical Publishers Association at: http://www.ppa.co.uk/news/2002/07/01broadband.htm accessed 15 July 2002.

87 See WAN (2001), Punie et al. (2002) citing European Journalism Centre's media news archive; and IDATE at www.idate.fr accessed 30 June 02.

88 Gann et al. (1999).

89 Nafus and Tracey (2002), p. 215.

90 Katz and Aakhus (2002).

91 Livingstone and Bovill (1999), p. 49.

92 Livingstone (2002), p. 20-21.

93 TaylorNelsonSofres_GovernmentOnline_Nov2001.pdf available at http://tnsofres.com, not accessed directly. Information provided by the Office of the E-Envoy.

94 ONS Dataset Display– Cross-Sectional at: http://www.statistics.gov.uk/statbase/xsdataset.asp?More=Y accessed at 10 June 2002 and OECD (2002).

95 ONS Dataset Display– Cross-Sectional at: http://www.statistics.gov.uk/statbase/xsdataset.asp?More=Y accessed at 10 June 2002.

96 Ducatel et al. (2000), p. 9.

97 Slevin (2000), p. 70; and Tuomi (2001).

98 Johnson et al. (2002).

99 See Haddon (1998); Haddon and Silverstone (1994); and Haddon and Silverstone (1996).

100 For instance, Cowan and Foray (1997); David (2001).

101 Nelson and Winter (1982).

102 Johnson et al. (2002).

103 Smith (2001). p. 33-4.

104 Fransman (2001).

105 In August 2002 the Department of Trade and Industry issued e-commerce regulations in line with the European Union Directive in this area.

106 Samarajiva et al. (2001).

107 OECD (2001b), p. 34.

108 Tadayoni (2001).

109 See, for example, Granada Television's interest in bidding for iTV contracts to provide government services, *NewMediaAge*, 30 May 2002, p. 1.

110 Kaiser et al. (2000).

111 This argument is related to the problems caused by the relative immaturity and maturity of different components of the ICT system. It does not rely on a finding of exploitation of significant market power or market failure analysis. However, in the skills and learning area it is possible that deficiencies could be attributed to a market failure due to information asymmetries and weak incentives to create new knowledge in the public or private sectors. This possibility is not explored here since the evidence of system failure with regard to the learning process and ICT use is strong in the case study literature.

112 EITO (2002) and see OECD (2002b).

113 See Umino (2002) for an OECD statement on priorities for government policy in this area: 1) promote broadband access; 2) harmonise regulations for broadband deployment and create incentives for investment; 3) encourage compatible standards; 4) promote digital broadcasting and media content production; and 5) invest in ICT-based education and e-learning for new skills and jobs.

114 Harding (2002), p. 37.

115 See also OECD (2000b) on Measuring the ICT Sector.

116 Charbit et al. (2001).

117 De Munck et al. (2001).

118 Nightingale and Poll (2000), p. 251.

119 OECD (2001a).

120 Barrett (1999); Rae (2002).

121 Dantuma and Hawkins (2001).

122 Verhoest et al. (2001).

123 Ducatel (2001).

124 OECD (2001a).

125 Smit (2002).

126 OECD (2001a).

127 Bianchi et al. (2001); Feindt (2001).

128 Ministerio de Ciencia y Technologia (2001).