



Contribution of the digital communications sector to economic growth and productivity in the UK

FINAL REPORT PREPARED FOR THE DEPARTMENT FOR
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1 Executive summary

Frontier Economics was commissioned by the Department for Culture, Media and Sport (DCMS) to investigate the communication sector's contribution to economic growth and productivity in the UK.

This work is intended to inform the Government's review of the communications sector "A Communications Review for the Digital Age¹".

The objective of this research is to address the following questions:

- What are the channels through which the communications sector drives economic growth and productivity?
- What is the quantified economic impact of the communications sector on economic growth and productivity in the UK?
- What are the insights from historical studies (and where appropriate international examples) for formulating policy interventions in the UK communications sector to maximise the potential for economic growth and productivity?

The work presented has been discussed and reviewed by an Expert Panel including Professor Martin Cave², Professor Nicholas Crafts³, Ofcom and senior government officials from HM Treasury, the Department of Business Innovation and Skills (BIS) and DCMS. The technical work undertaken has been discussed and reviewed by Professor Ron Smith⁴. Frontier is extremely grateful for the helpful input of these parties to this work.

Main findings

Our main findings are summarised in **Figure 1**.

¹ http://www.culture.gov.uk/images/publications/commsreview-open-letter_160511.pdf

² Professor Martin Cave, OBE, is Director of Warwick Business School's Centre for management Under regulation.

³ Professor of Economic History and Director of ESRC CAGE Research Centre, University of Warwick

⁴ Professor Ron Smith is Professor of Applied Economics, Birkbeck University.

Figure 1. Summary of findings

Key findings

The sector forms a significant component of the UK economy – accounting for over £50 billion (4.1 per cent) of total UK GVA (Gross Value Added)⁵.

Channels through which the sector contributes to economic growth and productivity

- The sector is intrinsically linked to a wide range of other sectors - it facilitates economic activity in those sectors which, in turn, can also contribute to growth. The channels through which the sector drives economic growth are both direct and indirect:
 - Direct channels include⁶: output, employment and, over time, enhanced productivity within the sector.
 - Indirect channels include⁷: speed and quality of information flows, business efficiency, access to markets, managing people and processes and diffusion of innovation.

Quantified impact of the sector on economic growth and productivity

- To complement existing studies, analysis by Frontier Economics suggests that a 1 per cent increase in communications equipment investment is potentially linked with a 0.05 – 0.06 percentage point increase in UK economic growth. The context and limitations of this analysis must be understood. For example, it does not include infrastructure investment such as broadband per se.

Policy insights

- A range of factors may influence the ability of the sector to contribute to growth including:

⁵ The value of output less the value of inputs used in the course of production of final goods and services

⁶ The term ‘direct’ refers to those activities and impacts on growth that can be directly attributed to the communications sector through national accounts, for example.

⁷ The term ‘indirect’ refers to those effects, the visible impact of which may be seen in the activity and productivity of other sectors due to technological change (for example, where the use of a communications service reduces the business time taken to undertake an activity) or those which are not priced in the economy.

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- the quality and coverage of infrastructure,
- organisational factors, and
- regulatory frameworks (including in other sectors)

The dynamic nature of the sector, as indicated by its high levels of technological innovation, implies that to support the sector's ability to drive growth, the policy framework is likely to need to be sufficiently flexible as well as take into account the sector's diversity and wide-reaching impact.

The channels through which the communications sector contributes to economic growth

For the purposes of this exercise, we have defined the digital communications sector as comprising:

- The telecommunications sector (the activities of providing telecommunications and related service activities, including transmitting voice, data, text, sound and video and also includes the internet), accounts for £29.7 billion of GVA⁸, which is 2.4 per cent of the UK total; and
- Digital content sectors: this refers to a cluster of “content” industries, identified by the Technology Strategy Board which are principally delivering digital output and are technology-aided⁹. They include video, film and photography, music, publishing, radio and TV computer games, social media and software that supports these industries and the telecommunications sector. These sectors account for £21.2 billion of GVA, which is 1.7 per cent of UK economic output.

Technological convergence has led to the blurring of the boundaries between the digital content sectors and telecommunication sectors, with firms increasingly managing many types of content and applications across diverse technological platforms¹⁰. Almost all individuals, businesses and other organisations rely on communications services at some level. The sector is therefore intrinsically linked with others by supporting economic activity in those sectors which can in turn contribute to growth.

The sector is an example of a general purpose technology (GPT) – an enabling technology which pervades all sectors of the economy, driving economic growth and productivity. These economic gains become even larger as the benefits of

⁸ Gross value Added – a measure of economic output. Source: Annual Business Survey 2009.

⁹ Technology Strategy Board (2009), Creative Industries: Technology Strategy 2009-2012

¹⁰ NESTA (2009) “Total Innovation”

increased investment in capital by the communication sector is reinforced by increased usage across the sectors and is complemented by factors such as skills and organisational change.

The sector is found to drive growth through a range of channels, both direct and indirect.

Direct effects

With annual capital expenditure of over £7 billion per year¹¹; investment in R&D over £1 billion a year¹²; exports of some £3.6 billion¹³ for telecommunications and £4.7 billion¹⁴ for the digital sectors per year; and 530,000 people employed in the sector¹⁵, it is clearly an important and significant part of the UK economy.

Indirect effects

Beyond the direct channels already discussed, there are indirect channels through which the sector contributes to economic growth, largely as a source of technological change thereby facilitating innovation and competition in other sectors. The indirect effects may be summarised as:

- **Enhanced speed and quality of information flows:** in essence this underpins all of the indirect impacts of the sector on the economy
- **Increased business efficiency:** the sector facilitates reductions in business costs through saving businesses time by for example standardising contracts, reducing costs of undertaking transactions, improved logistics processes etc.
- **Improved access to markets:** communications services facilitate greater access to **customers, suppliers** and the **labour market** through sharing information widely and thereby lowering search costs for consumers, businesses, workers and employers.
- **Management of people and processes:** improving management communications facilitates business efficiency; e-learning can be used to upgrade and maintain the skills of staff at lower cost; and greater access to information facilitates improved decision making

¹¹ Annual Business Survey 2009

¹² ONS Business Enterprise Research and Development 2009

¹³ ONS Pink Book 2010

¹⁴ This is a 2007 figure.

¹⁵ Annual Business Survey 2009

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- **Innovation:** this category is broad and includes firstly, **new or more flexible organisational structures**. For example, centralisation of distribution sites or just-in-time deliveries; flexible work patterns or business structures (for example, they may be more geographically dispersed). Secondly, it facilitates **new ways to interact with customers and suppliers** over the internet. Thirdly, **product innovations** are generated through the sharing of ideas and knowledge; and new communication tools can be created, such as social or professional networks. Finally, **services can be provided** as a substitute for face-to face visits (such the provision of medical advice online for example)

These indirect effects illustrate how the communications sector facilitates other activities in the economy. It is also important to recognise the value to consumers of efficiencies facilitated by communications because this can be welfare enhancing. In particular, if time is saved which can then be put to other productive uses, this may further contribute to economic output.

Quantifying the impact of the communications sector on economic growth

In some cases, the price paid by consumers for communications services actually undervalues the true value those services provide to the economy. Where such ‘spillovers’ exist, they are difficult to measure.

Analysis by Frontier suggests that on the basis of past trends, a 1 per cent increase in communications equipment investment is associated with a 0.05 – 0.06 percentage point increase in growth in the UK. This is an average effect based on trends over the 38 years to 2007. To provide a sense of scale of this effect, GDP in 2010 was £1.4 trillion¹⁶ so 0.05 – 0.06 per cent of this would be around £700-800 million. Importantly however, this is **not** to say that spending 1 per cent more on communications equipment (which, in this work does not include infrastructure, such as broadband) would necessarily add this amount to economic growth because it would depend very strongly on what particular sort of investments are made, when and where.

Further, the nature of investment and technological developments are likely to be significantly different in the future relative to the past. In addition, the returns on investment in terms of growth will be influenced by the existing levels of investment, usage of communications services etc.

Nevertheless, notwithstanding these caveats, the magnitude of the effects of communications equipment investment that have been identified by the analysis suggest that they are significantly greater than the market value. It therefore

¹⁶ ONS Blue Book 2010: http://www.statistics.gov.uk/downloads/theme_economy/bluebook2010.pdf

provides some support for the argument that the communications sector contributes positively to economic growth.

By way of comparison with analysis for other sectors (although it tends to focus on infrastructure's impacts on growth) Crafts et al (2005)¹⁷ found that the impact of railways infrastructure on labour productivity growth over 1830-70 was 0.14 per cent per year¹⁸. In addition, a report by Shanks and Barnes (2008) in Australia found that the network infrastructure used by the communications services industry has a similar impact on economic growth to that found in our analysis (though our analysis investigated the impact of communications equipment on productivity, rather than network infrastructure).

Limitations of the analysis should be noted, including data measurement issues; the difficulties in understanding the contribution of various factors to growth as part of a growth accounting framework; the highly aggregate nature of this analysis meaning it is not able to reflect that the effects of one sort of communications investment are not likely to be the same as another; relationships in the past do not necessarily allow conclusions regarding the future; and causality between investment and economic growth cannot be proven.

Policy insights

There are a range of factors which could potentially enhance the ability of the sector to contribute to growth effectively. These include:

- **Improving the quality and coverage of infrastructure to deliver the optimal provision of services¹⁹;**
- Several studies have found that a **critical mass** (i.e. a sufficiently high number) of users is necessary before the benefits of communications infrastructure and services can be fully realised;
- **Organisational factors:** management practices have been found in published studies to significantly affect productivity of organisations and their ability to exploit the benefits of communications; and,
- **Wider economic factors:** some forms of regulation have been cited in published studies as a factor which has been found to constrain the adoption of information and communication technologies.

¹⁷ Crafts and Leunig (2005) "The historical significance of transport for economic growth and productivity" <http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/researchannexes/researchannexesvolume1/historicalsignificance.pdf>

¹⁸ This was the estimated impact on total factor productivity – which is the metric used in Frontier analysis. The total effect estimated by crafts also included an impact of 0.12 from capital deepening.

¹⁹ It is beyond the scope of this study to explore optimal levels of infrastructure provision.

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Conclusions

It is clear the communications sector is a valuable component of the UK economy. The evidence presented here illustrates the magnitude of that contribution both directly (accounting for some 4.1 per cent of UK economic output), and indirectly (allowing other sectors to become more productive and drive economic growth).

The sector is intrinsically linked to other sectors of the economy, largely owing to their reliance on communications services and technologies.

This has a consequence for government policy when changes to the legislative framework or interventions in specific areas are being considered. An approach which takes into account the wide-reach of the communications sector, and its capacity for driving growth, would seem appropriate.

Although individual policy recommendations are not within the remit of this paper, the channels identified through which the sector contributes to economic growth suggest a nuanced policy approach. For example, the dynamic nature of the sector, as indicated by its high levels of investment in R&D, implies that to support the sector's ability to drive growth, the policy framework is likely to need to be sufficiently flexible to account for those developments and emerging technologies. This will be important when considering, for example, the quality and coverage of infrastructure provision, organisational factors and the regulatory framework.

Despite inevitable limitations with the technical analysis presented here, the conclusions drawn by Frontier, along with the other published studies, suggest the need for Government to ensure the policy framework is able to support this innovative, diverse and growing sector.

2 Introduction

Frontier Economics was commissioned by the Department for Culture, Media and Sport (DCMS) to investigate the communication sector's contribution to economic growth and productivity in the UK.

This work is intended to feed into the Government's review of the communications sector "A Communications Review for the Digital Age²⁰". It should be considered alongside other evidence being collated more widely for the Review.

Approach

This has been a 4 week project. We have largely relied on published evidence but we have set this within an economic framework to explore the sector's links with economic growth. The evidence on the quantified contribution of the communications sector to UK economic growth has been complemented by undertaking new technical analysis.

The work seeks to address three specific questions:

- What are the channels through which the communications sector drives economic growth and productivity?
- What is the quantified economic impact of the communications sector on economic growth and productivity in the UK?
- What are the insights from historical studies (and where appropriate international examples) for formulating policy interventions in the UK communications sector to maximise the potential for economic growth and productivity?

The evidence underpinning this work has been developed using a dual approach involving:

- A review of published material from a wide range of sources including among others: academic literature, sector regulators, industry commentators, international organisations such as the OECD and overseas governments.
- To complement existing evidence, we have undertaken new technical analysis to explore the quantified relationship between investment in communications equipment and economic growth (further explained in Box 1 on page 29). This is intended to provide a high level view of the sector's

²⁰ http://www.culture.gov.uk/images/publications/commsreview-open-letter_160511.pdf

impact on growth in the UK. It is not intended to underpin detailed policy development given it is a high level analysis only.

Some gaps in the available evidence should be noted. In particular, much of the available material focuses on the communications platforms (use of broadband or other technologies) rather than the content segments (such as social media, publishing, etc). Further work focusing on the content segments would therefore be useful.

Care has been taken to ensure that the work is robust and the limitations of the work are described. Further detail of the analysis is presented in the accompanying Economic Analysis paper²¹.

Defining the sector

For the purposes of this work, the digital communications sector is defined to include telecommunications along with the digital content sectors (video, film, photography, music, publishing, radio, TV, computer games, social media and software that supports all of these sectors and the telecommunications sector).

An alternative approach to looking at the communications sector is to separate it into three components:

- Infrastructure (e.g. masts, ducts, cables, cabinets)
- Equipment (e.g. switching apparatus, radio and television receivers)
- Services (e.g. fixed and mobile voice calls, internet)

The literature review contained in the accompanying Economic Analysis paper²² predominantly focuses on the infrastructure and services components of the sector, while the econometric analysis undertaken by Frontier is based on the equipment component.

This report is structured as follows:

- Section 3 explores in more detail the channels through which the sector is able to contribute to growth, as highlighted within the published material
- Section 4 explores the available evidence on the estimated quantified impact of the sector on growth

²¹ "Contribution of the communications sector to UK economic growth and productivity – Economic Analysis", Frontier Economics, August 2011

²² *Ibid*

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- Section 5 concludes by providing some insights for policy in terms of facilitating the sector's potential to contribute to economic growth and productivity²³.

²³ It has not been within the scope of this work to consider the regulatory framework in detail, nor to make specific policy recommendations

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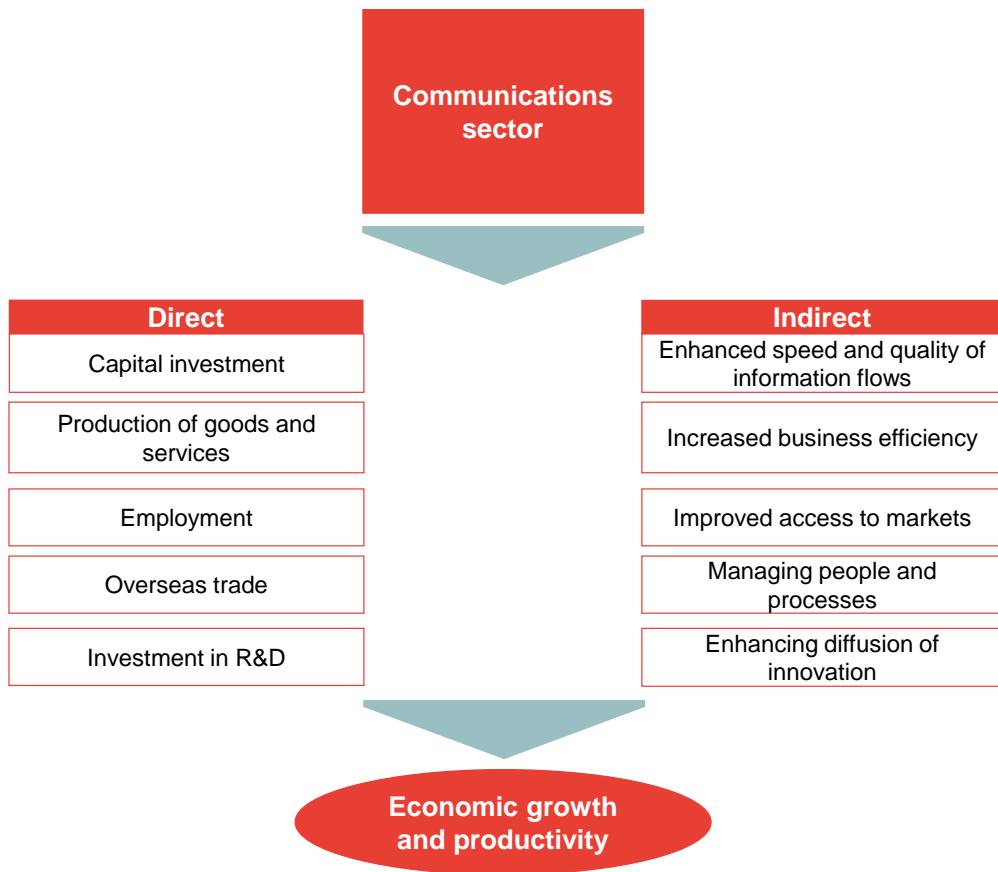
3 Channels through which the sector contributes to economic growth and productivity

This section outlines the channels through which the sector contributes to growth both directly, and indirectly.

Figure 2 presents the framework in which these channels can be considered, directly, through their contribution to output, employment or productivity growth, or indirectly, for example as a source of technological change affecting other parts of the economy²⁴.

²⁴ This approach has been cited in the OECD (2009) paper “Guide to Measuring the ICT Economy”

Figure 2. Channels through which the communications sector drives economic growth and productivity in the UK

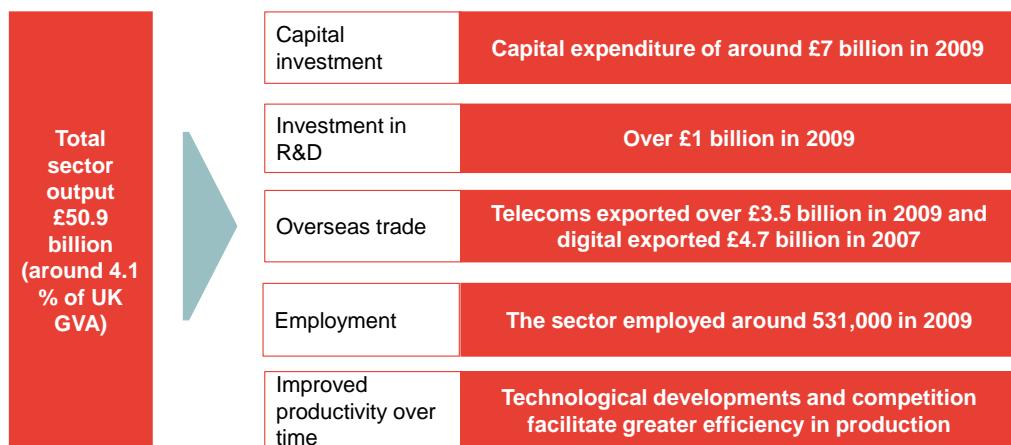


Direct²⁵ channels

As shown in **Figure 2** there are several channels through which the sector contributes to the economy directly.

²⁵ The term 'direct' refers to those activities and impacts on growth that can be directly attributed to the communications sector.

Channels through which the sector contributes to economic growth and productivity

Figure 3. Direct impacts of the communications sector on the economy

Source: ONS Pink Book 2009, ONS Annual Business Survey 2009, ONS International Trade in Services 2009

Each of these direct effects is described in turn below.

Output

The communications sector – the definition used in this research goes beyond telecommunications and includes digital content as well – forms a significant part of the UK economy contributing over £50 billion²⁶ to UK GVA²⁷ in 2009, some 4.1 per cent of the UK total. The following direct effects – capital investment, investment in R&D and overseas trade – feed into total output.

Capital investment

Investment made by the sector in capital infrastructure or other capital goods adds to the economy. Investment²⁸ in telecommunications has increased since the 1990s to its peak in the year 2000. Since then, investment has fallen back in real terms. Ofcom (2004) suggest that investment has fallen most dramatically in the fixed wireless networks sub-sector which is particularly capital intensive.

²⁶ Annual Business Survey, ONS, 2009

²⁷ GVA is gross value added – a measure of the economic output less the inputs of the economy. Source: Annual Business Survey, ONS, 2009

²⁸ Defined as net capital expenditure

Channels through which the sector contributes to economic growth and productivity

Capital expenditure for the whole sector was some £7.02 billion in 2009²⁹ composed of £6 billion telecommunications and software to support it, and £1 billion for digital communications.

Investment in R&D

Investment in research and development (R&D) is a further form of investment that directly adds to the UK economy. The telecommunications sector has experienced rapid change over the last decade in particular. Its pace of innovation and development is reflected by the rapid increase in R&D spending over the period 2001 and 2009 during which it rose from around £750 million to more than £1 billion (peaking at some £1.5 billion in 2007). The sector accounted for some 7 per cent of total R&D invested by UK businesses in 2009, behind only the pharmaceuticals industry (£4.4 billion), aerospace (£1.5 billion), computer industries (£1.5 billion) and the motor vehicles industry (£1.1 billion).³⁰

Overseas trade

In 2009, the UK exported around £3.6 billion of telecommunications services in total, representing just under 1 per cent of all UK goods and services exported in that year³¹. In the digital and creative industries, exports of goods and services totalled £4.7 billion in 2007, representing 1.3 per cent of all UK goods and services exports in that year³².

Obviously exports are only part of the story because the UK also imports products and services, but since 2000 (apart from a blip in 2008) exports of telecommunication services have exceeded imports of telecommunication services.

Employment

The sector is a direct employer of over 531,000 people (in 2009)³³, with more likely to be indirectly employed as a result of communications services. This total level of employment consists of 300,000 people employed in the digital content sectors and some 231,000 employed in telecommunications. By way of comparison with another major sector of the UK economy, around 1.5 million people work in the construction industry.³⁴

²⁹ ONS Annual Business Survey 2009

³⁰ Source: ONS Business Enterprise Research & Development 2009

³¹ ONS, Pink Book 2010

³² International Trade in Services, ONS. This includes the value of exports for video, film and photography, music, visual and performing arts, publishing, radio and television.

³³ ONS Annual Business Survey 2009

³⁴ Source: Annual Business Survey for 2008 (2009 data not complete)

Channels through which the sector contributes to economic growth and productivity

Improved productivity over time

Producing a given level of output more efficiently i.e. by relying on fewer resources such as people time or other inputs, is a direct benefit to the economy. The rapid pace of technological development within the sector and increasing competition push for greater efficiency within the sector such that more output can be delivered for given inputs.

Indirect³⁵ channels

Indirect channels are those that arise from the ability of the communications sector to facilitate activities in other sectors, which in turn contribute to economic growth. This may take the form of spillovers which refer to those impacts on the level of economic output or productivity that are not directly priced in the economy (i.e. beneficiaries do not directly pay for them).

The following describes those that can be inferred from published material.

Identifying the channels

As **Figure 2** shows, there are several channels through which the sector contributes to economic growth indirectly (though more may emerge over time as the sector evolves).

Although the focus here is the communications sector, **it is not possible to consider the communications sector in isolation of other sectors**, such as transport or energy. In many ways, these sectors are inherently linked as they each rely on the other for their effectiveness. For example, for the communications sector to improve logistics requires a well-functioning transport system which facilitates deliveries to be made when and where they are required. Also, in order to make the most of communications services such as fast access to the internet via broadband, energy is needed to power the technology platform used to access the internet (which is often a personal computer or mobile phone) and the network equipment. Many other interactions also exist across sectors.

It follows that the contribution of this sector to the economy may well overlap or indeed complement the channels through which other sectors also drive economic growth.

Several studies found that **the impacts on economic growth are likely to be greater if a critical mass of penetration is reached** i.e. there needs to be at least some minimum level of usage for the potential benefits to be fully realised. Also, the value to customers of a network or technology may increase as usage by

³⁵ The term ‘indirect’ refers to those effects, the visible impact of which may be seen in other sectors due to factors including technological change (for example, where the use of a communications service reduces the business time taken to undertake an activity) or those which are not remunerated economic activities

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others also increases, often referred to as “network externalities”. Importantly however, all infrastructure has a maximum possible level of physical usage; as this point is reached, use by one user may affect the use by others by for example, lowering the quality of service the infrastructure is able to provide.

The specific channels are now discussed.

Speed and quality of information flows

In terms of the specific channels illustrated in **Figure 2**, the first relates to the **improvement in speed and quality of information flows**. In many ways, this can be considered to be a general descriptor of the role of communications technologies in everyday life and economic activity. It is therefore fundamental to the role of the sector in facilitating other activities in the economy either to be more effective or productive.

Essentially, this is because communication costs time and in many cases, money. Therefore, any improvement to the pace and quality of that flow of information would eventually feed its way into GDP.

The value of communications more generally to businesses is demonstrated in the results of a survey for the British Chambers of Commerce (2003), which found that companies of all sizes and sectors considered more effective communication as the biggest benefit of having a broadband connection for their business.

The notion of sharing information efficiently underpins many of the other channels that will now be discussed.

Increased business efficiency

The availability of efficient communications infrastructure allows companies to reduce transaction costs associated with for example, ordering, gathering information and searching for goods and services. Also, the adoption of standardised electronic contracts for example, can lower the average cost of contracting, especially for business to business transactions³⁶. Companies can also improve their performance by adopting more efficient business processes by using certain communications applications which allow the implementation of remote monitoring and logistics management, among others³⁷.

According to a survey by the British Chambers of Commerce (BCC)³⁸, 46.4 per cent of businesses mentioned an improvement in business productivity

³⁶ Shanks and Barnes (2008)

³⁷ See ITU/UNESCO (2011).

³⁸ BCC (2003): “Business Broadband: A BCC Survey: A State of the nation survey into the penetration and impact of broadband on British business”, in association with Cisco Systems. September 2003.

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associated with broadband; and, 45.3 per cent said broadband contributed to a cost reduction.

More recently, Ofcom published the results of a survey on the business customer experience with regards to communication services³⁹. This found that businesses prioritise communications because they are seen as being ways of achieving cost savings and enabling more effective competition. Examples include: enhanced sales and marketing via web presence, better customer response via smartphones and greater workforce flexibility and efficiency via facilities such as remote access and video conferencing.

Improved access to markets (and enhancing competition)

Communications services are considered to facilitate access to markets from a number of perspectives:

- **Access to customers:** improved communications allows a far greater reach of consumer markets than would otherwise be the case. Internet-based sales are a particular example of this working in practice⁴⁰. An Ofcom survey (2010) highlighted the value businesses place on marketing via the internet, and implies businesses recognise the value in being able to access increasingly global markets at relatively low cost. OECD (2000) found that the internet offers the opportunity to reduce barriers to entry and make markets more contestable.

Brynjolfsson and Smith (2000)⁴¹ looked at the prices for books and CDs sold through the internet and via physical stores in 1998-1999 for example, and found that the prices of these goods were 9-16 per cent lower when sold over the internet. This would be a direct benefit to the consumer because it would free up cash that they can use to purchase other goods and services in the economy.

- **Access to suppliers:** being able to access a wider range of suppliers – and hence ensuring they compete with one another in a way they perhaps wouldn't otherwise – is able to directly drive down costs to purchasers. A study by Goldman Sachs⁴² (2000) found that the efficiency gains associated with e-commerce in business-to-business transactions ranged between 2 and 40 per cent of total input costs,

³⁹ Ofcom (2010): “The Business Customer Experience”, Research document, 7 December 2010

⁴⁰ This is because of what is known as the “long tail” phenomenon. The internet makes it possible for businesses to reach a larger number of customers making it feasible for them to sell niche products.

⁴¹ Brynjolfsson, E. and Smith, D. M. (2000: “Frictionless Commerce? A Comparison of Internet and Conventional Retailers”, *Management Science*, 46(4), pp. 563-585.

⁴² Goldman Sachs (2000): “The shocking economic effect of B2B”, *Global Economics Paper*, No. 37

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depending on the industry. If the upper end of this range is realised, this is clearly substantial.

- **Access to labour markets:** the development of broadband has facilitated the adoption by many companies of online recruitment processes, allowing the submission of applications from candidates globally, and even interviewing via teleconference. Access to a wider labour pool and reducing the search costs for both workers and employers is a productivity benefit as labour can more effectively match their skills to jobs.

Managing people and processes

A key benefit associated with the adoption of communication services by companies and individuals is the improvement in information flows within organisations.

Shanks and Barnes (2008) emphasize that better information flows inside a company facilitate better and more timely decision making. Quoting Nadiri and Nandi (2001),⁴³ they state that the modernisation of the communications network has increased the efficiency of managers' communications, helped the coordination of independent units and increased the transfer of information and knowledge. Similarly, they refer to Madden and Savage (2000)⁴⁴ who suggest that "The ability of managers to communicate efficiently over large distances reduces X-inefficiency and expands the stock of entrepreneurial talent".

More broadly, the development of communication systems have enhanced the implementation of "knowledge management" (KM) practices by companies. Clayton (2005) summarises the process of KM into three categories: gathering and storing knowledge; structuring knowledge; and, collaboration/sharing knowledge.

In addition to improving information flows inside companies, better communication services have allowed the development of applications such as e-learning, which increases access to education and training (inside and outside companies). Clayton (2005) analysed case studies which found that an interesting development among some firms has been people development combined with knowledge management to allowing collaborative learning. This has resulted in a higher number of trainees, higher worker productivity and lower costs.

⁴³ Nadiri, M.I. and Nandi, B. (2001): "Benefits of communications infrastructure capital in U.S. economy", *Economics of Innovation and New Technology*, vol. 10, pp. 89–107.

⁴⁴ Madden, G. and S. Savage (2000): "Telecommunications and economic growth", *International Journal of Social Economics*, vol. 27, no. 7/8/9/10, pp. 893–906.

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Enhancing diffusion of innovation

The communications sector drives innovation from two particular perspectives. Firstly, the availability of efficient communication services in combination with improvements in the transport sector has enabled businesses and other organisations to implement a number of **organisational changes**. Among others, these include:⁴⁵

- the centralisation of distribution sites
- industry relocation and concentration
- the implementation of just in time (JIT) processes.

These essentially relate to logistics. Businesses constantly seek to drive down their costs and yet expand the markets they serve - efficient communications allow them to do this. For example, large online retailers have streamlined their operations to reduce the reliance on inventories (which entail high storage costs) and instead operate with efficient distribution channels.

Efficient logistics systems often rely intrinsically on communications. For example, just in time delivery involves each stage of the production chain communicating with the next. The aim is to ensure a seamless flow of parts and materials through the process, without the need to invest in large inventories. This way of operating saves costs if implemented well.

A significant benefit afforded to businesses, other organisations and individuals is the flexibility that communications facilitates in terms of working practices. According to the Ofcom survey (2010), in 2010 over one third of the companies (36 per cent) worked from a home office. High levels of work mobility were also found, with almost four in five (78 per cent) of those interviewed working out of the office at other fixed locations and/or whilst travelling.

New organisational structures have emerged to exploit the opportunities provided by fast and efficient communications. Virtual firms for example, use the best people for the job on each project and are characterised by flexible working time, teleworking, knowledge management and flexible office spaces for meetings.⁴⁶

Decision making processes also appear to have evolved in response to the opportunities provided by improved information flows within organisations. Lee et al. (2006)⁴⁷, quoting Malone (2004),⁴⁸ describe how, as information costs begin

⁴⁵ See Shanks and Barnes (2008).

⁴⁶ See Clayton (2005).

⁴⁷ Lee, N, P. Schneider and I. Brinkley (2006): "R&D, ICT and Productivity: An evidence paper for the Knowledge Economy Programme", The Work Foundation.

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to fall, it becomes worthwhile to collect global information together in one central place, where decision makers can work strategically with a more informed view than local decision makers can. As communications costs fall, however, decentralised decision-making also becomes more effective and informed.

Secondly, from a **business operations** perspective, the communications sector's role in this appears to take several forms:

- **Direct contact with customers:** Clayton (2005)⁴⁹ finds that "...interacting with the end user over the internet is a major innovation (e.g. patients being able to have contact with a virtual medical team or customers awaiting deliveries being able to track them on their journey)."
- **Product innovation:** Martin and Nguyen-Thi (2010)⁵⁰, find that use of e-commerce increases the probability of product innovation and enhances innovative performance (measured as the percentage of total turnover from product innovations that are new to the firm)
- They also find that use of **internal communication tools** for facilitating communications, such as electronic groups, positively affects the probability of introducing product, process and organizational innovations;
- Plus, investment in software is significantly associated with the probability of introducing new **organizational approaches** inside the firm.
- The introduction of **online marketing** has been one of the major innovations enabled by communications services. The Ofcom (2010) survey shows that around three quarters of companies with access to the internet had a company website and 41 per cent were also using the internet for online marketing.
- Focusing on broadband, ITU / UNESCO (2011)⁵¹ also emphasize the potential effect on innovation, **not only within the communications equipment sector but also in other sectors** of the economy that rely on communications. For example, telemedicine, online education,

⁴⁸ Malone, T.W. (2004): *The Future of Work: How the New Order of Business Will Shape Your Organisation, Your Management Style, and Your Life*, Boston, MA: Harvard Business School Press

⁴⁹ See Clayton (2005), page 33.

⁵⁰ Martin, L. and T.U. Nguyen-Thin (2010): "Impact of R&D and ICT on Innovation and Productivity: Empirical Evidence from Micro Data", Paper to be presented at the Summer Conference 2010 on "Opening Up Innovation: Strategy, Organization and Technology". June 2010.

⁵¹ <http://www.broadbandcommission.org/report2/full-report.pdf>

Channels through which the sector contributes to economic growth and productivity

video-on-demand, or new forms of commerce and financial transactions.

- In addition, by enhancing information diffusion, ITU/UNESCO (2011) stress the role of broadband as an effective means of **fostering research and development activities for industry, as well as the transfer of technical and other types of knowledge.**

The consumer perspective

Although most published studies have been undertaken looking at the economy or business impacts of communications, there are also potential impacts on consumers – both in the communications sector and more broadly.

Higher consumer welfare through the sector's impact on prices, product variety, etc. would be expected.

Improving the information available and reducing search costs allows individuals to take better and more informed decisions. For example, the internet is increasingly relied upon to compare prices and services, such as when booking a holiday; and access to a wider range of goods and services than before, some of which may not be available in the high street, and at potentially lower prices, can raise welfare.

There is also emerging evidence of productivity gains and cost savings achievable as a result of improving access for citizens and businesses to information and public services - such as health and education - provided by local and central government (through the channels discussed earlier). For example, by reducing the time individuals have to devote to government services (through eGovernment such as when purchasing car tax for example), among others. Time saved could potentially be put to other productive uses.

Plus, given technological development, there are also likely to be significant social benefits:

- Greater social inclusion as a result of strong communication links with people in more rural and remote areas
- Greater interaction amongst people through social networking sites such as Facebook and Twitter, or free internet telephone services such as Skype.
- Quick and easy access to a plurality of information on news and current affairs which is vital for a healthy, well informed democracy.

The next section explores the estimated quantified impacts of the sector on economic growth.

Channels through which the sector contributes to economic growth and productivity

4 Estimating the quantified impact of the sector on the economy

Section 3 described the channels through which the sector contributes to growth. In this section, we focus on the quantified estimates of the contribution of the sector to the economy that have been identified in published material, most of which focus on productivity. A more detailed assessment is included within the economic analysis paper⁵² which accompanies this report.

Summary of the published material

Various studies have explored the estimated impact of the communications sector on growth. Although they have been reviewed as far as possible within this project, it has not been possible to form a view of their robustness. They are summarised in **Figure 4**.

Some highlights from the studies are:

- There is substantial evidence that the communications sector has a **positive impact on growth**
- **Critical mass** is an important issue as unless there is at least some minimum number of users of the particular communications technology in question, the full benefits to the economy are unlikely to be realised. In addition, there may be increasing returns such that the impacts are higher, the higher is the uptake
- The **impact of broadband on the economy is more significant than other forms of communication**, as found by the ITU/UNESCO study (2011).

⁵² Contribution of the digital communications sector to UK economic growth and productivity – Economic Analysis paper, Frontier (2011)

Figure 4 Summary of evidence: impacts of the communications sector on economic growth and productivity

Author	Country	Year	Summary of findings
Hardy (1980)	15 developed and 45 developing countries	1960-73	Number of phones per capita has a positive impact on growth
Roller and Waverman (1996)	21 OECD countries	1970s and 80s	Positive causal link between fixed communications and growth, provided a critical mass is reached
Shanks and Barnes (2008)	Australia		1 per cent increase in investment in communications network infrastructure used by the communication services industry raises productivity by 0.05 per cent Coefficient of 0.01 between digitisation and IT
Waverman (2005)	Developed and developing countries	1980 - 2003	Mobile telephony has a positive and significant impact on growth. Effect is twice as large in developing countries than in developed
Gruber and Koutroumpis (2010)	192 countries	1990 - 2007	Increasing returns to mobile communications
ITU/UNESCO (2011)			Compared mobile, fixed telecoms, internet and broadband and found the impact of broadband on growth is more significant than the others
Czernich (2011)	OECD	1996 - 2007	10 per cent increase in broadband penetration increases per capita growth by 0.9 – 1.5 per cent
Koutroumpis (2009)	15 EU countries	2003 - 2006	Positive and increasing returns to broadband investment with a critical mass of 20 per cent subscriber and 50 per cent household penetration

Box 1 summarises the technical analysis undertaken by Frontier Economics to complement this published material.

Estimating the quantified impact of the sector on the economy

Box 1: Frontier analysis of the impact of communications on productivity

To complement the existing evidence base, Frontier has undertaken some analysis. This draws on data from the EU Commission called EU KLEMS⁵³ over the period 1970-2007, covering 30 industries.

By using technical (econometric) analysis, we have estimated the links between increases in communications equipment capital stock and productivity. The full analysis can be found in the accompanying Economic Analysis paper⁵⁴.

In summary we have carried out a testing programme to explore:

- i) Whether the evidence suggests a positive contribution of communications to growth, and if so, on what scale
- ii) Whether there are industry specific effects which mean the impact of communications is inherently different in some industries than others (so-called ‘fixed effects’)
- iii) Whether the impact of communications on growth is different between two points in time (before and after 1995)
- iv) If the impact of communications on growth in the services sector differs from that in the non-services sector
- v) If there is evidence to help understand causality i.e. whether communications investment increases growth, or whether growth increases communications investment.

This analysis has relied on available industry-level data which can only ever provide a highly aggregated view of the relationship between communications and economic growth.

In summary, we find:

- A 1 per cent increase in communications investment⁵⁵ is associated with⁵⁶ a 0.05 – 0.06 percentage point addition to the growth of the UK economy i.e. if UK economic growth was previously 2 per cent a year, then by adding 1 per cent to communications investment could

⁵³ EU KLEMS Growth and Productivity Accounts: November 2009 Release, updated March 2011

⁵⁴ Contribution of the digital communications sector to UK economic growth and productivity – Economic Analysis paper, Frontier (2011)

⁵⁵ Defined here to be a 1 per cent increase in communications equipment capital stock. Note this definition does not include fixed infrastructure investment or some other investments in digital communications for example.

⁵⁶ Note here that although this language is used, it is not possible to prove or disprove causality

potentially increase UK growth to 2.05 per cent (plus the direct impact on growth of the higher level of investment)

- There is little evidence that there are some industries with inherent characteristics that mean communications impact differently on growth than in other industries
- The impact on growth before and after 1995 is not statistically different i.e. the effect is broadly similar over time
- The contribution of the communications sector to growth in the non-services industries appears to be more significant than in the services industries (the impact of the former implies increased communications investment of 1 per cent relates to a 0.08 per cent increase in growth, compared with 0.03 per cent in the latter)
- The evidence is not sufficiently significant to make any conclusion about causality.

As with any technical analysis, it is important to be aware of the **limitations** in order to interpret the results appropriately.

Limitations

- Causation is not proven by this analysis – although a relationship is found between communications and economic growth looking at past trends, it is not possible to draw conclusions about whether there is a causal link i.e. whether communications investment causes growth or growth causes an increase in communications investment.
- In this context, we have explored the relationship between communications equipment and a measure of growth known as total factor productivity (TFP). The definition of communications equipment is necessarily limited to its definition in the EU KLEMS data so is not all encompassing of the sector of interest and does not include fixed infrastructure, or some digital communications elements for example. It also does not reflect the level or intensity of use of that investment.
- Further, TFP is a well-recognised and relied upon metric but captures a whole range of factors. For example, “intangibles”⁵⁷ are able to drive TFP as distinct from the ‘spillover’⁵⁸ effects that are commonly assumed

⁵⁷ These are intangible investments such as investment in knowledge creation, which may not be directly measured in growth accounting. This issue has been explored by B. Van Ark and C. Hulten (2007) in “Innovation, intangibles and economic growth: towards a comprehensive accounting of the knowledge economy”

⁵⁸ Spillovers often refer to the impacts of technological change.

Estimating the quantified impact of the sector on the economy

to drive it. The use of TFP and the way in which it is estimated through the growth accounting framework is subject to data mis-specification because the quality of the data is reliant on the underlying assumptions used to generate it. Given a large range of factors are captured within one TFP metric, caution should be used in interpreting results.

- Given the analysis is necessarily looking at the past, although this provides some useful insights, the relationships of recent decades may not be mirrored in the future. The dynamic nature of the industry and the changing nature and composition of investment imply the returns are likely to vary at the more disaggregated level.
- In addition, this analysis is highly aggregated and at the industry level so hides a significant amount of variation across firms and market segments in terms of the impact of communications on growth.

This work should be considered alongside other available evidence, and interpreted accordingly.

Interestingly, the findings of the Frontier work are similar to the results found by Shanks and Barnes (2008). They looked at Australia and found that a 1 per cent increase in investment in the network infrastructure of the communications services industry raises productivity by 0.05 per cent (note this is a different variable to that used in the Frontier work).

5 Insights for policy: facilitating the sector's potential to contribute to economic growth

It is clear from the sections above that the communications sector is a valuable component of the UK economy.

Published studies suggest a range of factors can be identified that allow the sector to contribute more effectively to growth. These may be considered in the following terms:

- **Infrastructure:** this is fundamental to the provision of services
- **Organisational factors:** these relate to the way in which an organisation structures itself and relies on communications services
- **Wider economic factors:** this relates to those factors within the communications sector and more widely, such as the regulatory framework

These will be discussed in turn in the following.

Infrastructure

Communications services rely on supporting **infrastructure**. Competition in the use of infrastructure and regulated open access to it are intended to ensure optimal provision and quality for consumers. Without efficiently functioning infrastructure, the ability to provide communications services could therefore be hindered, with implications for their ability to contribute to economic growth.

The role of infrastructure is therefore fundamental within the sector. The drive to roll out fibre networks closer to customers will increase the downlink and uplink speeds available to consumers in areas covered by those new investments, as well as ensuring that there is sufficient infrastructure is also available in areas where such investment may not be taking place.

Organisational factors

Bloom et al. (2005b) explored the importance of **organisational factors**, i.e. management practices, for ICT performance. They draw on work undertaken by McKinsey looking at the practices of 730 manufacturing firms in France, Germany, the US and the UK. This evidence showed that management practices explained up to 10-15 per cent of the productivity gap between the US and the UK.

The management factors they have explored include shop-floor management (such as lean internal supply chains, documentation of process improvements and the rationale behind improvements); monitoring (tracking individuals' performance and regular appraisals and job plans); "consequence" management

(making sure that plans are kept and appropriate sanctions and rewards are in place); targets (realistic financial or holistic); and, incentives (promotion criteria, pay/bonuses and fixing/firing bad performers etc).

Wider economic factors

Wider economic factors have been explored from various perspectives. It appears that some forms of regulation can be shown to constrain the ability of the sector to contribute to growth in a range of ways. Gust and Marquez (2002),⁵⁹ find that burdensome regulatory environments and, in particular, regulations affecting labour market practices (such as tax burdens for firing employees for example) have impeded the adoption of information technologies and slowed productivity growth in a number of industrial countries.

Van Reenen et al. (2010)⁶⁰ reach a similar conclusion when looking at the relationship between ICT and productivity in a comparison of the US and Europe. In particular, they find that labour and product market regulations may be significant determinants of cross-country differences in the impact of ICT. Such regulations include employment protection and dismissal law.

This is further supported by Crafts et al (2005) in referring to a study by Hausman (1997) in which regulation was found to delay the uptake of innovative products such as mobile phones in the US. Crafts et al (2005) also refer to a study by McGuckin (1995) which found that some regulations can constrain the ability of firms to exploit the opportunities offered by communications technologies by for example, acting as a constraint on just in time delivery systems. Particular issues referred to include land-use regulations, barriers to entry, restricted shopping hours, trucking regulations and obstacles to cross-border trade. This highlights again the issue raised earlier: that the communications sector and its ability to drive growth cannot be considered in the absence of considering other areas of the economy too.

Conclusions

This report outlines the ways in which the communications sector is a valuable component of the UK economy. The evidence presented here illustrates the magnitude of that contribution both directly (accounting for some 4.1 per cent of the UK economy), and indirectly (allowing other sectors to become more productive and drive economic growth).

⁵⁹ Gust, C. and J. Marquez (2002): “International Comparisons of Productivity Growth: The Role of Information Technology and Regulatory Practices”, Board of Governors of the Federal Reserve System.

⁶⁰ Van Reenen, J., N. Bloom, M. Draca, T. Kretschmer, R. Sadun, H. Overman and M. Schankerman (2010): “The Economic Impact of ICT”, Enterprise LSE Ltd.

This work has shown how the sector is intrinsically linked to other sectors of the economy, largely owing to their reliance on communications services and technologies. Therefore there are several routes through which the communications sector is able to contribute to economic growth in a diverse and wide-reaching way. These interdependencies mean it should not be considered in isolation of other sectors.

Therefore, a flexible approach to policy design – whether it be changes to the legislative framework or intervention in specific areas – which takes into account the wide-reach of the communications sector, the diversity of its constituent components and its capacity for driving growth, is necessary.

As identified previously, although individual policy recommendations are not within the remit of this paper, the channels identified through which the sector contributes to economic growth suggest a nuanced policy approach, to the benefit of both industry and consumers.

For example, the dynamic nature of the sector, as indicated by its high levels of investment in R&D, implies that, to support business innovations and promote the sector's ability to drive growth, the policy framework is likely to need to be sufficiently adaptable to account for these emerging technologies. Similarly, the pattern of changing consumer behaviour in the last decade, as evidenced in the context of key market trends set out in Ofcom's annual Communications Market Report⁶¹, demonstrates how great the consumer appetite for new technology can be. Ensuring a system is in place within the developing communications landscape that responds to the requirements of industry whilst adequately protecting consumers is essential.

Though it is possible to suggest through the analysis in this report additional avenues of potentially fruitful exploration for further research, it is also evident that much of the available evidence and analysis presented in this report is very aggregate in nature. In practice, the sector is diverse and therefore the ability of sub-segments of the sector to impact on growth and productivity are likely to vary. It will be important for any policy action to therefore be targeted appropriately.

The limitations of the analysis presented in this report rest at least in part on the fact that it relies on looking at past trends. Although recent data captures the rapid pace of technological change - as illustrated by the shifts in both consumer habits and business practices over the last 10 years in particular - the pace of developments means it will be important to monitor the impacts of those developments over time.

⁶¹ See <http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/>

However, the conclusions drawn from the technical analysis by Frontier in Section 4 along with the other published studies (a number of studies point to a positive causal connection between investment in broadband networks, which leads to increased levels of broadband penetration, and wider economic growth⁶²) suggest the need for Government to ensure the policy framework is able to support this innovative, diverse and growing sector.

⁶² For example, ITU/UNESCO (2011).

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