Reaping the Telecoms Dividend

Our opportunity for telecoms to drive innovation and productivity in British business and the economy

January 2004

The authors

This report has been researched and written by Andrew Heaney of Spectrum and Brian Williamson of Indepen and represents our own independent views and opinions. We wish to thank Cable and Wireless for their assistance in preparing this report.

Andrew Heaney is a Partner with Spectrum and leads Spectrum's fixed practice globally. He has worked with telecoms regulators and operators for over 13 years advising on policy, regulation, strategy and business development. Brian Williamson is a Principal Consultant with Indepen. He has advised governments, regulators and operators in the telecoms and other sectors on policy and regulation.

Spectrum Strategy Consultants is a global management consultancy providing advice to the telecoms and media sectors. Spectrum advises on issues including regulation and policy, licensing, product development, business strategy, technology strategy, implementation and change management.

Indepen is a management and economic consultancy providing advice and assistance to organisations addressing the challenges of regulation, deregulation, competition, restructuring and internationalisation. Indepen was established in 1990 and has focused on advising regulators and regulated businesses in the UK and internationally, particularly in the telecommunications, water, gas and electricity sectors.

Copies of the report can downloaded from:
www.spectrumstrategy.com
www.indepen.co.uk

Andrew Heaney
Spectrum Strategy Consultants
Greencoat House, Francis Street, London SW1P 1DH
www.spectrumstrategy.com
(t) +44 (0)20 7630 1400
(e) andrew.heaney@spectrumstrategy.com

Brian Williamson
Indepen
Diespeker Wharf, 38 Graham Street, London N1 8JX
www.indepen.co.uk
(t) +44 (0)20 7324 1807
(e) brianwilliamson@indepen.co.uk

Executive Summary

Executive summary

This report presents new evidence and insights that point toward a clear need for a new regulatory approach in the UK that will allow telecoms innovation to flourish. The report also includes new analysis particularly on the current performance of the UK in leveraging telecoms innovation and quantifies the economic gain that improved regulation could deliver.

This executive summary emphasises the key messages from the main report that underlie our conclusions. The key issues addressed are:

- a review of new economic analysis that shows the substantial impact ICT[1] innovation has on productivity improvement and economic growth (Section 1 in the main report)
- a new evaluation of the key role that telecoms innovation has in enabling ICT driven economic growth (Section 1.3)
- an assessment of how well the UK telecoms sector is performing in innovating (Sections 2 and 3)
- the key principles for a new regulatory approach for telecoms, if the UK is to tap into these substantial economic benefits and not risk telecoms holding back the economy (Section 4)
- a quantification of the economic impact for the UK through introducing a new regulatory approach that is more conducive to innovation (Section 5)

At the end we present our view of the need for decisive action.

ICT innovation will be the bedrock of future economic growth

ICT was previously thought to have little impact on GDP growth but more recent economic analysis challenges this view. The comment below by Erkki Liikanen in October 2003 demonstrates these new views.

> "*There is more and more evidence that the adoption of ICT is a key to productivity growth. In the US, it has been unusually robust, and has spread to the wider economy, so much that even sceptical economists such as Robert Gordon had to change their mind.*"

Recent economic research has estimated the impact that ICT has on the economy. Reports by OECD (Aug 03), Susanto Basu et al (Oct 03) and several others have estimated the impact of ICT in the US to be an increase in GDP growth of about 1 percentage point per year (i.e. from, say, 3% to 4% GDP growth per year).

The majority of this benefit has come from indirect impacts i.e. ICT enabling businesses across the whole economy to innovate and improve their productivity. These benefits have been based on ICT innovation enabling businesses to improve productivity through, for instance, reducing labour costs through use of IT, introducing new and flexible working structures, making quicker and better informed business decisions, reducing transaction costs and improving internal and external information flows. A compelling example of this is Wal-Mart who have used supply chain management and other ICT innovations as a core enabler to improve their productivity, competitiveness and market share.

We, in common with many other observers, see this increase in GDP growth due to ICT innovation continuing for an extended period as existing ICT technologies become more diffused, production processes are transformed across the economy and as additional value derives from the networking effect

[1] ICT is information and communications technology. This sector includes semiconductors, IT hardware and software and telecoms services.

(i.e. Metcalfe's Law). These characteristics are similar to those of general purpose technologies such as electricity and railroads where the full productivity impacts came in over a long period. In the case of ICT, this on-going increase in GDP growth may be boosted (in magnitude) or extended (in duration) by further technological advances in IT hardware, IT software and telecoms infrastructure and services.

The implication of these findings is that ICT innovation is transformational and will be fundamental to future economic growth.

ICT driven economic growth will be constrained if telecoms innovation does not keep up

Without telecoms innovation, the impact of ICT innovation will be constrained since the benefits (particularly the indirect ones) from IT and computers can only be realised when computers are linked. The key drivers of productivity improvements from ICT innovation are from impacts such as better information and communication flows and improved decision-making which are very reliant on effective and improving interconnection of computers. The fact that the impact of ICT on increased economic growth in the late 90s coincided with the widespread diffusion of networking (and most particularly the Internet) also reinforces this idea.

This view of the importance of telecoms has also been supported by others, for example:

- Alan Greenspan (2000): "*The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks* "
- Crandall and Jackson (2001) "*… once one computer can access remote sources of information and transmit the information generated to other computers, its benefit expands enormously*."
- Affuso and Waverman (2002): "*The ICT revolution is not just the spread of telecommunications infrastructure, but the spread of networked computer systems, the internet and the world-wide-web*".

Telecoms innovation is a critical enabler for ICT to deliver sustained economic growth. In essence, the economy's dependence on telecoms is growing with convergence within the ICT sector – if telecoms innovation falls behind IT innovation, telecoms could act as a bottleneck to ICT and the whole economy. In order to quantify the impact of telecoms we have used an estimate that telecoms innovation currently accounts for 15% to 30% of the total impact from ICT in increasing GDP growth – i.e. a 0.15 to 0.30 percentage point increase in GDP growth. This is equivalent to about £400 billion higher GDP to the UK economy (in net present value terms).

The environment in the UK today is not conducive to telecoms innovation

The UK is currently not fully tapping into the economic benefits that telecoms innovation can deliver – the sector is not conducive to innovation and innovations are severely delayed. The key problems are explained below.

Downstream competitors to BT do not get equivalence of access to BT's upstream services (note: upstream refers to access networks and downstream refers to trunk networks, service provision and retail activities). Without equivalence, these operators cannot compete effectively or innovate rapidly. The key areas of lack of equivalence are the delay in the introduction of 'fit for purpose' wholesale products (typically 2 to 3 years delay) and then, even after introduction, the systemic lack of equivalence in price and also in non-price factors such as product development and transaction processes.

A representative example of this is the progress of carrier pre-selection (CPS) and wholesale line rental (WLR) which were aimed at allowing downstream operators equivalent access to BT's upstream voice products. A summary of the history of this is described in the box below.

CPS was first discussed in 1998 and was targeted for launch in January 2000. After various interim products, the first potentially 'fit for purpose' product (i.e. for all calls and not requiring a reply slip rather than an electronic request) was introduced in July 2002. Up to October 2003, BT's downstream operations were able to use information from competitive operators to proactively call potential 'defectors' to try and persuade them not to switch (known as 'save' activity which was only stopped by Oftel intervention following competitor pressure). Even today over 5 years after initial discussions, the costs alternative operators are required to pay are not transparent, they pay higher charges than BT (e.g. the PPP charge on traffic which BT downstream does not pay on BT-to-BT traffic) and they have to transact with BT upstream through a different set of systems than BT downstream uses. WLR is going through the same slow process.

Innovation in any industry typically comes from having a diversity of players and potential for entry – the current lack of equivalence is stifling the UK's biggest potential source of telecoms innovation.

The incumbent, BT, is also constrained by regulation and appears to have weak incentives to innovate. BT's downstream activities are hampered by current regulatory constraints which limit their ability to innovate – these constraints are unfortunate but necessary and proportionate actions intended to counter BT's market dominance and scope for abuse arising from vertical integration i.e. ownership of upstream and downstream activities. BT's downstream activities also lack full competitive pressures to innovate. BT's upstream activities appear to lack strong incentives to innovate which in turn constricts all downstream players' innovative ability to deliver benefits to their customers.

More generally, effective competition which is the foundation of innovation is limited. Competition and market forces create the most powerful incentives to innovate – airlines, mobile and the retail narrowband Internet access sectors are all clear examples of the unique ability that competition has to drive innovation. In an innovation-conducive environment (e.g. effectively competitive markets) innovations are introduced quickly as firms strive to gain competitive advantage. Unfortunately, in the UK telecoms sector we have had to (and are still) relying on regulatory intervention (rather than competitive market forces) to allow innovation to get to market – subscription-free Internet access, unmetered Internet access and ADSL all required intensive and lengthy regulatory intervention before new innovative services could be launched. There are also other innovations that are yet to reach the market – for instance, guaranteed availability levels, different classes of service, new access pricing structures and widespread SDSL – and it is unclear whether these will ever get to market without more regulatory intervention. The mere fact that regulatory intervention is required is a clear sign that innovation is being delayed – detailed case by case intervention as a necessary pre-requisite to innovation points to regulatory failure, not regulatory success.

We do not see that the current regulatory approach, which relies on lengthy and intensive post-hoc intervention to allow innovations to get to market, will improve the sluggish rate of innovation that we currently experience. If this regulatory approach continues the whole ICT sector and thus the economy could be held back by the lack of innovation in the telecoms sector.

To tap into gains from telecoms innovation, our approach to regulation needs to be modified

The increasing importance of telecoms innovation combined with the unfavourable conditions for innovation today point to important implications for future telecoms regulation. The current regulatory approach does not maximise innovation – a new objective-led and more strategic regulatory approach is needed. The key implications for regulation are described below.

In future policy-making, regulators must properly consider the full economic impact and particularly the indirect effects of telecoms innovation on the economy (this total impact is sometimes referred to as the dynamic gain). Most economic analysis in policy-making today focuses on the static gains from price reductions within the telecoms sector – this approach is partial and typically only captures 1% to 10% of the potential total economic benefits. If this partial approach is continued it is likely to result in policies that do not yield the substantial dynamic gains that can flow from innovation.

The second implication is that the regulatory approach needs to be changed in line with the following principles that together will facilitate innovation in the sector and in the wider economy:

- Ensuring equivalence of access to BT's upstream assets for all downstream operators through introducing standard systems and processes that are used by all downstream operators (including BT's downstream activities). We have established that equivalence does not currently exist and this is damaging innovation. Although there is a significant cost to doing this, the cost is small in comparison to the gains. The cost should not be borne by just BT or just the downstream competitors. While equivalence is necessary it is not sufficient on its own to prevent abuse and facilitate efficient and effective competition.
- Preventing price based discrimination against competitors. Even with equivalence BT will still have an incentive, and the ability, to discriminate against downstream competitors through, for instance, restrictive pricing structures or loading costs onto certain products. Retail price controls, or allowance of excessive returns at the access level, may exacerbate this problem by introducing the potential for a margin squeeze. There is a balance to be struck here between effective prevention and/or penalties for abuse and the allowance of greater pricing flexibility of access products.
- Alongside equivalence and prevention of price based discrimination, regulation should ensure adequate returns to facilitate efficient investment and innovation wherever prices are regulated. Application of this principle to access pricing would also be expected to reduce incentives to sabotage access via non-price means. However, in this report, we do not evaluate whether the returns to any party as a result of regulation are too high or too low to facilitate efficient investment.
- Adjusting the scope and 'style' of regulation recognising that regulatory intervention has been and will continue to be a poor means of delivering innovation rapidly. The three elements within this style are:
  - minimising the scope of regulation wherever possible and appropriate to allow operators freedom to innovate
  - wherever regulation is still required, working with the grain of commercial incentives to ensure that there is room for and reward for innovation. Regulatory 'command and control' style intervention, however well done, cannot deliver the degree and speed of innovation that commercial incentives can
  - minimising regulatory uncertainty, unpredictability and the threat of opportunism which can discourage investment and innovation

These principles will not deliver improved innovation if they are applied individually – if, for instance, BT was given more freedom, then without proper equivalence and control over or penalties for discrimination this could actually have the impact of reducing innovation.

Ofcom's duties reflect both the need to maximise static gains (e.g. price reductions) and dynamic gains (e.g. promoting innovation and investment). These principles reflect our belief that in future there must be a much greater emphasis than previously on those duties that reflect the dynamic impacts and the interests of 'citizens' as well as consumers.

The benefit of more innovation-conducive regulation is at least £20 billion

If Ofcom were to improve the regulatory environment, we predict significant gains for the UK. We have used a number of approaches to estimate the economic impact that would result from regulation that is more conducive to telecoms innovation. Using plausible and conservative assumptions, these produce estimates ranging from £20 billion to £90 billion in net present value terms. Our view, on the basis of the evidence, is that the benefit of improved regulation in the UK is likely to be at least £20 billion.

The overall benefits of at least £20 billion will be felt throughout the economy and all sectors will feel the benefits from increased GDP through general increases in wealth and expenditure. However, the benefits will be greatest in the sectors which will be intensive ICT future users and/or where an effective ICT environment creates incentives and advantages for firms locating in the UK – we see the key beneficiaries of improved regulation are likely to be retail, finance, business services, government, and some areas of media and manufacturing. Conversely these same sectors will be most vulnerable to lack of regulatory change. Consumers will also benefit substantially through better ICT products and services but more importantly and as they will enjoy better goods and services from other sectors of the economy particularly, retail, media and finance.

The current situation and potential gains point to a need for decisive action

The current regulatory approach in the UK will not reap the substantial economic benefits that can come from telecoms innovation. To tap into this substantial upside of at least £20 billion requires decisive but feasible change, not just adjustments to the current regulatory approach. Given the size of the opportunity, the actions to capture these gains are worthy of active and early consideration.

Main report

Introduction

This report presents new evidence and insights that point toward a clear need for a new regulatory approach in the UK that will allow telecoms innovation to flourish. It also includes new analysis particularly on the current performance of the UK in leveraging telecoms innovation and quantifies the economic gain that improved regulation could deliver. The structure of the main report is described below.

Section	Key focus	Page
1	Explores the linkage between ICT innovation and more particularly telecoms innovation and economic growth	8
2	Explains the role of competition in driving innovation	18
3	Assesses the current performance of the sector in delivering innovation	22
4	Highlights the key implications for future regulation if UK businesses and the economy are to tap into the gains from ICT driven innovation	34
5	Provides a quantification of the impact that improved telecoms regulation could have on the economy	39
6	Presents the overall conclusions of the report	49

1 The strong linkage between telecoms innovation and economic growth

This section stresses the critical role that telecoms has had and will have in innovation across all sectors to drive economic growth. It is structured as follows:

1.1 highlights recent and compelling evidence that points to clear linkage between ICT and economic growth

1.2 explains how ICT innovation enables economic growth

1.3 explains why telecoms innovation is critical to ICT's impact on increasing economic growth

1.4 describes why telecoms and ICT will continue to be critical to economic growth in the future

ICT is information and communications technology. This sector includes semiconductors, IT hardware and software and telecoms services.

1.1 The clear linkage between ICT and economic growth

Received wisdom through the 1980s and early 1990s was that ICT had had limited impact on productivity and economic growth. One typical example of this was the Solow Productivity Paradox – "*You can see the computer age everywhere but in the productivity statistics*".[2]

However in the last two to three years, differing views have been put forward. The Chairman of the Federal Reserve, Alan Greenspan, brought prominence to the view that ICT was in fact contributing to a strong upswing in productivity and GDP growth when he observed in April 2000:[3]

"*Until the mid-1990s, the billions of dollars that businesses had poured into information technology seemed to leave little imprint on the overall economy. The investment in new technology arguably had not yet cumulated to a sizable part of the U.S. capital stock, and computers were still being used largely on a stand-alone basis. The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks ... now, five years on, there can be little doubt that not only has productivity growth picked up from its rather tepid pace during the preceding quarter-century but that the growth rate has continued to rise, with scant evidence that it is about to crest.*"

Recently (and only very recently) new economic analysis has provided more compelling evidence and views have converged. The quotes below highlight this change of heart.

[2] Robert Solow (Nobel Prize winner in Economics). 12 July 1987. New York Review of Books.
[3] Remarks of Alan Greenspan, "Technology Innovation and Its Economic Impact" before the National Technology Forum, St. Louis, MO (April 7, 2000).

The ICT economic growth story: a change of heart[4]

Erkki Liikanen	Professor Robert Gordon	Professor Nicolas Crafts
"There is more and more evidence that the adoption of ICT is a key to productivity growth. In the US, it has been unusually robust, and has spread to the wider economy, so much that even sceptical economists such as Robert Gordon had to change their mind."[5]	*"If there was a consensus about anything as the boom years of the miracle were followed by a slowdown and perhaps a subsequent recession, it was that the core of the miracle was an acceleration in technological progress centred around the 'New Economy' of computers, IT more generally, and the internet, and that the clearest manifestation of the miracle in the economic data – the post-1995 productivity – could be traced directly to the IT revolution."*[6]	*"For the first time since 1950 European catch-up ceased and productivity gaps between the US and Europe started to increase again – including that with the UK. This development obviously owed a good deal to the impact of ICT, and the Solow Productivity Paradox (that you could see the computer age everywhere but in the productivity statistics) seemed well and truly exploded."*[7]

What is even more significant than the increasing consensus of the relationship between ICT and GDP growth, is the magnitude of the relationship which points to ICT causing a one percentage point increase in GDP growth in the US in the late 1990s (i.e. from 3% to 4% growth per year). Below we highlight some of the key studies and findings on verifying and quantifying the relationship.

- The OECD (August 2003) surveyed evidence on ICT and economic growth and reported the results of three studies for the US showing that ICT contributed between 0.4 and 0.5 percentage points to economic growth during 1990-95 of 2.5% per annum, and between 0.9 and 1.0 percentage points to overall economic growth of 4.0% per annum during 1995-2000.[8]
- Basu et al (October 2003) [9] identified a marked shift in total factor productivity growth (a robust measure of true productivity improvement[10]) in the US which was linked to a relatively higher ICT capital growth in the first half of the 1990s.[11]
- Jorgenson, Ho and Stiroh (October 2003) found that the US GDP growth rate increased by 1.85 percentage points in the period 1995-2000 compared to 1990-1995, of which ICT contributed 0.93 percentage points. In addition, they identified that the structure of output was shifting toward the ICT producing industries, but even more substantially towards sectors that are intensive users of ICT.[12]
- Van Ark, Inklaar and McGuckin (October 2003) concluded that most European economies showed considerably lower investment levels in ICT than the US, and a deceleration of productivity growth since the mid 1990s in contrast to the acceleration in the US. Faster productivity growth in intensive

[4] Part of the reason for the consensus building momentum was because the continued productivity growth evident during this US economic slowdown emphasised ICT's role and the conclusion that ICT is having a fundamental impact (since productivity growth normally reduces during slowdowns).
[5] Erkki Liikanen, European Commissioner for Enterprise and Information Society. 12 October 2003. "Back on the Growth Path" ITU TELECOM 2003 Conference Geneva.
[6] Robert Gordon. February 2002. "Technology and economic performance in the American economy." NBER Working Paper 8771. Gordon considered that the acceleration may be temporary. More recent literature points to a higher long term growth outlook
[7] Professor Nicholas Crafts, London Business School. 2002. Britain's relative economic performance 1870-1999. Institute of Economic Affairs Research Monograph 55.
[8] OECD. August 2003. "ICT and economic growth – evidence"
[9] Susanto Basu, John Fernald, Nicholas Oulton, Sylaja Srinivasan. October 2003. The case of the missing productivity growth: or, does information technology explain why productivity accelerated in the United States but not the United Kingdom? NBER Working Paper 10010.
[10] Total factor productivity means the residual growth in output after account has been taken of input growth including capital and labour inputs.
[11] ICT capital growth contributes with a lag to high total factor productivity growth.
[12] Jorgenson, D, Ho, M, Stiroh, K. 7 October 2003 (Draft paper). "Growth of the U.S. industries and investments in information technology and higher education." http://post.economics.harvard.edu/faculty/jorgenson/papers/jhscriw.pdf

ICT using industries such as wholesale and retail trade and securities trade in the US accounted for the largest part of the productivity growth differential between the US and the EU.[13]

- Jorgenson (December 2003) concludes that a powerful surge in investment in information technology and a jump in productivity growth in IT producing industries after 1995 occurred in all the G7 economies. In G7 economies other than the US the contribution of ICT to overall growth tended to be masked by declines in other sectors of the economy.[14]

This analysis clearly points to ICT having had a massive role in economic growth which, as we demonstrate later, can be expected to continue to have a similar role in future.

1.2 How ICT enables economic growth

Before passing by this important conclusion of the strong contribution of ICT to economic growth, it is worth touching on the factors or 'transmission' effects that actually cause the sharp increase in GDP growth. These key factors are described below.

What is striking, and again a new finding at the macroeconomic level, is that the majority of the ICT contribution to GDP growth is due to ICT enabling other sectors of the economy to be more productive – this is often referred to as the *indirect* impact. The *direct* impact (i.e. increases in the size of the ICT-producing sector within the economy or improvements in productivity in the ICT-producing sector) has played a role but it is relatively small in comparison.[15]

Basu et al (October 2003) analysis of the US[16], showed that about 75% of the overall increase in GDP growth was indirect.[17] What this points to is that ICT driven economic growth is actually far more to do with ICT's indirect impact on productivity and growth in non-ICT sectors than it is to do with the direct effect of the increasing size of the ICT sector in the economy. Basu et al's findings that most of the productivity growth is indirect are consistent with Van Ark et al[18] conclusions that ICT intensive usage sectors had driven the jump in US productivity and Jorgenson et al[19] finding that the structure of output is shifting toward the ICT producing industries, but even more substantially towards the ICT using industries. Finally, O'Mahony and van Ark (December 2003) note that "*The estimates [for TFP] confirm the now widely accepted proposition that the US TFP growth acceleration occurred in ICT using as well as ICT producing sectors.*"[20]

This result that most of the benefit from ICT is indirect is not surprising when one examines how ICT is used.

---

[13] Bart van Ark, Robert Inklaar, and Robert McGuckin. October 2003. "ICT and productivity in Europe and the United States – Where do the differences come from?" The Conference Board and Growth and Development Centre of the University of Groningen. Economics Programme Working Paper Series #03-05. Published in *CESifo Economic Studies*, Volume 49 (3), Autumn 2003.
[14] Jorgenson, D. 3 December 2003 (Draft paper). "Information technology and the G7 economies". http://post.economics.harvard.edu/faculty/jorgenson/papers/handbook_extract_2.pdf
[15] The importance of this indirect effect compares say to the clothing industry where indirect effects are small since new clothing goods are generally not able to improve the productivity of other sectors of the economy.
[16] Susanto Basu, John Fernald, Nicholas Oulton, Sylaja Srinivasan. October 2003
[17] The non-ICT producing sectors contributed about 0.9 percentage points to an overall productivity growth acceleration of around 1.2 percentage points i.e. around 75% of the overall increase in productivity growth due to ICT was indirect. This split of productivity growth approximately corresponds to the overall increase in GDP growth which therefore implies that about 75% of the increase in GDP growth was indirect. The total factor productivity acceleration corresponding to the GDP growth acceleration differs between studies since total factor productivity is a residual after accounting for measured inputs, and the measurement of the capital input in particular differs between studies.
[18] Faster productivity growth in intensive ICT using industries such as wholesale and retail trade and securities trade in the US accounted for the largest part of the productivity growth differential between the US and the EU. Bart van Ark, Robert Inklaar, and Robert McGuckin. October 2003.
[19] Jorgenson, D, Ho, M, Stiroh, K. 7 October 2003
[20] Mary O'Mahony and Bart van Ark (ed). December 2003. "EU productivity and competitiveness: An industry perspective. Can Europe resume the catching-up process?" European Commission Enterprise publications. Page 11. http://europa.eu.int/comm/enterprise/enterprise_policy/competitiveness/doc/eu_competitiveness_a_sectoral_perspective.pdf

Businesses in all sectors of the economy have used ICT more intensively to improve their productivity by using more powerful and cheaper PCs, the Internet, new software applications and business data networks. These goods and services have been enabled by intensive innovation at all levels in the ICT sector – there has been substantial improvements in ICT technology and huge innovation and advances in manufacturing, by service providers and by users.

One of the most impressive examples of the use of ICT to transform business has been Wal-Mart. Wal-Mart has been a leader in introducing ICT aggressively including bar codes, EDI and scanning guns.[21] More recently, it has invested heavily in ICT for supply chain management to allow it to work effectively with its suppliers to manage stock and availability more effectively and give suppliers real-time stock and flow information. This allowed Wal-Mart to improve its productivity ahead of its competitors and substantially increase its market share. The benefits of many of these ICT innovations have now flowed across the retail sector and lead to a jump in productivity growth[22] from 2% (1987-1995) to 6.3% (1995-1999). Similarly, Dell has created a new business model based on ICT using Internet based ordering, build-to-order and strong supply chain management which has allowed it to reduce inventory by over 80% (versus competitors) and get new product to market 30-90 days ahead of competitors.[23]

Use of ICT to transform industries is not limited to these few examples – it is becoming increasingly prevalent. The table below describes some other examples of how these innovations have been used in other sectors right across the economy outlining some case studies of specific examples of how customers have used ICT (drawn from C&W experience).

The indirect impact of ICT innovation: case studies

- Hilton hotels replaced its disparate, regional websites with a consolidated platform. The new technology allows customers to interact in their local language with any Hilton hotel in the world, real time.
- Marks and Spencer purchased an IP virtual private network (IP-VPN) which allowed it to carry voice, data or credit card authorisation traffic on the same network. The VPN included a prioritisation of traffic, which meant that other traffic was not swamped by customer credit card authorisations, and delays at the tills were minimised.
- Heinz needed to establish a single, coherent communications strategy in order to co-ordinate production and distribution as it restructured its European operations. It needed a solution that would reduce operational costs and enable rapid, smooth integration of new sites and systems, so Cable & Wireless designed and implemented a single unified network infrastructure for Heinz to carry for voice, data and video traffic using IP convergence technology. The solution, which includes IP-enabled LAN and WAN services, has enabled Heinz to make an overall operational expenditure saving of 10%
- Schools in the east of England have built a broadband wide area network using IP-VPN technology. Schools are now benefiting from services such as high-speed internet access, videoconferencing and secure data transfer. One school offers training on its specialist milling equipment using videoconferencing links to pupils at other schools
- Ryanair upgraded its network using IP-VPN technology. It improves Ryanair's ability to support customers who want to book flights online, and it allows Ryanair engineers and pilots to share vital operational information, helping Ryanair to meet its punctuality targets
- Lloyds TSB procured new networking and telephony facilities for 1,100 staff in its Cardiff contact centre. It enables calls to be answered more efficiently, through an automatic call distribution system. It also allowed faster processing of loan applications and quicker access to information for Lloyds TSB Asset Finance Division's customers

[21] Bradford Johnson. 2002. "Retail: The Wal-Mart effect." *McKinsey Quarterly*, Number 1
[22] As measured by real value-added per hour
[23] Darden Graduate School of Business Administration, University of Virginia. 1999. "Dell Computer: Business to Business over the Web. http://faculty.darden.edu/ebusiness_materials/dell_case.pdf

The exhibit below describes general productivity benefits that ICT can deliver to all sectors of the economy.

The indirect impact of ICT innovation: general benefits

- Improved business efficiency through, for example, just-in-time (JIT) manufacturing [24], better stock management, lower wastage, improved availability, and new management processes
- More flexible working practices enabled through use of ICT for, for example, effective homeworking and hot-desking
- Better and more efficient availability of information that allows, for instance, business performance to be identified more immediately and allows managements to make better informed business decisions
- Reducing the cost of transactions in the sale and purchase of goods and services
- Increasing the efficiency of management, especially by enabling more effective communications (e.g. email, file transfer, e-supply) both internally within firms, and externally with partners, suppliers and customers
- Improving market competitiveness through better information and more price transparency
- These indirect impacts are in addition to the new goods and services for consumers which, in particular improve choice and convenience and drive direct economic benefits

What is clear is that innovation through the introduction of new goods and services has been able to transform the ways businesses operate and improve their productivity. Without this innovation, the US would not have achieved the substantial increase in GDP growth.

1.3 Telecoms' role in ICT

The analysis above clearly points to the critical role that ICT and ICT innovation has in economic growth. This begs the question, 'is telecoms important within this?' and 'if it is important, how big is its role?'. This section highlights the role telecoms plays and provides an estimate of its contribution.

The surge in the contribution of ICT to economic growth in the US from 1995 coincided with two major changes – firstly, a doubling of the rate of decline in semiconductor and IT equipment prices[25], and secondly, the widespread interconnection of computers (most obviously characterised by the Internet). By itself, this suggests that telecoms innovation is crucial to the developments in the ICT sector and the ability of the overall ICT sector to increase GDP growth.

The case studies and examples of the impact of ICT (above in Section 1.2) reinforce this aspect that many of the productivity benefits of ICT investments (in terms of, for instance, delivering quicker, better information, more efficient communication and better stock management) are only fully valuable and impactful on productivity and growth in the whole economy when computers are effectively networked.

This view of the critical role of telecoms has been resonated by a number of economists who have examined ICT's role in economic growth, for example:

- Alan Greenspan (2000) [26]: "*The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks* "
- Crandall and Jackson (2001) [27]: "*The obvious candidate for the sudden acceleration in economic growth after 1994 is the Internet. In the 1980s, the computer revolution was limited by the absence of networking capabilities. A personal computer can read and transform information faster than earlier*

[24] For example, "*The results support the idea that the inventory to sales ratio declined more in industries with a higher ICT intensity, consistent with the idea that an important ICT benefit is its support for just-in-time inventory control*". Robert Inklaar and Robert McGuckin. December 2003. "Structural and Cyclical Performance." In O'Mahony and van Ark (ed.) "EU productivity and competitiveness: An industry perspective". Page 166

[25] Jorgenson, D. March 2001. "Information technology and the US Economy." American Economic Review, 91(1).

[26] Remarks of Alan Greenspan, "Technology Innovation and its Economic Impact" before the National Technology Forum, St. Louis, MO (April 7, 2000).

[27] Crandall and Jackson. July 2001. "The $500 billion opportunity: the potential economic benefit of widespread diffusion of broadband internet access." Criterion Economics.

models, but until it is connected to a source of information, an increase in processing power provides limited benefits. However, once one computer can access remote sources of information and transmit the information generated to other computers, its benefit expands enormously."

- Affuso and Waverman (2002) [28]: "*The ICT revolution is not just the spread of telecommunications infrastructure, but the spread of networked computer systems, the internet and the world-wide-web*".

Many of these comments relate to the Internet. However, in reality there are many forms of networking including company data networks, remote access networks, broadband, IP VPNs as well as mobile networks that have allowed companies and consumers to take full advantage of the networking of computers. Thus, when considering networking and connectivity, it is important not to limit thinking to the Internet.

This clearly points to the conclusion that telecoms innovation has a major impact in enabling the ICT sector to drive increased productivity and GDP growth. Telecoms innovation is a critical enabler for ICT to deliver a sustained increase in economic growth and the economy's dependence on telecoms is growing with convergence between IT and telecoms. However, putting a definitive figure to the impact of telecoms innovation within ICT is difficult – Affuso and Waverman (2002) noted "*Measuring this contribution of telecom is particularly difficult*".[29]

One approach to considering the contribution of telecoms within ICT to economic growth is simply to consider various measures of the share of telecoms within ICT, and of the direct contribution of telecoms to ICT. The table below shows a range of these measures.

Role of telecoms in ICT (late 90s)

Metric	US	Europe	UK
Share of value added (in 2000)[30]	29%		14%
Share of GDP (in 1998)[31]			20%
Contribution to labour productivity growth (1995-2000)[32]	16%	33%	

These measures suggest that telecoms share of the ICT role in economic growth is in the range of 14% to 33%. These measures do not though necessarily account well for telecom's role in the indirect element of increased GDP growth nor do they account for telecoms enabling role.[33] However, in order to quantify the impact we have used a conservative estimate that telecoms innovation currently accounts for 15% to 30% of the total impact from ICT in increasing GDP growth – i.e. a 0.15 to 0.30 percentage point increase in GDP growth. This is equivalent to about £400 billion to £900 billion higher GDP to the UK economy (in net present value terms). Section 5.2 provides an explanation of the derivation of this.

[28] Affuso and Waverman. February 2002. "The impact of electronic infrastructure on productivity and growth – a report for the performance and innovation unit". London Business School. http://www.pm.gov.uk/files/pdf/LBS.pdf
[29] Luisa Affuso and Leonard Waverman. February 2002
[30] ICT accounted for 6.26% of value added, while communications accounted for 0.85% of value added in the UK economy in 2000. Communications in the UK therefore accounted for 13.5% of value added within ICT. In the US, in contrast, communication accounted for 1.59% of value added whilst ICT accounted for 5.5%. Communications in the US therefore accounted for 28.9% of valued added within ICT. Basu et al. October 2003.
[31] Nicholas Oulton. 2001. "ICT and productivity growth in the United Kingdom". Bank of England Working Paper.
[32] Bart van Ark, Robert Inklaar, and Robert McGuckin (2003).
[33] In reality, telecoms and IT are almost totally dependent on each other. Because ICT innovation depends on telecoms innovation, if telecoms innovation lags IT innovation it will constraining all ICT innovation – in other words, telecoms could act as a bottleneck to growth.

1.4 Will ICT and telecoms matter in the future?

One reaction to the evidence above could be that, whilst ICT innovation and investment has driven economic growth in the past, this was a 'one-off' impact. Advocates of this position might say that the industry has matured – the Internet is now in place, uptake of IT is peaking. The implication of this would be that ICT's future role in GDP growth will be lower: the direct GDP growth increase would reduce with a future of declining prices for ICT which will not be offset by growth in demand; and, the indirect element will reduce since there are fewer remaining productivity benefits to be gained.

However, we see ICT playing a continuing and sustaining role in increasing economic growth. The reasoning for this view is:

- Firstly, there will be continuing productivity improvements and GDP growth based just on today's ICT technology. Continuing diffusion combined with increasing innovation in the use of this ICT will deliver a sustained increase in GDP growth rates into the future. This is similar to the impact of electricity and railroads which increased GDP growth rates over a long period
- Secondly, there will continue to be technological advances that will allow further advances in the capability of ICT itself and new ICT innovations

These issues are described below.

Whilst there have been substantial ICT improvements over the past ten years, diffusion of existing ICT services is far from complete. For example:

- Although about 70% of businesses are connected to the Internet, most of these are on narrowband connections at 56kbps. Only about 10% of businesses use the Internet for receiving orders and about 20% for making orders[34]
- Only about half of UK homes have a PC and only about 4% of UK homes[35] have a broadband connection (most of these are low speed connections of 512kbps or less)
- Mobile data is in its infancy and businesses are yet to exploit the opportunity of high speed connections away from 'fixed' locations
- The use of sophisticated software such as ERP and CRM is mostly limited to larger businesses

This points to substantial future benefits from existing ICT as diffusion increases and as providers innovate to create new ways to use existing ICT and production and management processes are modified to take advantage of it. Work by Brynjolfsson[36] has shown that it takes time for ICT innovation to be exploited by companies as there is a large amount of complementary investment and time required in creating new organisational and human capital.[37]

The impact of increasing diffusion will be particularly dramatic in the telecoms sector. Networks are subject to 'Metcalfe's Law', namely that as the number of nodes in a network increases the number of connections (and the value to all users) by the square of the number of users connected. This means that as the technology becomes diffused its benefit to users and its economic value increases at a higher rate than the

[34] OECD. August 2003. "ICT and economic growth – evidence" p25
[35] September 2003, source: Oftel
[36] Erik Brynjolfsson and Lrin M Hitt. June 2003. "Computing productivity: firm-level evidence". MIT Sloan Working Paper 4210-01. Published in *Review of Economics and Statistics*, Vol. 85, Issue 4, November 2003.
[37] Prof Brynjolfsson estimated that for every $1 of ICT investment a further $10 of other investment is required. Brynjolfsson and Hitt also found that it takes time for individual firms to reap the productivity and output benefits associated with ICT. Benefits were up to five times greater over five to seven years than they were at the time initial investment was made.

increase in penetration. One might therefore expect the contribution of telecoms and ICT to GDP growth to increase as existing ICT and networks are rolled out. As Affuso and Waverman[38] explain:

"*Telecommunications infrastructure is intrinsically different from other types of infrastructure: information highways are different from transportation highways. One seemingly important characteristic of telecommunications technologies, which is not present in other types of infrastructure, is the presence of network externalities: the more users, the more value is derived by those users. Given that these network externalities are not equally present in public infrastructure in general, one might expect that telecommunications infrastructure investments lead to larger growth effects than have been found for the other types of infrastructure*."

The characteristics of ICT in terms of having a continuing impact on increasing GDP growth is similar to the impact of other technologies which have been labelled as 'general purpose technologies' (GPTs). Past examples of GPTs include railroads and electrification – each of these had a transformational impact on the economy and fuelled sustained increased productivity and GDP growth over a long period. For example, the shift from steam to electric power took place between 1880 and 1930 in the US, and increased the productivity of labour and capital input during this period. However, the full productivity benefits of electricity actually came through over an extended period. This was because the full productivity benefits were only achieved as production and management processes were changed and the technology became more widely deployed. This is a process that can take a long time.

Basu et al[39] find support for the hypothesis that ICT is a general purpose technology and can therefore be expected to have a sustained impact on GDP growth. Oliner and Sichel (May 2002) reached a similar conclusion in considering whether the increase in productivity growth in the US is likely to be continue. "*This exercise generates a range for labor productivity growth of 2 percent to 2.75 percent per year, which suggests that much – and possibly all – of the resurgence is sustainable*".[40] The lag between diffusion and benefits in ICT that has been experienced in the US also implies that there will be sustained macroeconomic benefits from ICT.

These results suggest that ICT and telecoms will continue to contribute to an increase in GDP growth into the future, even if the underlying rate of technical progress in ICT slows or stops. However, there are many indicators that suggest that technological progress in the hardware/semiconductor industry, software and telecoms industries will continue apace for the next 10 to 20 years that will enable a new breed of applications and services that will continue to drive increased GDP growth. Some of the key technological drivers are highlighted below.

[38] Luisa Affuso and Leonard Waverman. February 2002
[39] Susanto Basu, John Fernald, Nicholas Oulton, Sylaja Srinivasan. October 2003
[40] Oliner and Sichel. May 2002. "Information technology and productivity: where are we now and where are we going?". *Federal Reserve Bank of Atlanta – Finance and Economics Discussion Series.* http://www.federalreserve.gov/pubs/feds/2002/200229/200229abs.html.

ICT technological drivers

IT Hardware	US	Europe
The forecast (known as 'Moore's Law' made in 1965[41]) predicted that the number of transistors per integrated circuit would double approximately every two years, remains true today and is expected to hold for at least another decade. The capacity of memory chips is also increasing in line with Moore's Law. Therefore, we can expect that ICT hardware will continue to improve in performance for some time to come. Intel conservatively estimate that there is another 15 years of potential advances[42]	Software advances could in principle continue indefinitely (since they depend on human invention). Historically, ICT software has greatly advanced the user interface with computers and the internet and the processes it can complete. Also software compression techniques (which are continuing to advance) allow greater quantities of useful information to be stored and transmitted for a given bandwidth[43]	Although there has been much recent technological progress there remain many new technologies or improvements to existing technologies that will enable further growth. For instance, • DSL that can go up to 8Mbps over copper and 50Mbps over fibre • Gigabit to the home over plastic optical fibre • New wireless technologies such as the 802.x and Bluetooth • New modulation techniques that enable better quality and throughput • New mobile technologies such as 4G and improvements to 3G • Continuing improvements in IP to allow better quality of service • Wide area Ethernet

Together these will provide the ICT sector with a platform for continuing innovation which will enable a new breed of services and applications that will continue to enable productivity improvements and economic growth. The table below shows some examples of new service and application innovations and improvements that are possible in future – though fundamental innovations are unlikely to be anticipated.

Examples of potential new ICT applications

• Grid computing - which may allow networked computing resources to be used far more effectively. • Robotics which will extend ICT into general purpose machines • The concept of on-demand enterprise computing and network based applications which will allow companies to use more sophisticated software and deploy and integrate software more efficiently than could be achieved with the traditional model of running many applications remotely	• New home based services such as television on demand (using PVR and broadband) or ultimately the intelligent home concept where many home devices are networked • 3D video conferencing and 'tele-immersion' • e-medicine and remote diagnostic • In the Criminal Justice sector, remote ID parades and remote trials and bail applications • New approaches to working such as joint workspaces, white boarding and collaborative working	• e-education or more generally the ability for more interactive education to be available online will facilitate better and more accessible learning • More effective home-working options with better/cheaper home connectivity. Aside of social benefits this would for instance, reduce travel costs • RFID (Radio Frequency Identifiers) which are tiny wireless devices that can be used to, for example, check physical stock or identify vehicles in a toll or vehicle management system

In conclusion, there is little or no reason to expect the contribution of ICT innovation to increasing GDP growth to reduce in the near future. The on-going diffusion and innovation in use of existing technologies

[41] Moore's Law and the progression of processing speeds can be seen in http://www.intel.com/research/silicon/mooreslaw.htm
[42] Intel predict a theoretical limit to Moore's Law with 16-nanometer manufacturing process which they expect to be reached sometime after 2018 (source: http://zdnet.com.com/2100-1103_2-5112061.html)
[43] For example, MPEG-2 made possible the recording of feature length films on DVD, MPEG-3 allowed the development of the music download industry, while MPEG-4 has made possible the transmission of reasonable quality real time video over DSL lines which will help facilitate the convergence of TV and telecoms

combined with on-going and rapid technological advances will mean that ICT will play a key role in increasing GDP growth for decades to come. Equally, there is no reason to expect telecoms role within ICT to diminish. If anything the dependency of ICT on telecoms will increase since most of the new ICT applications are more dependent on telecoms and also, the networking effect of telecoms will increase telecom's importance as diffusion rises.

1.5 Conclusion

This section addressed the critical and substantial role that ICT and telecoms innovation has had and will continue to have in economic growth.

Since 1995 in the US, ICT has increased GDP growth by one percentage point each year. The majority of this benefit was based on innovations in the ICT sector improving economy-wide productivity.

Telecoms innovation has played a critical role – telecoms innovation is a critical enabler for ICT to deliver sustained economic growth and the economy's dependence on telecoms is growing with ICT convergence. We conservatively estimate that 15% to 30% of the total increase in growth from ICT (i.e. 0.15 to 0.3 percentage points on GDP growth each year). The impact from ICT innovation will probably continue for decades. Within ICT, telecom innovation may have an increasing role in ICT's effect on GDP growth due to, in particular, networking effects.

In the next section we examine the critical role that competition has in stimulating innovation.

2 The critical role of competition in driving innovation

This section emphasises the critical role that competition has in stimulating innovation and economic growth.

In many senses, the role of competition in driving innovation seems very obvious – this relationship is a mainstay of market based economic theory. However, rather than just passing over this issue, we have highlighted our view on why this relationship exists drawing on theoretical, survey based empirical and anecdotal evidence.

Perhaps the most compelling (and extreme) evidence supporting the role of competition is the relative success of free-market economies compared to centrally planned communist economies. It is commonly accepted that central planning limited innovation and economic growth and the success of the capitalist economies was and is based on competition and innovation.

The underlying reasons why competition would be expected to foster innovation, investment and economic growth are less straightforward. Below we have described various views on why competition has such an impact on innovation.

Why competition drives innovation[44]

- Competition allows diversity in approach. Competition allows constant experimentation and innovation in what to produce, how to organise production, and how to price output. In effect, competition lets 'many flowers bloom' and allows diversity of thinking i.e. 'many minds are better than few'
- Competition allows the entry and exit of firms in markets which is critical for growth. The entry and exit of firms has been shown to account for a substantial share of productivity growth. As Barnes and Haskel note: *"The major insight from plant-level evidence is that at least half of productivity growth over a decade is due to changes in the market fortunes of goods and bad firms, with entry and exit particularly important in this reallocation process".*[45] Lack of competition allows weaker firms to survive and improve gradually. Competition ensures that only firms that innovate rapidly and successfully survive
- Competition creates incentives for firms to innovate to reduce production costs. With effective competition prices are set by the market[46] and firms retain cost reductions creating strong incentives to innovate to cut costs. In an ineffectively competitive industry, or with a regulated monopoly, prices and costs for individual firms are more closely linked – thereby weakening incentives to innovate to cut costs.[47]
- Competition allows benchmarking to improve performance. Owners and managers of and within competitive firms have other firms in the same market against which to benchmark performance. Improved reward systems can therefore be implemented based on differences in performance due to effort and innovation, rather than differences due external events impacting the industry as a whole.[48]

This theory has been borne out time and again in different markets. Below we highlight views of a number of economists on the role that competition has in driving innovation.

- In a comparison of regulation and performance in OECD countries Alesina et al (2003) found that barriers to entry (and restrictions of competition) are negatively related to investment and innovation.[49] The study focussed on airlines, road freight, railways, telecommunications, postal

[44] Property rights and respect for risky investments are also necessary if competition is to drive innovation. Property rights (intellectual or other types) and respect for risky investments facilitate R&D and irreversible investment in long lived specific capital by assuring investors that their innovations and investments will not be expropriated.
[45] Mathew Barnes and Jonathan Haskel. 2000. "Productivity, competition and downsizing." Paper for HM Treasury seminar held at 11 Downing Street on "Economic Growth and Government Policy".
[46] This concept is known as price takers where players in a market take the price set by the market and cannot influence the price themselves
[47] Brian Williamson. 2000. "Competition, policy stability and growth". Paper for HM Treasury seminar held at 11 Downing Street on "Economic Growth and Government Policy".
[48] Farrell. 2001. "Monopoly Slack and Competitive Rigor", in Eric Rasmusen, Readings in Games and Information. Oxford: Blackwell Publishing.
[49] Alberto Alesina, Silvia Ardagna, Giusseppe Nicoletti, and Fabio Schiantarelli. March 2003. "Regulation and investment". National Bureau of Economic Research Working Paper 9560.

services, electricity and gas. They found that a reduction in barriers to entry and increasing competition leads to a reduction in the mark-up of prices over costs, and hence to a reduction in the penalty for expanding the capital stock and production.[50]

- A study by the OECD (2003) on ICT and economic growth concluded in relation to policy implications that: "*… policy should foster market conditions that reward the successful adoption of ICT; a competitive market environment is key for this to happen*."
- The World Bank (1999) in examining competition in wireless telecoms noted: "*Many governments, particularly in developing and emerging market economies, still doubt the benefits of competition in wireless services. But international experience shows that competition in any of the digital technologies brings substantial benefits to users and creates powerful incentives for incumbent fixed-line operators to lower prices, introduce new services, and increase productivity*"[51]
- Nickell (1996), in a general review of competition and corporate performance in the UK, concluded that "*…competition, as measured by increased numbers of competitors or by lower levels of rents, is associated with a significantly higher rate of total factor productivity growth".*[52] *Nickell also concluded that* "… market power, as captured by market share, generates reduced levels of productivity".
- An OECD (2001) study of regulation, market structure and performance in telecommunications concluded that: "*Based on the comparative experience of a large set of OECD countries over the 1990s, it provides empirical support evidence that liberalisation of entry and the development of effective competition in telecommunications services generally leads to higher productivity, lower prices and better quality*."[53]

These examples support the idea of the link between competition, investment/innovation and economic growth. Competition also drives lower prices and lower costs.

The concept that competition drives innovation is further reinforced by examining the sources of innovation. This points to an important and critical role for smaller, non-incumbent firms. Obviously without effectively competitive markets, non-incumbents cannot exist and prosper. Research by the DTI[54] also suggested that propensity to innovate was not driven by scale.

The role of non-incumbents is also very apparent in the telecoms sector. As Cave and Vogelsang (2003) [55] noted in relation to the Netherlands the non-incumbents were the source of most innovation. "*What is immediately striking about this process [the development of competition in the Netherlands] is that, although KPN remains the dominant supplier of traditional telecommunications services, other innovations have sprung predominantly from other companies"*

[50] The barriers to entry indicator took a value of 0 when entry is free (i.e. a situation with three or more competitors and with complete ownership separation of natural monopoly and competitive segments of the industry) and a value of 6 when entry is severely restricted (i.e. situations with legal monopoly and full vertical integration in network industries). The UK telecommunications market falls between these two extremes.
[51] World Bank Viewpoint "Competition in mobile telecoms". 1999. http://rru.worldbank.org/viewpoint/HTMLNotes/184/184rosso.pdf
[52] Stephen Nickell. 1996. "Competition and Corporate Performance". *Journal of Political Economy*, Vol 104(4).
[53] Oliver Boylaud and Giuseppe Nicoletti. 2001. "Regulation, market structure and performance in telecommunications". OECD Economic Studies No 32.
[54] "Living Innovation", DTI and Design Council 2000. It uses a study of fifty innovating firms to show that propensity to innovate is a function of company culture, driven by leadership, mission and values rather than the size of the company
[55] Martin Cave and Ingo Vogelsang. 2003. "How access pricing and entry interact". *Telecommunications Policy* 27: Page 726..

The same has been true in the UK. The table below shows the first player to market for a number of new telecoms products over the last several years in the UK. What is revealing is the important role of non-incumbents and secondly the diversity of innovators (even though innovation was substantially limited under prevailing regulation) – both issues that point clearly to the role of competition to drive innovation.

Product/service innovations in the UK[56]

- Subscription free Internet access – Freeserve/Energis
- Unmetered Internet access – AOL[57]
- National Ethernet – Neos Networks
- Differentiated SLA packages – COLT
- Video on demand over DSL – Kingston
- IP MPLS – Cable and Wireless
- Broadband – ntl/Telewest
- ADSL – BT
- SDSL – Bulldog/Easynet

More generally in UK telecoms, competition (even though substantially limited under prevailing regulation) has been a key driver of most of the innovation successes in the past 15 years. The most compelling corroborations of this are the narrowband Internet access market from 1997 (where the UK experienced a huge level of innovation which rapidly increased uptake driven by innovations in the way services were offered by Freeserve, initially, and then AOL) and the mobile sector from 1993 when the opening up of additional radio-spectrum allowed more operators to enter the market. What happened in the mobile sectors is outlined below.

Mobile in the UK

The mobile sector experienced huge growth from 1993 driven by massive investment and innovation triggered by the introduction of more competition increasing the number of operators from two to four. The key areas were:

- New packages to appeal to a wider market (rather than the previous 'one size fits all' approach) combined with lower prices and (in 1997) pre-pay packages
- Investment in network coverage and capacity, product development and marketing which together increased by around four fold
- The operators themselves innovated in the way that they operated their business to be able to manage lower revenue customers profitably and reduce their costs

This created direct economic growth due to expansion of the telecoms sector as expenditure and consumer surplus increased. This innovation also resulted in huge indirect benefits as businesses were able to become more productive as staff, customers, suppliers and partners all became more contactable, wasted time was reduced and travel time could be used more productively.

[56] These are our best estimates since historic launch dates are not always available
[57] Although BT came to market at the same time the initial drive was from AOL

This linkage between competition and innovation is also apparent outside the telecoms sector – the airline sector particularly in the UK and Europe has experienced similar dynamics. The key aspects are described below.

Innovation in the European airline industry

European air travel deregulated in the mid-90s with the open skies policy and more open access of landing slots. This allowed the entry of many new players which brought a profound and beneficial change in the industry. This created a huge amount of innovation across a number of levels:

- Entry of new services and opening up of new routes
- Changed booking process (running a simple booking system with no or limited intermediaries)
- Yield management through offering different priced tickets depending on advanced booking and other price innovations
- Non-allocated seating
- Offering 'no frills' packages (no waiting lounges, fitting more seats in the airplanes, no food, no newspapers, etc),
- Using secondary airports with lower landing fees

As a result, a customer segment with low income but high flexibility, that before the mid-90s could not afford frequent air travel, benefited from the entry of new airlines. Also, many other existing travellers have been able to take advantage of these new providers. Benefits were substantial – for example, passenger volumes grew rapidly, and the incumbents were forced to innovate themselves.

2.1 Conclusion

Whilst, as we pointed out in the introduction to this section, the role of competition and competitive market forces in driving innovation seems obvious, in this section we have provided compelling theoretical, survey based empirical and anecdotal evidence that the linkage is strong. Competition creates the conditions and behavioural incentives for innovation and it also allows smaller firms which are critical to innovation to enter new markets and innovate.

In the next section we examine how effective the UK telecoms sector in delivering on innovation, in particular relation to competition's role in driving investment and innovation.

3 Is the UK telecoms sector conducive to innovation?

We highlighted in Section 1 the linkage between telecoms innovation and economic growth. Section 2 addressed the importance of competition to drive innovation. This section addresses the issue of whether the current telecoms sector is conducive to fostering competition, innovation and investment.

When looking at innovation in the telecoms industry (as with other industries) it is necessary to consider all parts of the value chain in delivering services. We generally refer to these as *upstream* and *downstream* activities. Upstream activities in telecoms are those activities physically close to the customer such as the local access network. Downstream activities are typically core network, product development and retailing activities. It is also necessary to consider the role of incumbents and non-incumbents Therefore, to assess how well the sector is performing in delivering innovation, it is important to look at combinations of these activities and companies.

As we outline below (Section 3.1), non-incumbent upstream competitors have had limited impact on competition and innovation since they have limited scale and reach.[58] Therefore, although in the longer term, upstream competition may increase, for the purposes of this evaluation of telecoms innovation today it has limited relevance. Accordingly, we have excluded this group from our analysis. The other three groups considered are BT upstream, BT downstream and downstream competitors. The ability and incentive for each of these groups to innovate is discussed in turn in this section:

- Downstream competitors to BT (Section 3.2)
- BT's downstream activities (3.3)
- BT's upstream activities (3.4)

Before starting the assessment of each group, we examine the evolution of regulation and competition (3.1) in the UK to provide context for the following sections and in particular why downstream competition is critical to the sector's success and innovation.

3.1 Current state of regulation and competition in the UK

Ever since BT was privatised and competition introduced in 1984[59], regulation has played a key role in the sector. The broad aim of regulation was to foster competition recognising that regulation is an inferior surrogate for true competition. The quotes below reinforce this view.

Regulation versus competition

Stephen Littlechild[60]	Beard et al[61]
"*Competition is indisputably the most effective – perhaps the only effective means – of protecting consumers against monopoly power. Regulation is essentially the means of preventing the worst excesses of monopoly; it is not a substitute for competition. It is a means of 'holding the fort' until competition arrives*"	"*… regulation is incapable of fully replicating the incentive and performance properties of a competitive market. Even under the best of circumstances, regulation can be expected to yield results relatively inferior to those offered by effective competition*"

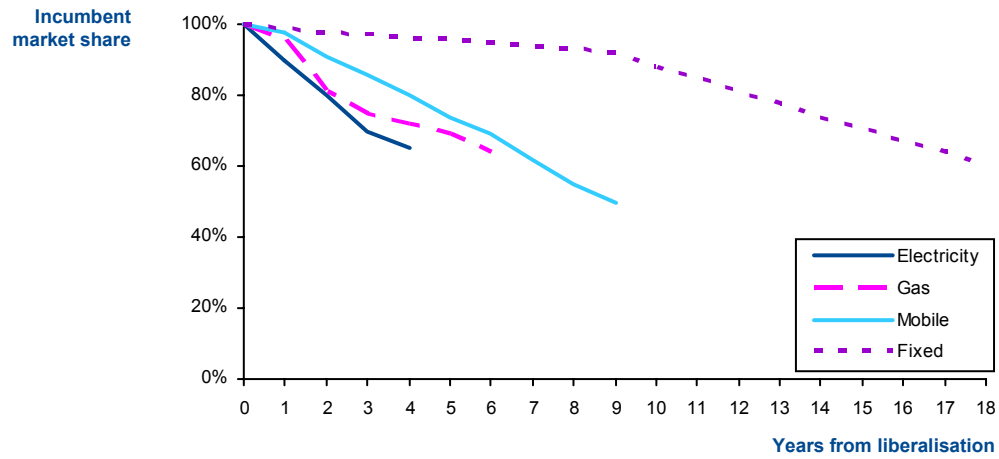
[58] For example, for larger companies, alternative upstream access providers together may only be able to provide access for 20% to 40% of sites. Even if these are of a high quality, the overall proposition will rely on BT's upstream offer
[59] Some liberalisation happened in 1982 although we use 1984 as the starting point
[60] Stephen Littlechild, in his 1983 report on Regulation of British Telecommunications Profitability for the Department of Industry, noted in paragraph 4.11
[61] Beard, T, Kaserman, D, Mayo, J. September 2001. "Regulation, vertical integration and sabotage." *The Journal of Industrial Economics,* Volume XLIX (3).

Since liberalisation in 1984, the UK has gone through several stages of regulation, all aimed at increasing competition. The key stages were:

- duopoly period (1983 to 1990): one new operator (Mercury) with a focus on retail price reductions through price caps. By the end of this period BT still had a market share of about 90%
- initial post-duopoly period (from 1991): 'open' entry aimed at developing additional competition and in particular facilities or access-based competition (i.e. in the upstream market). However, the level of facilities based competition that emerged was much more limited than hoped for by many.[62] Consequently, upstream competition failed to deliver the competitive stimulus in the market
- more recently, regulation has focused on facilitating competition in downstream markets predicated on facilitating access to the incumbents facilities for competitors in downstream layers[63]

However, now 19 years after initial liberalisation, BT still has 60% share of the retail or downstream market and 80% to 90% of the upstream market. Comparing the retail market share of BT versus other incumbents in liberalised markets, we see that the electricity, gas and mobile[64] markets achieved what the telecoms markets took 19 years to do in between five and nine years.

Incumbent market share evolution



Within this overall trend there are two other features that are worrying in the context of competition. Firstly, in some newer market segments, BT's share is higher – in other words we are going backwards. The key example of this is the broadband Internet access market which is substantially less competitive than the analogous narrowband Internet access market – BT has about a 50% share of retail (versus 20% to 25% in

[62] Early attempts at wireless local loop failed, cable competition is limited and confined to specific geographical areas, fibre based competition is limited to very urban areas for business customers only. For example, "*The only sector where there was the possibility of avoiding this was in telecoms, where the concept of competing networks was tried in the UK (but not elsewhere) but failed".* John Cubbin and David Currie. May 2002. "Regulatory creep and regulatory withdrawal: why regulatory withdrawal is feasible and necessary". City University

[63] For example, "*it is important to lay down principles to guarantee transparency, access to information, non-discrimination and equality of access, in particular for organisations with significant market power*" Para 9 of the ONP Directive (Directive 97/33EC). "*NRAs should have the power to secure … adequate access and interconnection and inter-operability of services in the interests of end-users*". Para 6 of the Access Interconnection Directive (Directive 2002/19/EC).

[64] For illustrative purposes we use the point of entry of the third operator as the liberalisation point and conservatively count both Vodafone and Cellnet together as though they were a single incumbent operator

narrowband) and over 95% share of the intermediate trunk market[65] (versus 30% to 35% in narrowband). Secondly, BT's market share is increasing in some segments.[66]

In the context of the importance of competition as a driver of innovation, the low current level of competition (combined with reducing competition in some segments) suggests that the sector is not conducive to innovation. The following sections examine in more detail some of the problems that are hampering innovation and (at the same time) competition. It points towards the under-performance of the sector as a whole in terms of its competitiveness and innovation due to constraints on the key players.

3.2 Innovation by non-incumbents

As described above, many of the current regulatory objectives are centred around ensuring fair access to upstream monopoly elements. One of the primary aims of this was to allow downstream competitors to compete effectively and innovate. However, fair access is not simple to achieve since BT is vertically integrated and it is rational and in its shareholders' interests for BT to treat downstream competitors differently to its own downstream activities.

The risk of such undue preference by vertically integrated dominant providers has been clearly recognised by policy makers who have taken steps to prevent such behaviour and try to ensure that all downstream operators are treated on an equivalent basis to BT's own downstream operations. The quotes below are from relevant EC and Oftel regulation on equivalence issues and show a clear recognition of equivalence as a prerequisite to a competitive market and also the need for equivalence to replicate as far as possible the dynamics one would expect to see in a competitive market.

Policy relating to equivalence

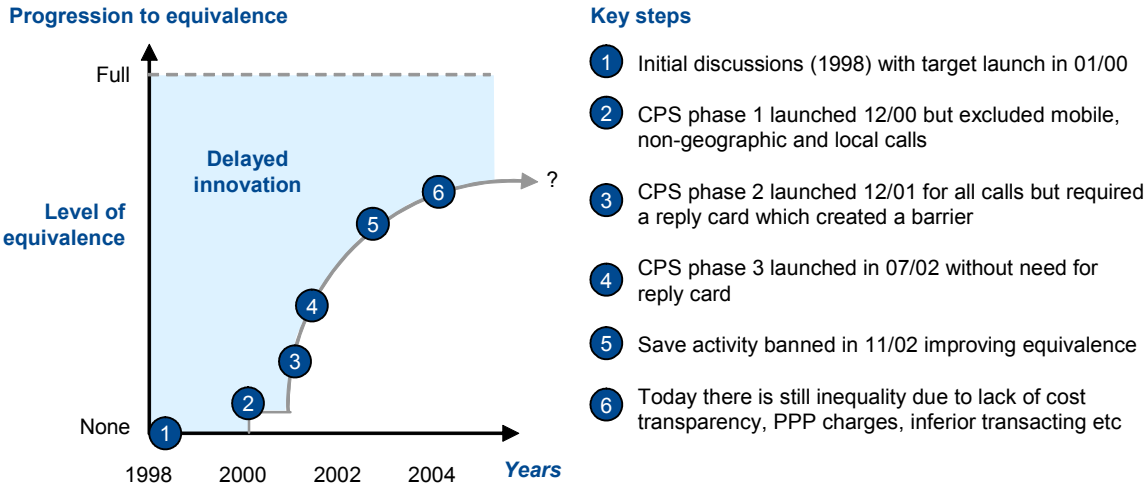
EC Directive	Oftel
"*Obligations of non-discrimination shall ensure, in particular, that the [upstream SMP] operator applies equivalent conditions in equivalent circumstances to other undertakings providing equivalent services and provides services and information to others under the same conditions and of the same quality as it provides for its own services, or those of its subsidiaries or partners*"[67] [emphasis added]	"*Oftel intends to apply this [requirements for fairness, reasonableness and timeliness] to all obligations to provide access. Oftel takes 'fair and reasonable' to mean, amongst other things, that terms and conditions under which products are offered are consistent with those which would be offered in a competitive market, sensible, practical, and do not impose a margin squeeze on competitors*"[68] [emphasis added]

However, we believe that there is and clear strong evidence that we are a long way away from achieving equivalence. The initial difficulty that downstream competitors face is delay in gaining 'fit for purpose' wholesale upstream products. Typically, it takes 2 to 4 years from first request for a partially 'fit for purpose' wholesale product to be made available. Even when this product is available it is not on an equivalent basis and it often takes years more to get an offering that is close to being equivalent. As far as we can see, there is no upstream product that is offered by BT on an truly equivalent basis. Essentially non-equivalence is systemic.

[65] This is the wholesale market for backhaul of ISP traffic. Wholesale providers collect traffic at or close to BT's DLEs and transit the traffic to the ISP.
[66] For example, BT's market share of call traffic increased from 66.2% (Q2 02) to 69.3% (Q2 03) and lines 81.8% to 82.2%. Note: the quarters given are calendar quarters. Source: http://www.ofcom.org.uk/static/archive/oftel/publications/market_info/2003/fixed/miuq5_1103.pdf page 5
[67] Article 10(2) of the Access Interconnection Directive (Directive 2002/19/EC). This requirement is valid for both existing and new services.
[68] "Imposing access obligations under the new EU Directives", 13 September 2002 Para 3.39. http://www.ofcom.org.uk/static/archive/oftel/publications/ind_guidelines/acce0902.htm

An example that characterises many of the problems is CPS which was aimed at allowing downstream operators equivalent access to BT's upstream voice products. The slow evolution of CPS towards equivalence is shown in the exhibit below. It shows how initial delays and a slow erosion of inequalities mean that lack of equivalence persists for a long time. The blue shaded area represents the delay in gaining innovation – the slower the progress towards equivalence the greater the area and the greater the damage to innovation.

Progress of CPS towards equivalence



Below we provide some examples of the various sources of lack of equivalence across a range of products. We have broken these into four groups

- Delay in initial availability of wholesale products
- Lack of equivalence in price
- Lack of equivalence in non-price factors
- Lack of ability to check for and/or enforce equivalence

Each of these is discussed below.

Note: in all the examples below BT is referred to in terms of BT Downstream (BTD) and BT Upstream (BTU) rather than the actual operating divisions (e.g. BT Wholesale and BT Retail) since these operating divisions provide a mixture of downstream and upstream roles[69]

[69] We have been provided many of the examples of these anecdotes by C&W. We have independently verified some of these but verification of all the examples has not been possible due to much of the relevant information needed to verify these not being available in the public domain

Delay in availability of wholesale products

Key examples of the delay in availability of wholesale products are explained below. Clearly without key access products downstream competitors cannot fully innovate.

Delay of fit for purpose wholesale products

- The main upstream input product for companies to offer managed data services are private circuits. Initially downstream competitors were offered no wholesale product but bought retail private circuits (RPC) with volume discounts. For many years they requested a wholesale product. In 1999, they began to lobby for a proper wholesale product and eventually in 2001, BT was required to introduce a wholesale private circuit product (called PPC – partial private circuits)
- In December 1999, several operators requested that BTU offer an unmetered origination product to allow them to offer a retail unmetered internet access product to end users. BT initially refused. Within a month, BTD announced it would offer a unmetered internet access product at retail. In May 2000, after further lobbying Oftel required BT to offer a wholesale product (now called FRIACO) that would allow downstream competitors to offer a retail unmetered service. Eventually, BT did offer a FRIACO product but it was initially only available if downstream competitors interconnected into the BT network at the deepest level in the network (BT's DLEs). Interconnection at a higher level (Single Tandem) was initially not offered and then, when offered, was rationed and priced highly. The impact of this was to limit competition in the downstream market since few downstream operators had sufficient scale to warrant such a high number of interconnects
- In July 1999, BT announced it would launch an ADSL backhaul product (IPStream) and a wholesale version of this called DataStream. BT launched IPStream in May 2000. Up until the end of 2002, DataStream was impractical to use. Even now (start of 2004) it is used in an extremely limited way since the product is not workable under the terms offered.
- BTD has retailed a LAN Extension service (LES[70]) for several years. A wholesale product was first requested in July 2001. Today (2½ years later) a wholesale product is not available preventing downstream competitors from offering Ethernet services on an equivalent basis using BTU infrastructure[71]
- Carrier pre-selection (CPS) was first discussed in 1998 and was targeted for launch in January 2000 (an EU requirement). After various substandard products (including an interim option that required end customers to install a dialler on each extension), CPS phase 3, the first close to 'fit for purpose' product (i.e. for all calls and not requiring a reply slip rather than an electronic request) was introduced in July 2002. The poor usability of the previous CPS versions was evidenced by the very low uptake until phase 3 was launched. Notably much of the delay in CPS was justified by BT's decision to install non-CPS capable equipment in the mid 1990s.
- Wholesale line rental (WLR) has been requested by downstream competitors for a long time although initial formal discussions were not held until November 2001. WLR phase 1 was launched in 2002 although this is not 'fit for purpose' since it did not cover certain types of lines (e.g. ISDN products) and excludes call features such as divert and select services. The phase 2 (targeted for March 04) product was originally intended to include these omissions but it is likely that these will not be available until August 2004

[70] LES is an Ethernet based service for data transmission
[71] Downstream operators could offer the service using another BTU wholesale product PPCs but this would mean that downstream competitors would be severely cost disadvantaged since both the price per Mbps is higher and the capacity (in Mbps) needs to be bigger since the standard units of PPCs are different to Ethernet services e.g. to offer a 100Mbps Ethernet service would require purchasing a 155Mbps PPC

Lack of price equivalence

Even when wholesale upstream products are made available, there is still a risk of non-equivalence.

The most obvious form of lack of equivalence (once a wholesale service is made available) is price. If downstream competitors are charged higher prices than BT's own downstream activities, competitors would be at a cost disadvantage to BT reducing competition and innovation. However, whilst on-going intervention from Oftel has in the past delivered some improvement, there are still major weaknesses in the current regime and downstream competitors to BT do not gain access on equivalent prices. Below we give some indicative examples of lack of price equivalence.

Price issues

- Downstream competitors are required to pay a PPP[72] charge which is supposed to cover the cost of BTU of doing business with downstream competitors. For some types of traffic this adds a cost of over 20% over the basic price. It appears that BTD is not required to pay the PPP charge (on BT-to-BT traffic) or any similar charge even though BTU must incur costs to do business with BTD
- Downstream competitors are required to pay quarterly in advance for PPC rentals whereas we believe that BTD pays monthly in arrears
- DataStream is the wholesale input product that downstream competitors use to compete in offering downstream products to compete with BT's IPStream and Internet access services. Since its launch there have been numerous complaints of a margin squeeze that has prevented downstream competitors from offering a product to compete with IPStream
- Since the FRIACO wholesale service was launched (albeit very late, see above), BT has levied an IN charge which was supposed to recover relevant costs from its Intelligent Network platform. This charge represented about a 13% surcharge over the basic product. After 2 years of lobbying by downstream purchasers of this product and intervention by Oftel, BTU admitted that the IN functionality was not used and therefore the charge was not justified. The charges were refunded. It is not clear whether BTD ever paid these IN charges
- PPC prices paid in 2001 were probably about 50% more than levels reflective of cost[73]
- More generally, the whole process to ensure price equivalence is not transparent and is characterised by a high level of information asymmetry in favour of BT. This problem is made more difficult since in many cases BTD does not purchase the same wholesale products that downstream competitors do. Therefore, there can be little confidence that there is price equivalence

[72] PPP is product management, policy and planning
[73] In 2001 and 2002, PPC prices were reduced by a total of 50% to what were deemed to be levels that were more reflective of cost. Given it is unlikely that costs fell by much more than 20% over this period we can infer the price premium prior to the reduction was over 50%. We make no comment about overall price/cost levels today

Lack of equivalence in non-price factors

Lack of equivalence can also occur on non-price factors which also disadvantage downstream competitors and reduce competition and innovation. The incentive to not offer equivalence on non-price factors becomes increasingly important as wholesale prices are reduced as Beard et al[74] and others[75] have noted.

As with price, BT has come under consistent pressure from Oftel to offer equivalent services to downstream competitors. However, whilst there has been improvement over time, most intervention has been focussed on trying to deliver equivalent wholesale products (although this has broadly failed as we point out above) rather than ensuring the pre-requisite equivalence of transacting processes for BT's own downstream activities and downstream competitors. Since discrimination in terms of transacting processes is as important as price and product specification as a means of discrimination, continuation of this approach to regulation cannot be expected to deliver equivalence. Below we highlight examples of non-price terms that we believe are symptomatic of the lack of equivalence from different and inferior transacting processes.

Non-price terms

- Generally, downstream competitors have to transact with BTU through 'bolt on' systems to BT's main systems (often called 'service provider gateways'). BTD transacts directly with the main systems. This in itself diverges from the strict principle of equivalence requirement. It is also true that the system provides downstream competitors with an inferior transacting service than BTD receives. For example:
  - for CPS, downstream competitors are required to enter a customer identifier using a postcode. They are not able to check its validity against the postcode that BT has in its systems (even though the postcodes BT captures are sometimes incorrect). Nor are they able to enter the BT account number as a means of validating the customer. BTD can do this
  - downstream competitors are required to use different service provider gateways for each product. BTD, in effect, uses a single system
- For wholesale line rental, BTU has insisted on credit vetting downstream competitors and on receiving payment by direct debit. For large downstream competitors such as C&W this process is unnecessary and inefficient (for both customer and supplier). It is likely that, in effect, downstream competitors pay for the cost BTU incurs in doing this as well as their own cost. BTD does not need to pay BTU by direct debit
- For most wholesale products, downstream competitors are required to provide binding demand forecasts (for up to 12 months out). If the out-turn deviates from the forecast downstream competitors incur costs either in having to pay for the full forecast or being unable to get product. As far as we are aware, BTD does not need to forecast with these same cost impacts.
- BT received preferential access to advertising on the front pages of it phone directories to promote its directory enquiries (DQ) service
- The process that is used to request new products from BTU is called the Statement of Requirement (SOR). It appears that BTD does not use this process
- Of all the Statement of Requirements that downstream competitors have submitted in the last 2-3 years (a total of about 100), only about 5% of these have been delivered by BTU without Oftel intervention and those that were tended to be the less significant ones (e.g. a battery back-up service in one case).[76] A reason BT has sometimes given for not meeting an SOR is that the request is incompatible with their technical architecture – however, BTU will not provide downstream competitors with details of their architecture (for confidentiality reasons) so that SOR requests are made 'in the dark'
- For CPS, up to October 2003, BTD was able to use information that downstream competitors provided to BTU to proactively call potential CPS 'defectors' to try and persuade them not to switch. This was known as 'save' activity and was only stopped by Oftel intervention following pressure from downstream competitors

[74] Beard, T, Kaserman, D, Mayo, J. September 2001
[75] In addition, Mandy (2000) in "Killing the Goose that may have laid the golden egg: only the data know whether sabotage pays", *Journal of Regulatory Economics*: 17(2) notes that "*If an industry has an upstream margin much closer to the bilateral monopolist's optimum … then the level of inefficiency and intensity of downstream competition needed to avoid sabotage are correspondingly lower.*"
[76] Based on an informal poll by C&W of itself and other OLOs (other licensed operators)

Lack of ability to check for and/or enforce equivalence

The last issue regarding lack of equivalence is the ability to check for and enforce equivalence. It is accepted that BT has an incentive to give undue preference to its own downstream activities in order to maximise its shareholders interests. Therefore, it is critical for the regulator to be able to check for any lack of equivalence and if necessary impose penalties. Currently, it is extremely difficult to check for equivalence given the lack of transparency. We highlight below some examples of the problems in this area.

Inability to check for and/or enforce equivalence

- In many cases, BTD does not purchase the same products as downstream competitors do making it at worst impossible (and at best extremely difficult) to ensure equivalence. For example:
  - in the case of downstream competitors purchasing PPCs, BTD does not purchase PPCs but rather 'network components' from BTU
  - The logical upstream product for offering IPStream is DataStream. BT does not use DataStream as an input itself to provide IPStream
- Whilst BT has a Wholesale division and a Retail division these do not map well onto the downstream (and upstream) elements. This means that there is a lack of clarity when it comes to regulatory accounting to check for, for example, cross-subsidies or margin squeezes. This makes it very difficult to enforce equivalence. Examples of this include
  - BT Retail provides part of the PPC product
  - BT Wholesale provides both upstream and downstream elements of the ADSL product (DataStream, an upstream product, and IPStream, a product that downstream competitors wish to offer, respectively)
  - BT Retail provides some product development effort for BT Wholesale
- The service levels that BTD gets from BTU are not always measured. For example, for PPCs, BTU is not required to report the performance levels that it delivers to BTD[77]
- Penalties to enforce equivalence (to the degree to which they exist) are not used and are not effective. Even though there is clear lack of equivalence no penalties have ever been imposed on BT

The examples above across the four areas of equivalence, whilst not comprehensive, do demonstrate that there is a clear lack of equivalence. The problems are often greatest in new product areas such as DSL and Ethernet. This lack of equivalence limits downstream competitors ability to compete on a level playing field.

At best, the impact of this is that the power of competition to drive innovation is reduced and innovation is delayed. At worst innovations may be lost since through delay since BT may be able to gain such a dominant position that downstream competitors are unable to innovate themselves. In Section 2 we highlighted that non-incumbents are critical to innovation. With downstream competitors hindered in their ability to innovate, the ability of the whole sector to innovate is significantly reduced and the wider economy severely damaged.

3.3 Innovation by BT downstream

Innovation in the telecoms sector is not just dependent on competitors to BT. BT's downstream activities need to have freedom to compete, innovate and invest. However, an unfortunate but necessary and proportionate side effect of the regulation aimed at limiting undue preference (amongst other things) has been to constrain BTD's ability to compete and shackle it, in some areas, from competing and innovating

[77] BTD (BT Retail in this case) is required to report the service levels that BTD provides to its customers which, we presume is considered a proxy for the service level that it receives from BTU. Measuring the service level BTD receives from BTU is unfeasible since BTD does not purchase PPCs from BTU (it purchases what are referred to as 'network components')

vigorously. Some indicative examples of the lack of commercial flexibility and regulatory burden and their impacts are described below.

- In theory, BTD is prevented from launching retail products before an equivalent upstream/wholesale product is available. This limits BTD's ability to gain first mover advantage which is one of the mainstays of the rationale to innovate. We say 'in theory' here since although BT is required to launch fair and reasonable wholesale products simultaneously to retail products, this does not happen and BT is in effect able to disregard this requirement (as highlighted in Section 3.3)
- BT has in the past had limited commercial flexibility in some areas – for instance, restrictions on pricing flexibility (which customers find frustrating[78]) and bundling (for instance, ISP services were required to be sold separately) and the need to publish prices in advance of launch (in a competitive market innovating players would tend to delay publishing information about new launches to maintain their competitive edge). However, these restrictions have been relaxed in many areas[79], may be further relaxed and, in any case, BT is able to circumvent these to some degree by bundling price controlled services with uncontrolled services
- In order to facilitate equivalence on provisioning times for PPCs, BTU is required to delay delivering PPC-like circuits to BTD[80] (or 'sit on an order') in order to ensure a 'level playing field'. In effect, the market is brought down to the lowest common denominator. Again although this is the rule, there is no robust way of this requirement on BT being ensured or enforced
- BTD (along with BTU) has a large regulatory burden in terms of compliance governance, regulatory management, compliance training for many of its staff and regulatory reporting. The cost of this probably runs into £10s millions per year

Another particularly damaging aspect of the regulatory regime on BT is the subtle behavioural effect it probably has on the way that BT operates and innovates which can result in the rate of innovation being substantially slowed to the sometimes conflicting demands of meeting regulatory as well as shareholder requirements.

Lastly, the lack of effective competition means that BT is lacking the full competitive pressures to induce it and incent it to innovate rapidly.

3.4 Innovation by BT upstream

Investment and innovation needs to occur both upstream and downstream to deliver new services. For example, in narrowband internet access, most managed data services and mobile the majority of innovation occurs downstream in terms of developing new services and developing the core network (i.e. the network excluding access). In other cases, such as the initial roll-out of broadband, investment and some innovation occurs upstream. However, even in cases where the innovation is mostly in the downstream part of the market, the upstream suppliers often have a crucial role to play in allowing the downstream innovation to happen. Some examples of how BTU can play this 'sanctioning' role include:

- For downstream operators to be able to offer unmetered Internet access and voice bundles, BTU needs to price its wholesale input services by capacity and not by minute

[78] For example, "*Corporates perceive that they do have the buying muscle to ensure competitive pricing, however, they do not feel that they can always use this with BT. The main issue in relation to Oftel is the heavy regulation of BT. It is felt that Oftel prevents BT from giving the best deal*" from http://www.ofcom.org.uk/static/archive/oftel/publications/research/2003/q13Telecomsb0703.pdf

[79] For example, they can discount and do not need to publish prices on services where they do not have SMP and requirements to publish are down to a very short period in some cases

[80] "Partial private circuits: phase two: A direction to resolve a dispute concerning the provision of partial private circuits". Paragraph 6.231 onwards. http://www.ofcom.org.uk/static/archive/oftel/publications/broadband/leased_lines/ppc1202/ppcs1202.pdf. 'sit on an order' was a comment by BT on this delay

- For downstream operators to offer high quality managed data network services that can support mission critical services they need high quality access products from BTU
- For downstream operators to offer cost effective ubiquitous DSL broadband services depends on BTU's roll-out of DSLAMs to many exchanges
- For downstream operators to be able to offer attractive broadband services to business and consumers they need to be able to offer a range of access speeds (including symmetric services), contention ratios and pricing packages such as pay-as-you go or capped use. The ability to offer these is dependent on the product range and pricing structures of BTU's wholesale products

Therefore, any discussion about innovation must cover and include BTU.

In a competitive market, one would expect these upstream innovations to happen naturally and quickly – upstream suppliers would innovate to grow profit and survive and would continually strive to meet the needs of their downstream customers. For instance, upstream suppliers would proactively develop new ideas and products for their downstream customers, relayering, repackaging and unbundling their offering to meet downstream customers needs.

In the UK telecoms market this does not always happen. Below we give some examples of upstream products that are currently not available that are required by downstream players (including BTD itself) to allow them to innovate.

- Guaranteed availability levels with penalties on BTU's PPCs. By way of comparison, COLT (which owns its own local access infrastructure) offers guaranteed availability levels with penalties
- A wider range of SLAs and higher SLA levels on BTU's PPCs covering availability, fault repair time and penalties.[81] These would allow downstream providers to offer more mission critical services based on PPCs and tailor services to their customers
- Earlier and more widespread introduction of SDSL to be able to bring the substantial benefits of more affordable broadband to smaller businesses and smaller branches of larger businesses
- Range of SLAs[82] (e.g. fault repair time) and options of access speeds and contention options on DSL services (ADSL and SDSL). This would allow downstream competitors to offer a far wider range of services, packages and price points for broadband services
- Different structures for voice interconnection prices to be able to create new and different voice packages. BTU's price structures are predominantly based on BTD's time of day banding

The lack of these products should not be taken as lack of equivalence since these products are not available to BTD downstream. However, they clearly suggest that the market is not working as a competitive marketplace would and consequently innovation and investment is constrained. The reason for BTU not providing these products is unclear but one has to assume that lack of incentive must play a large part.

[81] BTU do offer some options on PPCs. For instance, in addition to the standard PPC with a 99.85% availability they also a protected path with 99.995% availability although this second option is over 4 times the price of the standard option and in neither case are penalties available. There is only one level of repair time (5 hours) although there are two 'care' options which have different levels of penalties for missing repair time. There are no guarantees or options for latency or packet loss levels.

[82] SLA – service level agreements which define parameters of the service such as provisioning time, maximum fault rates, time to repair faults etc

3.5 Conclusion

The evidence in this section clearly points to a sector that is ineffective in delivering rapid innovation and investment. Through a combination of ineffective competition, lack of equivalence, regulatory constraints and poor incentives, the marketplace is not performing to maximise innovation. The key problems are:

- BT's downstream activities are constrained by regulations that limit its commercial flexibility and place a large regulatory burden on it
- Downstream competitors to BT are unable to compete and innovate effectively due to the lack of equivalence and also lack the full competitive pressure to innovate rapidly
- It appears that BT's upstream activities lack the incentive and/or ability to create wholesale products that would allow downstream operators (including BTD) to innovate

Perhaps the strongest evidence of the deficiencies of the current market in delivering innovations quickly can be seen by examining how innovations have happened in the past. The table below shows how we performed in bringing innovations to market – it points to a picture where through lack of incentives, lack of competitive market forces and other factors, the sector has been slow in delivering innovation. These are typically because BTU has not innovated (and so downstream innovation could not happen) and/or innovation was delayed since it relied on slow regulatory intervention to allow innovation to happen.

UK performance in introducing innovation to end users

Innovation	Was it delayed?	By how long	Why?
Subscription free Internet access	Yes	Probably 5+ years	Could not happen until the payments received from BT for terminating an Internet call[83] prices rose above the national and Internet transit costs. The termination payment is effectively the difference between the retail price for a local call and the charge for originating the call. Until regulation had finally driven the charge for call origination down to cost subscription free Internet access was not possible. If regulation had driven costs down to cost earlier the innovation would have happened earlier
Unmetered Internet access	Yes	2+ years	Was not proactively offered by BTU. Only happened after heavy regulatory and political pressure on BT to offer a flat rate origination product (FRIACO). Even when it was introduced the wholesale offer was limited which restricted competition
Residential broadband / ADSL	Yes	3+ years	Offered first by cable although could have been offered via BT's network earlier. Given cable's limited reach, many homes and businesses were delayed in their ability to get broadband early
Variety of ADSL packages	Yes	3+ years	Up until November 2003, only one ADSL product was available that was suitable for residential customers (512kbps, 50:1 contention). Although a 1Mbps product has been introduced there are still only two speeds and no 'pay as you go' options
SDSL	Yes	5+ years	BT has been almost 3 years behind the introduction of SDSL by Easynet[84] whose own launch was delayed by the slow local loop unbundling process. BT's launch of SDSL is about 5 years behind the US. BT, who is best placed to roll-out SDSL, will launch commercially with only 100 exchanges enabled

In an innovation-conducive environment (e.g. properly competitive markets) one would expect innovations to be introduced quickly as firms strive to gain competitive advantage. Unfortunately, in the UK telecoms sector we have had to rely on regulatory intervention to allow innovation to get to market and therefore

[83] This is sometimes known as the terminating payment or payment to OLO (POLO)
[84] Easynet launched in April 2001 and BT is likely to launch commercially in early 2004

these valuable innovations have been delayed. Detailed case by case intervention as a necessary pre-requisite to innovation points to regulatory failure, not regulatory success.

There are also other innovations that are yet to reach the market – for instance, guaranteed availability levels with penalties, a wider range and higher level SLAs for PPCs and widespread SDSL – and it is unclear whether these will ever get to market without more regulatory intervention. The mere fact that regulatory intervention is required is a clear sign that innovation is being delayed.

We do not see that the current regulatory approach, which relies on lengthy and intensive post-hoc intervention to allow innovations to get to market, will improve the sluggish rate of innovation that we currently experience. In an environment that is increasingly dependent on innovation and particularly downstream innovation, the weaknesses of the current regulatory approach will become increasingly damaging. However, with the lack of existing or prospective vigorous competition in the upstream markets, we believe that regulation has a critical role to play in creating an environment that is conducive to innovation and that allows regulatory withdrawal to the extent possible from what should be commercial transactions within an appropriate framework of incentives. In the next section we examine implications for regulation if it is to achieve this goal.

Below we present a digression on what the development of regulation can tell us about the level of innovation.

Digression: Is increasing regulation symptomatic of a lack of innovation?

An interesting weathervane for the level of competition and innovation is, paradoxically, the level of regulation – one would expect that if effective competition was truly increasing, regulation would reduce. Littlechild expected competition to be sufficient to remove the need for most telecoms regulation in 5 to 10 years from liberalisation (in 1984). However, twenty years on effective competition has not substituted for regulation in significant areas of the telecommunications industry and Oftel (Ofcom from 2004) are still 'holding the fort'. Although some regulation has been removed (e.g. much retail price regulation), overall regulation of telecommunications has grown in complexity and cost[85], not receded as anticipated.[86] As a necessary and proportionate response to the strength of BT and the desire to increase competition, Oftel has had to become more interventionist to the degree of it almost designing some products.[87] In essence, the market appears to be having to rely on lengthy and intensive post-hoc intervention to continually treat the symptoms of competitive distortions, rather than trying to create a regulatory framework that allows the sector to function effectively with limited intervention.

[85] Oftel's cost has increased by almost five time since the late 1980s and is currently increasing at over 15% per year. Source: Oftel
[86] Jon Stern 2002 provides some background as to the causes of this. "Regulatory forbearance – why does Oftel find it so hard?". London Business School – Regulation Initiative Public Policy Paper. http://www.london.edu/ri/Public_Policy_Papers/Public_policy_paper_2002-1.pdf
[87] For example, a recent PPC determination led and managed by Oftel ran to over 400 pages. "Partial private circuits: phase two. A direction to resolve a dispute concerning the provision of partial private circuits" 23 December 2002. http://www.ofcom.org.uk/static/archive/oftel/publications/broadband/leased_lines/ppc1202/ppcs1202.pdf

4 Implications for future regulation

The increasing importance of telecoms innovation combined with the unfavourable conditions for innovation today point to important implications for future telecoms regulation. The current regulatory approach does not maximise innovation – a new objective-led and more strategic regulatory approach is needed. The key implications for regulation are described below.

The most important implication is the need to properly consider in future policy-making the full economic impact and particularly the indirect effects of telecoms innovation on the economy (this total impact is sometimes referred to as the dynamic gain). If this is not done then policy-makers risk making decisions that damage the economy. This is discussed further in Section 4.1.

The second implication is that regulation should be changed to effectively address the conditions that limit innovation today. In particular, regulation should address the constraints that the three key groups experience in driving innovation (i.e. BTU, BTD and downstream competitors). We do not aim to prescriptive about how this can be done but we offer four inter-linked principles that we think should together allow innovation to happen more rapidly and more successfully. This is discussed in Section 4.2.

Ofcom has a large number of statutory duties which need to be balanced in making regulatory policy – we consider that our recommendations on principles are consistent with these. What our report implies is that the weighting given to certain statutory duties (and regulatory approaches) needs to be emphasised for instance duties such as: “encouraging investment and innovation”; “promoting competition in relevant markets”, “to further the interests of consumers in relevant markets, where appropriate by promoting competition”, and "to further the interests of citizens in relation to communications matters". We believe that in future there must be a much greater emphasis than previously on those duties that reflect the dynamic impacts and the broader interests of ‘citizens’ as well as consumers.

4.1 Proper consideration of dynamic economic effects

Most economic analysis in telecoms policy-making today[88] is dominated by consideration of static benefits within the telecoms sector. However, a static benefits analysis is far too partial – typically, a static analysis may only pick up 1% to 10% of the total economic benefit (Section 5.1 provides an explanation of this). While dynamic costs and benefits may be harder to quantify it is crucial to delivering good regulation to be approximately right rather than precisely wrong in appraising alternatives approaches. In particular a static analysis focuses on direct benefits of existing goods and services within the telecoms sector and ignores other substantial impacts such as:

- The shift in demand that comes from networking impacts
- The creation of new goods and services (i.e. innovation)
- The impact outside the telecoms sector i.e. in the rest of the ICT-producing sectors and in the non-ICT producing sectors

Future policy-making must take into account the impact on these dynamic gains – otherwise, future policies may not take full advantage of the potential of telecoms to drive economic growth, or may be misdirected towards goals that are harmful to the maximisation of overall benefits to society. So, for example, Ofcom may have need to make a regulatory decision which either results in a price reduction or in more rapid

[88] For an example see “Oftel's policy review of two-part charging - 27 January 2003” Figure 2.1. http://www.ofcom.org.uk/static/archive/oftel/publications/licensing/2003/twopc0103.htm

introduction of new services. A static analysis based decision will likely favour the option resulting in a price reduction which would cause a delay in service introduction. In future, the benefit of innovation must be taken into account which may cause decisions that result in higher short term prices in order to maximise benefits to customers and citizens over time.

Another implication of the need to maximise dynamic gains is that the success of regulation should be increasingly measured in terms of whether it delivers innovation, consumer choice and increased GDP growth rather than on static impacts such as short term price reductions for existing services.

4.2 Allowing the sector to be more innovative

It is clear to us, that the sector is not currently working to maximise innovation. The regulatory approach needs to be changed in line with four principles that *together* will facilitate innovation in the sector and in the wider economy. Each of these principles is described below.

Ensuring equivalence

Achieving equivalence has implicitly been a key intent of regulatory policy for many years. However, as we described in Section 3.2, we are some way off from it being achieved and there are few signs that it will be achieved in the current environment. The costs of not ensuring equivalence are also likely to rise with increasing convergence in ICT and increasing downstream innovation in telecoms.[89]

Effective equivalence could be achieved within the context of a vertically integrated BT through the creation of a common set of systems, platforms and processes that would allow all downstream players (including BTD) to work with BTU to procure the same products at the same prices, terms and conditions.[90] This has also been supported by others e.g. Lehr and Hubbard (2003).[91] The introduction of common systems will allow a number of benefits for innovation:

- Allow downstream competitors to be more competitive and innovative
- Allow BT more ability to innovate since if equivalence is achieved it will allow many regulatory constraints to be lifted from BT downstream and will increase competitive pressures on them which their increase the incentive to innovate
- Possibly increase the incentive on BT upstream to innovate for the benefit of all operators[92]
- Allow equivalence to be easily and effectively monitored and ensured with limited intervention and at limited cost

We believe that the cost of achieving equivalence whilst significant will be a small fraction of the gains of having a more innovative and convergent sector.[93] The cost of setting up these systems should not be

[89] Lehr and Hubbard argue equivalence of access is more important in a convergent telecommunications sector to ensure innovation in downstream markets. Lehr and Hubbard. September 15, 2003. "Economic case for voluntary structural separation." Preliminary draft quoted with permission of authors. http://intel.si.umich.edu/tprc/papers/2003/191/StructuralSeparation2.pdf. "*By defying a competitor economic access to bottleneck facilities, the ILEC can effectively foreclose the competitor from the market. The abuse of market power could adversely impact competition all along the value chain of information technology businesses that depend on access to or interconnection with PSTN ... Industry convergence which is accelerated by the transition to packet-switched networking based on the Internet Protocols (IP) magnifies the risk from abuse of monopoly power over a 'last mile' bottleneck. The convergence of computing and communications technology means that these assets are increasingly used together as closely coupled components in complex information technology systems. Computers, software, and applications are more valuable when networked. Communications services, computer equipment and services, and media content are increasingly inter-related which means that economic distortions in one sector may more easily spillover to other sectors.*"

[90] For one example of how this might be achieved see "From the Market Reviews to a Model of Transactional Transparency", UKCTA, September 2003. www.ukcta.com

[91] Lehr and Hubbard. September 15, 2003. "*one way to improve open access regulation is to mandate that all communication between the wholesale and retail operations occur using the same interfaces and procedures used by other carriers.*"

[92] For example, since BTD could only use the same wholesale products as other downstream operators they would be an incentive on BTU to ensure that products are 'fit for purpose'

borne by just BT or just downstream competitors (not least because it is unlikely to be incentive compatible) – logically, since the benefits of more effective competition and innovation accrue all companies and all customers, the cost should be borne across the whole industry.[94]

While equivalence is necessary it is not sufficient on its own to prevent abuse and facilitate efficient and effective competition. Below, we address some other necessary conditions to help maximise innovation.

Preventing price discrimination

We believe that there needs to be strong measures to prevent price discrimination. Even with equivalence through common systems and processes BT will still have an incentive, and the ability, to discriminate against downstream competitors who offer different innovative services through, for instance, restrictive pricing structures or loading costs onto certain products.[95] Retail price controls, or allowance of excessive returns at the access level, may exacerbate this problem by introducing a margin squeeze. There is a balance to be struck here between effective prevention and/or penalties for abuse and the allowance of greater pricing flexibility of access products.

Ensuring adequate returns

Alongside equivalence and non-price discrimination, regulation should ensure adequate returns to facilitate efficient investment and innovation wherever prices are regulated. Application of this principle to access pricing may also reduce incentives to sabotage access via non-price means.[96] However, in this report, we do not evaluate whether the returns to any party as a result of regulation are too high or too low to facilitate efficient investment.

Modified scope and style of regulation

We see that there is a need to adjust the scope and 'style' of regulation recognising that regulatory intervention has been and will continue to be a poor means of delivering innovation rapidly. The three elements within this are outlined below

Limiting the scope of regulation

Regulation is accepted as inferior to competition and is particularly inhibiting where innovation is at play since innovation requires a level of speed that regulation cannot hope to match. As we highlighted in Section 3, BTD is quite heavily regulated (due to its ownership the monopoly elements of BTU) which limits BTD's ability to innovate. Provided that these other principles are achieved regulatory constraints should be lifted off BT downstream wherever appropriate. This idea was resonated by Cubbin and Currie in 2002.

---

[93] The cost of setting up these systems greenfield is probably of the order of £0.5bn although the total cost could be reduced by staging the implementation in line with BT's own upgrades, and some or the costs of subsequent systems changes or duplication to accommodate competitors would be avoided. As we highlight in Section 5, we see the potential gains from a more innovative telecoms sector to be at least £20bn

[94] Lehr and Hubbard. September 15, 2003. "*Adoption of an open access regime creates a wholesale market for services that would not exist otherwise. Creation of this market entails one-time implementation costs (e.g. to establish the necessary electronic ordering and provisioning interfaces). These costs will be incurred by all market participants, and the beneficiaries will include end-users who benefit from enhanced competition*."

[95] So for instance they could allocate an unreasonable level of costs onto products where BT's downstream activities have a weak market position and so effectively overloading an unreasonable proportion of BTU's total costs onto downstream competitors

[96] "*sabotage is always profitable when the input price cap is severe, an ironic finding given economists general penchant for supporting prices close to incremental costs*" Beard et al 2000.

"*There is of course, usually little option but to regulate the natural monopoly part of these sectors: the pipes and wires part of the business … the natural monopoly elements needs be defined as narrowly as possible*."[97]

Use of incentives wherever possible

Wherever regulation is still required, regulation should work with the grain of commercial incentives to ensure that there is room for and reward for innovation. Regulatory 'command and control' style intervention, however well done, cannot deliver the degree and speed of innovation that commercial incentives can. Where innovation is involved the problems of regulatory slowness are particularly problematic. We see that incentives should be used as far as possible rather than regulatory intervention – this principle should lay across everything Ofcom does. Policies that align incentives (i.e. approaches which make good and innovation-supporting conduct profitable) are far more likely to be successful than those where incentives are misaligned and regulatory intervention and policing needs to be used. However, this also means that where BT does not act in the interests of innovation, intervention should ensure swift and effective compliance.

Minimising unnecessary regulatory uncertainty

In future regulation should be set to minimising regulatory uncertainty, unpredictability and the threat of opportunism which can discourage investment and innovation. Generally, investment and innovation will be increased when risk is reduced. There is much irreducible risk in the telecoms market (as with other markets) in areas such as demand and technology. However, in the current environment regulatory risk is playing a large role. For example, players do not know what access prices will be and/or they are unsure of whether they will get fair access to BT's upstream products.[98] Regulatory uncertainty can also damage investment and innovation is if operators in a market believe that a regulator may be opportunistic in future and set regulated prices at a level that do not allow recovery of sunk costs, thereby effectively expropriating investments.[99] Regulators and policy-makers in telecoms should act to increase predictability and remove (or more realistically reduce) regulatory uncertainty and risk as far as reasonably possible.

These four principles will not deliver improved innovation if they are applied individually – if, for instance, BT was given more freedom, then without proper equivalence and control over or penalties for discrimination this could actually have the impact of reducing innovation.

[97] John Cubbin and David Currie. May 2002. "Regulatory creep and regulatory withdrawal: why regulatory withdrawal is feasible and necessary". City University.
[98] This issue is analogous in part to that in monetary policy where historically discretionary monetary policy led to high inflation and poor economic performance. Levine P; Stern J; Trillas F. August 2003. Independent Utility Regulators: Lessons from Monetary Policy. LBS Regulation Initiative Working Paper 52. David Currie, Paul Levine, and Neil Rickman. October 1999. "Delegation and the ratchet effect: should regulators be pro-industry?". CEPR Discussion Paper no 2274
[99] This regulatory opportunism might arise where once investment is sunk, a regulator may be tempted to offer regulated returns that cover variable costs only. The solution to the problem is to offer some form of commitment to allowing recovery of sunk investments.

4.3 Conclusion

We see that the increasing importance of telecoms innovation, and consequently the increasing damage that the current regulatory approach will have on economic growth point to a clear need for a new regulatory approach. We have suggested a number of implications and principles for future regulation that we believe should be at the heart of future regulatory.

Although some of these approaches are new, this should not be seen as a reason not to pursue this change. The UK was one of the first telecoms sectors to liberalise in 1984 and thus it should be ahead of other countries in terms of competition and should be at the vanguard of new regulatory approaches.

In the next section we provide our estimate of the economic gains that could be delivered from improved regulation.

5 Improved regulation could deliver at least £20 billion of benefit

In this section, we provide our view of the magnitude or quantum of the economic benefits that could accrue from developing a more innovate telecoms sector through improved regulation. We estimate that the impact is at least £20 billion.

Our approach is focused on estimating the full aggregate economic impact from improved regulation. We have used a number of methods to assess the dynamic impact including a top down approach as well as a number of bottom up approaches. Our approach focuses on using a dynamic gains approach to identify the aggregate impact rather than the orthodox static approach.

This section is structured as follows:

- A review of the dynamic approach which we use compared to the orthodox static approach for quantifying economic benefits to provide context our evaluation (Section 5.1). In particular, this highlights the inadequacy of the orthodox approach in capturing the full gains
- A top down approach (5.2) to evaluating future economic impact of ICT and the impact of an improved regulatory regime
- Two other approaches (5.3) based on service specific analysis to provide some cross-checks to the top-down calculation
- Our overall conclusion on the impact of improved regulation (5.4)
- An assessment of how different sectors will benefit (5.5)

5.1 The inadequacy of static assessment

As we explain below, we believe that the impact of improved regulation is likely to be at least £20 billion. This is far larger than the type of gains that one would identify from an orthodox static analysis. The approach we have used is essentially a dynamic gain analysis and captures many effects that are not included in a static analysis. In this section we explain why dynamic impact assessment is so much larger than an orthodox static one.

Orthodox methods of economic analysis tend to focus on static gains. Typically these are:

- Gains from a price reduction[100]
- Gains from cost reductions that may derive from, for instance, increased competitive intensity driving producers to innovate in how they deliver services[101]

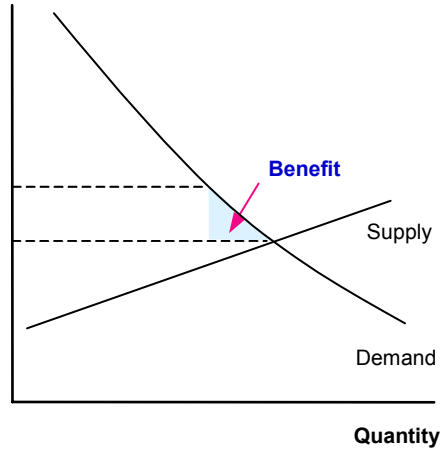
An orthodox static approach also tends to consider impacts at a point in time, although they may change substantially over time. These static gains are illustrated below in the context of standard economic supply/demand diagrams.

[100] The orthodox static approach to estimating the benefits of better regulation is to estimate the direct gains in welfare at a point in time. For a price reduction two things happen. First, consumers pay less and producers earn less i.e. there is a transfer of value from producers to consumers but no net gain. Second, consumers will consume more of the service at the new lower price resulting in a net gain to society.

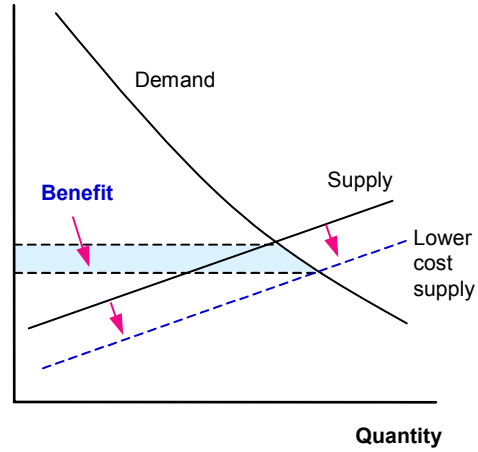
[101] Gains from cost reductions are only sometimes included in static economic analysis

Static benefits

Price reduction



Cost reduction



Dynamic gains capture a number of other additional benefits that are caused by increases in demand and introduction of new services. For a sector such as telecoms where there is continual diffusion, innovation and large networking effects, these impacts are substantial. The key impacts are:

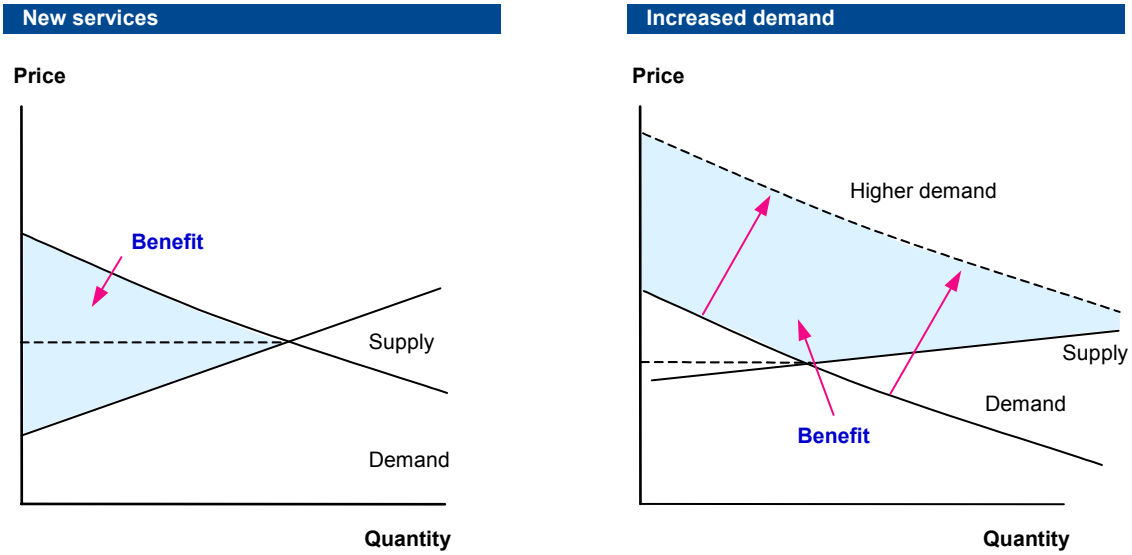
- introduction of new telecoms goods and services over time due to innovation.[102] The entire consumer surplus of new services is relevant (in comparison, a static approach only covers the impact on existing services)
- a shift in the demand curve over time due to increasing willingness to pay (that builds with experience of use) and networking effects103 (which builds as penetration increases)
- the indirect impact that these have outside the telecoms sector itself. Due to the enabling impact of telecoms on the rest of the ICT sectors and in turn the ability of the ICT sector to drive productivity in the non-ICT producing sectors this impact can be substantially larger than the impact within the telecoms sector

A dynamic assessment also captures the full value of these in multiple years (typically using a net present value, NPV, approach). One reason for this is that the benefits may grow in a non-linear fashion and so evaluation for a single year is inappropriate. The following diagrams illustrate these different type of dynamic benefits (some of the indirect impact in other sectors may be effectively captured in the shifted demand curve in the right hand exhibit).

[102] For instance, a regulatory change in, say the terms of DataStream may allow new content or ASP services to be introduced or new service packages that are attractive to new groups. Alternatively, a regulatory change driving down local origination rates and consequently increased termination payments allowed the subscription free Internet access market to develop. In some cases, new services may substitute for existing services.

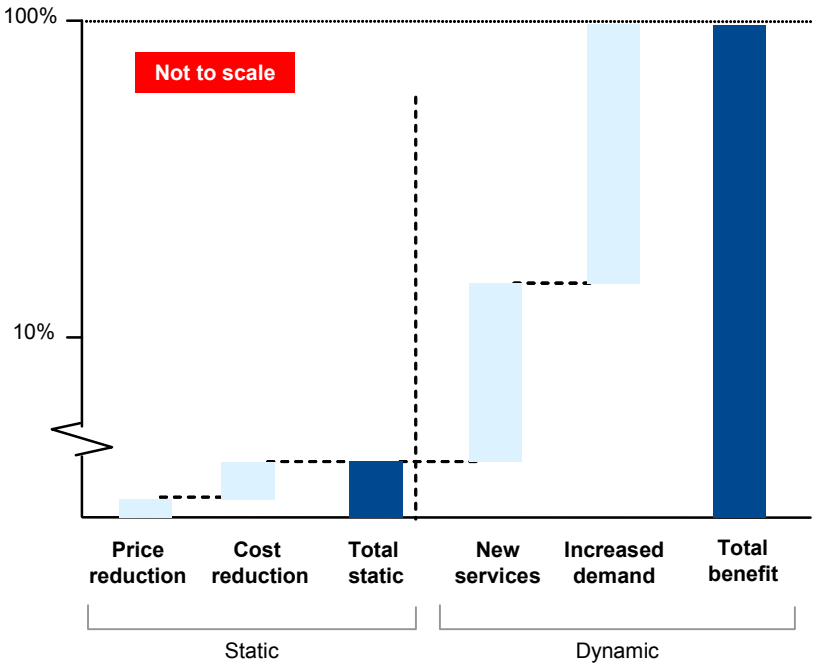
[103] The economic value of networks, including fixed and mobile telephone networks and broadband networks, increases more than proportionately with the number of subscribers. According to 'Metcalfe's Law' the value of a network increases with the number of possible connections i.e. with the square of the number of people connected. An outward shift of a linear demand curve also happens to produce benefits that grow as the square of the number of consumers, since the area under the demand curve, which is a measure of consumer benefit, increases as the square of demand. Benefits therefore grow faster than revenues even if price do not fall over time, and the timing of growth in new services can have a large impact on overall benefits.

Dynamic benefits



Even visually, these diagrams point to a large difference between the static benefits captured by orthodox analysis and the dynamic gains. Below we have provided a relative sizing of static benefits versus dynamic. Note: the exhibit is not drawn to scale – the static benefits are expanded to show them more clearly.

Relative sizes of static and dynamic benefits



Note: The size of the bars represents the average impact of each effect in a single year (i.e. by annualising the NPVs) in order to eliminate the difference in static and dynamic approaches that derives from the use of a single year (static approach) and multiple year (dynamic approach). This provides a like-for-like comparison

This exhibit is not precise but using a variety of sources from Crandall, Jackson, Romer and others it is possible to estimate the relative size of the static benefits versus the total. We estimate the static benefits to be between 1% to 10% of the full dynamic benefits depending on the type of service effected.[104]

An illustration of the importance of the benefit of new goods and services versus price reduction is provided by the work of Erik Brynjolfsson et al (2003) which found that "*Our analysis indicates that the increased product variety of online bookstores enhanced consumer welfare by $731 million to $1.03 billion in the year 2000, which is between 7 and 10 times as large as the consumer welfare gain from increased competition and lower prices in this market*."[105] Work by Romer came to a similar conclusion.[106] This reinforces our key point that dynamic benefits are often overwhelmingly important, and that reasonable attempts at quantification are possible.

The partiality of the static analysis is very clear – even if a static approach is made multi-year (i.e. by assuming the impact continues and taking an NPV), it does not and cannot capture all the gains to the economy – a dynamic analysis gets far closer.

5.2 The top down approach

In this section we use a number of steps to apply the evidence of the impact of ICT (in the US) to the UK to assess what the impact of improved regulation would be. We first calculate the impact of the differential GDP growth rate due to ICT in net present value terms (a vertical difference or wedge between two growth trajectories). We then assign a share of the contribution to telecommunications, and finally allow for an estimate of the potential impact of better regulation of the telecommunications sector focussed on maximising innovation and dynamic gains.

The US evidence points to a strong contribution from ICT to increasing GDP growth of around 1% percentage points each year. However, there is a question over how long this increased growth might be sustained. In Section 1.4. we outlined that the GPT nature of ICT (and particularly telecoms), the low current diffusion of existing ICT technologies and the future technological advances which all point to ICT increasing GDP growth for a sustained period. This would suggest that the increase in GDP growth from ICT could go on for many decades. This view is confirmed by others. For the purpose of this analysis we conservatively assume that the increase in GDP growth is for 25 years (which is a shorter period than for either railroads or electricity).

Applying the differential growth rate in the US to the UK into the future we are able to construct GDP projections for the UK with and without the impact of ICT.[107] The exhibit below shows this projected

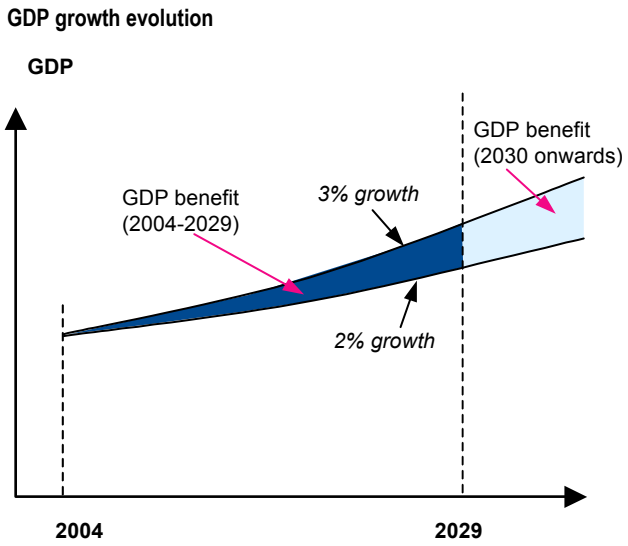
[104] The ratio can be calculated using a simplified case where the elasticity of demand = -1 and the elasticity of supply = -1. In this case, if we consider a price reduction on an existing service that brings the price down to the equilibrium level that delivers a £1 price reduction benefit (i.e. the triangle). On the basis of these assumptions, the cost reduction impact will be £20 (if the cost is reduced by the same amount), the benefit from a new service (of the same size as the existing service) is £200, and the impact of a shift in the demand curve £2,000 for a product where Metcalfe's Law applies. Adjusting these amounts to reflect the level of new service spin-offs, the time it takes for new services to develop and the time it takes for diffusion to happen to reap the networking effects we estimate that the ratio of static benefits (i.e. price reduction plus cost reduction) to total benefits (i.e. including new services and increased demand) is between 0.01:1 and 0.10:1. In other words, static of total benefits is 1% to 10%

[105] • Erik Brynjolfsson Yu (Jeffrey) Hu • Michael D. Smith. November 2003. "Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers." *Management Science*, Vol. 49, No. 11. Working paper version available at http://ebusiness.mit.edu/erik/WorkingPapers/ConsumerSurplus.pdf?abstract_id=400940

[106] The importance of new services to economic analysis, and their general neglect in orthodox analysis, was highlighted by Romer who analysed the impact of trade barriers which impeded the introduction of new services. Romer concluded that standard estimates of the benefits of improved policy may be around 10-fold too low. Paul Romer. 1994. "New Goods, Old Theory, and the Welfare Costs of Trade Restrictions". *Journal of Development Economics* 43. 5-38.

[107] Based on UK GDP in 2002 of £1,044 billion. Office of National Statistics. Real GDP. http://www.statistics.gov.uk/STATBASE/expodata/files/6630823002.csv

forward at per capita growth rates of 2%[108] per annum versus 3% per annum. The 1.0% differential corresponds to the assumed potential contribution of ICT to increasing the GDP growth rate.



The impact of this 1% increase in GDP growth each year is to increase GDP by approximately £500 billion in 2029. However, to account properly for this economic gain it is important to take account of the gains in each year. The standard method of doing this is to discount the future gains depending how far they lie into the future and sum these up to derive the net present value (NPV) of all the gains (i.e. the difference between the two curves in NPV terms). Conservatively ignoring any of the economic benefits after 2029, the value of the increased GDP growth due to ICT is £2,880 billion[109] – this is equivalent to almost three times the level of UK GDP in 2002. If the impact is measured for more years (than the 25 years assumed), the impact is far greater.

The next step in the top down analysis is to quantify how much of this increase in GDP growth is due to telecoms. As we noted in Section 1.4, there are several factors that are strongly suggestive that telecoms plays a substantial and critical role within ICT. We estimated (Section 1.4) that telecoms share of the total ICT contribution is currently between 15% and 30% although this is probably an increasingly conservative estimate going forward given the enabling role of telecoms and its increasing importance. This provides a figure for the contribution of an innovative telecoms sector to economic growth of between £430 billion and £860 billion in NPV terms.

The last step in this analysis is to assess how much an improved regulatory regime could increase the contribution of telecoms innovation to the economy. We explained in Section 3 that innovation is constrained and delayed – for instance: innovation upstream was limited (probably due in a large part to lack of incentives); and, innovation in downstream markets was hindered by delay in downstream competitors gaining access to upstream/wholesale products on an equivalent basis and BT's downstream activities being constrained and lacking competitive pressures to innovate. We also explained in Section 4 that convergence, the development of broadband and the emergence of new technologies such as IP

[108] The NPV of the wedge is not sensitive to the assumed base case growth rate over a realistic range of assumptions – rather it is the growth increment that is important.
[109] Discounting at 4.0%, the mid-point of the HM-Treasury discount rate of 3.5% per annum for the base case 2% per annum per capita growth assumption and a rate of 4.5% for the accelerated growth rate of 3% per annum per capita. This is consistent with the dependence of the discount rate on the economy wide per capita growth rate set out in Annex 6 to the HM-Treasury "Green Book" where the discount rate formula is given as 1.5% plus the GDP growth rate per capita. http://greenbook.treasury.gov.uk/annex06.htm

networks can all be expected to increase the leverage of regulation on the performance of the telecommunications and downstream sectors. However, putting a number to the potential improvement from removing these obstacles is obviously a more difficult task.

One method of checking this assumption is to consider what the impact of delay is. Delays effectively shift GDP curves to the right. A one year delay would have the impact of reducing the gains from innovation and thus GDP by 4.0% (the discount rate we use).[110] We explained in Section 3 the average delay in equivalence and thus innovation was 3 to 5 years considering the initial delay in launch of a partially 'fit for purpose' wholesale product and then the slow progression to full equivalence thereafter. Applying (conservatively) the 3 to 5 years delay would suggest a range for the impact of regulatory leverage of 12% to 20%.[111] In addition to delays, some innovations may be lost since either competition may be foreclosed due to BT gaining a dominant position by delaying equivalence and/or downstream competitors simply not requesting products from BTU given the difficulty in getting them.

We believe that it is credible and plausible to expect an improvement in economic benefit of over 5% through better regulation to drive improved innovation. A 5% assumption would imply that regulation could improve the level of innovation in the sector by just 5%. We also show the calculation with a 10% assumption which is we believe also conservative.

The table below gives a range for the benefit from improved regulation applying the steps and assumptions described above. We provide a low case using the more conservative assumptions discussed above and a high case which takes very plausible but slightly less conservative assumptions.

Range of top down estimates of the economic impact of improved telecoms regulation

Metric	Low	High
UK GDP in 2002	£1,044 billion	£1,044 billion
Assumed increased GDP growth attributable to ICT	1.0% for 25 years	1.0% for 25 years
Net present value of difference	£2,880 billion	£2,880 billion
Share of ICT GDP growth increase attributable to telecoms	15%	30%
Value of increased GDP growth attributable to telecoms	£430 billion	£860 billion
Percentage 'leverage' of improved regulation	5%	10%
Impact of improved telecoms regulation	£22 billion	£86 billion
Equivalent to a change in GDP growth rate of	0.0075% for 25 years	0.03% for 25 years

The lower estimate is £22 billion of economic benefit from an improved regulatory environment. This is equivalent to less than 1/100th of one per cent increase in GDP per year for 25 years. We believe the lower estimate to be conservative for two reasons.

- Uses the conservative end of range for the role of telecoms, even though we know that much of ICT's indirect impact on the economy is dependent on telecoms, due to the enabling role of telecoms and telecoms increasing importance
- Uses a low estimate of what impact improved regulation could have even though we have identified in Sections 3 and 4 that there are many weaknesses today and some tangible ways to improve, and that convergence and broadband are increasing the leverage of telecommunications regulation on the whole economy.

[110] Since, for every year that the entire benefit stream is delayed, the net present value is reduced by the discount factor.
[111] Approximately, 12% = 4.0% x 3 years. 20% = 4.0% x 5 years

5.3 Partial service specific approach

This section uses economic analysis of particular telecoms products and services and applies the lessons and data to provide alternative estimates to the top down calculation we provided above. In particular we draw on two pieces of analysis, one by Hausman on voice messaging services and one by Crandall and Jackson on broadband. Whilst these only focus on existing services and do not capture new services, they do provide a useful benchmark for the top-down forecasts.

Hausman (1997)[112] estimated the loss of consumer surplus[113] due to regulatory delays in introducing voice messaging services (i.e. voicemail). The approach Hausman adopted was to treat the absence of a service due to regulation as equivalent to a price for the service that would drive demand to zero. Hausman estimated the loss of direct consumer welfare gains due to delays by the FCC in allowing AT&T to introduce voice messaging services by 5 to 7 years at between $2.5 billion and $9.1 billion.

To make this data relevant to the UK is it necessary to recalibrate for a number of differences including size of the economy, level of delay and impact on all telecoms services. Using a number of plausible and conservative adjustments provides a figure for the impact of delay in the UK of about £80 billion.[114]

Crandall and Jackson (2001) [115] made estimates of the direct benefits of widespread diffusion of broadband. With broadband penetration of 8 per cent (in 2001) and an average price of $40 per month, broadband revenue was about $4 billion per year. Assuming that demand for such service is linear with an elasticity of -1.0, the value of the service to consumers – the direct consumer surplus – is $2 billion per year in addition to the $4 billion they pay. Crandall and Jackson then considered how expenditure and benefits would grow with demand growth given the shift in the demand curve due to networking effects in particular. They calculated that if broadband service were ubiquitous, similar to ordinary telephone service, annual expenditure would rise to $58.7 billion per year and, assuming an outward shift of the demand curve (with constant slope), consumer surplus would increase to $427 billion per year. The results are summarised below.

Ratios of consumer surplus to consumer expenditure

	Consumer expenditure	Consumer surplus	Consumer surplus to expenditure ratio
At 8% penetration	$4 billion	$2 billion	0.5:1
At 50% penetration	$31.2 billion	$121 billion	3.9:1
At 94% penetration (equivalent to telephony)	$58.7 billion	$427 billion	7.3:1

[112] Jerry Hausman. 1997. "Valuing the effect of regulation on new services in telecommunications." Brookings Papers on Economic Activity – Microeconomics.
[113] Both changes in consumer surplus and changes in income (GDP per capita) can be used as measures of economic welfare.
[114] We re-calibrate using a mid-range figure of $6bn for six years of delay. Normalising this to the UK for differences in GDP and discount rate yields a result of £1.2bn (This approximately adjusts for the size of the UK economy and the use of a 4.0% modified HMT discount rate versus the 8% effective rate that Hausman used). This is equivalent to £0.2bn for each year of delay. Voice messaging services account for about 1% of total telecoms expenditure (VMS revenues implied by Hausman were about $2bn of a total US telecoms market of about $190bn). Thus the impact on the economy of delay due to regulation in all telecoms services would be about £20 billion per year of delay – if the impact was similar for all telecoms as voicemail services. Considering the level of delay in the UK (taking a mid point of 4 years) the impact of regulatory delay across the whole sector would be £80 billion. If anything, this may be an underestimate for the whole sector since some other services exhibit higher levels of technical innovation, more opportunity to create new services, a higher impact on productivity and a greater networking effect compared to voice messaging.
[115] Crandall and Jackson. July 2001. "The $500 billion opportunity: the potential economic benefit of widespread diffusion of broadband internet access." Criterion Economics, L.L.C. See also: Crandall, Hahn, and Tardiff. 2002. "The benefits of broadband and the effect of regulation." In Broadband: Should We Regulate High-Speed Internet Access? Robert W. Crandall (Editor), James H. Alleman (Editor). Brookings-AEI Joint Centre.

As can be seen from the table benefits can easily be greater than total consumer expenditures, and grow proportionately faster than expenditures as demand grows.

Crandall and Jackson then examined the economic impact of accelerated uptake that would result from, for instance, improved regulation. They considered alternative S-shaped adoption curves with the same start point (8% of households with broadband) and end point (94% of households with broadband in 2025). What they found was that the differences in net present value terms of the overall benefits of more rapid adoption versus slower adoption of broadband (due to poor regulation) was around $500 billion to US consumers and producers. Crandall and Jackson recognised that their results seemed incredible but commented

"A skeptic, on reading this, will necessarily have doubts – how could speeding up the adoption of a technology have such massive benefits? The key lies in the substantial benefits that ubiquitous broadband can convey to consumers. Once virtually everyone has the service, the network effects from developing new services become very large. Moving these benefits forward a few years can create very large benefits – even when evaluated from today's perspective."

Re-calibrating this figure ($500 billion) to the UK, we can derive an economic benefit from faster uptake due to improved regulation of around £100 billion for broadband.[116] Broadband is only one service but a key one. The figure for the whole telecoms industry would be higher than £100 billion.

5.4 Conclusion on impact of improved regulation

In this section we have provided quantification of the impact that improved regulation could have through fostering an environment that would encourage more and earlier telecoms innovation. The benefits are clearly far higher than the orthodox static analysis would have but quantifying them is a more difficult exercise.

The top down analysis gives a range of £22 billion to £86 billion and the service specific approaches using Crandall and Jackson give approximately £100 billion (for broadband only) and using Hausman £80 billion (extrapolated for all services). The differences between these estimates may be due to a range of factors – for instance, the higher estimates from the bottom up analysis may suggest that in the top down method we have been overly conservative in the leverage of improved regulation or role of telecoms within ICT. However, what this analysis does clearly demonstrates, is that for a range of plausible assumptions, the economic impact from improved telecoms regulations is big. It could be extraordinarily big, but whichever way you cut it is big.

Our view, on the basis of this evidence, is that the benefit of improved regulation in the UK is at least £20 billion.

5.5 Who will benefit?

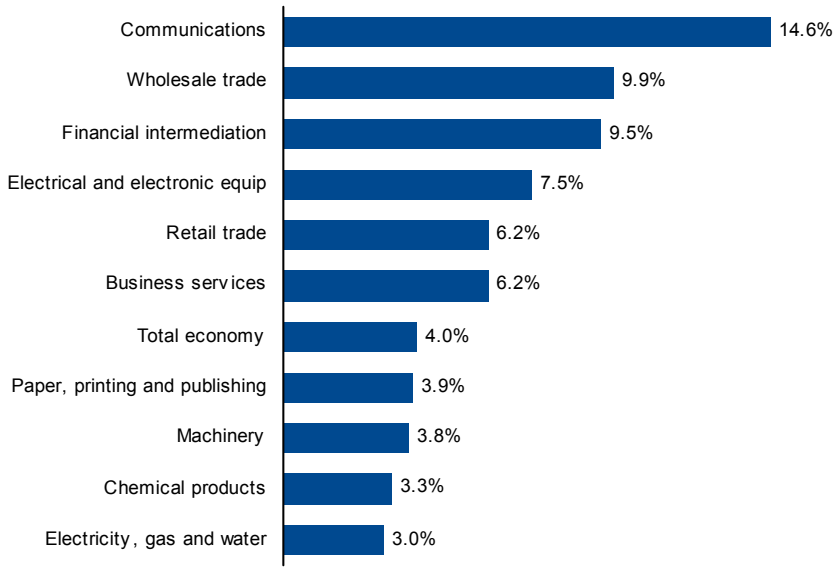
Our estimate of the benefits for the UK economy through improved telecommunications regulation on the contribution of ICT to economic growth is at least £20 billion. A natural question is who the beneficiaries would be. In this section we briefly examine who the beneficiaries are likely to be and conversely, which groups will be most damaged by lack of regulatory change.

[116] This approximately adjusts for the size of the UK economy and the use of a 4% adjusted HMT discount rate versus the 8% that Crandall and Jackson used

In the first instance, the benefits of improved regulation will touch all telecoms and ICT users – this will include both businesses and consumers.

Within business, the sectors most affected will be those who are the more intensive users of ICT innovation in the future. One way of looking at which sectors will be more intensive is the current role of ICT. One measure of this is ICT share of value added in each sector (this is effectively the share that ICT has in wealth creation of businesses/sectors[117]). The current share of ICT in some of the most ICT intensive sectors is shown in the exhibit below.

Share of ICT in value added terms for selected sectors in the UK (1995 to 2000)[118]



This broadly points to communications, wholesale trade and finance as the most ICT intensive sectors. However, this is not necessarily a good indicator of future ICT intensity. Some examples of where future ICT use may differ from current use are given below

- The retail sector is likely to see increasing intensity of ICT as businesses innovate (as have Wal-Mart) in their use of ICT in areas such as supply chain management, e-commerce, mobile and offering telecoms services to improve productivity and profitability. In 2003, IT spending increased by 27% but is still substantially less as a share of revenue than US retailers[119]
- UK government (which is not included in the standard industry data but currently has low ICT usage) is likely to go through a substantial amount of upgrade and innovation in its use of ICT over the next 5 to 10 years. For example:
  - schools are upgrading capacity significantly to 2Mbps and 8Mbps per school[120]

[117] Value added is sales less the cost of bought-in goods and services which can be distributed to employees, providers of capital, governments and future investments
[118] Robert Inklaar, Mary O'Mahony and Marcel Timmer. December 2003. "ICT and Europe's Productivity Performance: Industry-level Growth Account Comparisons with the United States." Research Memorandum GD-68. University of Groningen Growth and Development Centre. Source: http://www.eco.rug.nl/GGDC/pub/online/gd68(online).pdf. Table B.1
[119] Source: Retail Knowledge Bank. UK retailers spend 1.4% of revenue on technology whilst US retailers spend 2%
[120] Schools are planning to upgrade connectivity to 2Mbps to primary and 8Mbps to secondary schools, deliver a computer to pupil ratio of 1:8 in primary and 1:5 in secondary, improve school infrastructure and introduce interactive whiteboards and also laptops for Teachers http://www.dfes.gov.uk/ictinschools/funding/subject.cfm?articleid=263

- the Health Service is planning major upgrade including Integrated Care Records Service, Electronic appointment booking and substantial improvements in IT infrastructure [121]
- local government are targeted to have all services online in 2005 and current growth in IT spend is forecast at 25%[122]

- Manufacturing as well as retail is likely to benefit substantially from supply chain initiatives based on ICT to reduce stock, improve availability and allow better co-ordination with suppliers.[123] This impact will probably be most marked in electronic and perishable goods manufacturing
- Our own and C&W's research and experience also points to other industry sectors that are or will be intensive future ICT users particularly in the professional services, technology (e.g. the ICT sector itself) and creative media sectors (such as content and games development) as they use the opportunities offered by broadband and the digital age to develop new services and remain internationally competitive

Benefits will also accrue to UK sectors and businesses where an effective ICT environment creates incentives and advantages for firms locating in the UK. This obviously will not be relevant for the government sector but it will be critical for some areas of finance, business services and manufacturing.

Overall, we see the key beneficiaries of improved regulation are likely to be retail, finance, business services, government, and some areas of media and manufacturing (as well as the communications sector itself). Conversely these same sectors will be most vulnerable to lack of regulatory change.

For ICT consumers (i.e. residential), the beneficiaries of a new regulatory approach are likely to be quite broad. Today's early adopters (and intensive users) are likely to benefit as they will have new and innovative services available earlier. Also later adopters will benefit since more effective competition will enable innovations to diffuse to this group more quickly (in a similar way to competition in mobile causing mobile to become a mass market offering).

Not all of the benefits that business users receive will remain within the sectors themselves. As players in each of the sectors adopt ICT innovations (through imitation supported by job mobility), competition will tend to drive many benefits through to consumers[124] – so for instance, whilst initially supermarkets themselves will benefit from using ICT innovations, many of the benefits will flow through to supermarket customers who will receive better services and/or lower prices. However, since innovation in the use of ICT is a continuous process, businesses that innovate will continue to benefit.

Therefore, the overall benefits of at least £20 billion will be felt throughout the economy. The main winners in the long run will be consumers through better ICT products and services and better goods and services from other sectors of the economy. However, all businesses and particularly more ICT intensive sectors will also see large benefits especially where an improved ICT environment will impact locational choice.

[121] For example, the Health Service is planning an upgrade to include Integrated Care Records Service, Electronic appointment booking, Electronic Transmission of Prescriptions and an underpinning telecoms and IT infrastructure. http://www.nhsia.nhs.uk/nhsnet/pages/n3/presentations/workshop/n3_pitn_170703.pdf

[122] Local governments are targeted to have all services online in 2005 and current growth in IT spend is forecast at 25% http://www.socitm.gov.uk/Public/surveys/IT+Trends.htm

[123] For example, "*The results support the idea that the inventory to sales ratio declined more in industries with a higher ICT intensity, consistent with the idea that an important ICT benefit is its support for just-in-time inventory control*". Robert Inklaar and Robert McGuckin. "Structural and Cyclical Performance." In O'Mahoney and van Ark (eds.). December 2003. Page 166.

[124] Erik Brynjolfsson and Lrin M Hitt. June 2003. "Computing productivity: firm-level evidence". MIT Sloan Working Paper 4210-01. Brynjolfsson and Hitt found that for US firms, where the benefits of ICT are currently most apparent, used complementary inputs such as organisational and management change to reap the full benefits of ICT. The authors cite Wal-Mart as an example of a firm that has demonstrated ICT-enabled efficiencies in supply chain management, and who competitors are attempting to imitate (they note with varying degrees of success to date).

6 Conclusion

This report has highlighted the increasing importance of telecoms innovation in driving substantial economic growth in the future. It has also revealed the weaknesses of the telecoms sector today in maximising innovation which is rooted in the inadequacies of the current regulatory approach.

The current regulatory approach in the UK will not reap the substantial economic benefits that can come from telecoms innovation. To tap into this substantial upside of at least £20 billion requires decisive but feasible change, not just adjustments to the current regulatory approach. Given the size of the opportunity, the actions to capture these gains are worthy of active and early consideration.