The internet – the new helping the old

A report for
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About Plum

Plum Consulting offer strategy, policy and regulatory advice in the telecoms, spectrum, online and audio-visual media sectors. We draw on economics and engineering, our knowledge of the sector and our clients' understanding and perspective to shape and respond to convergence.

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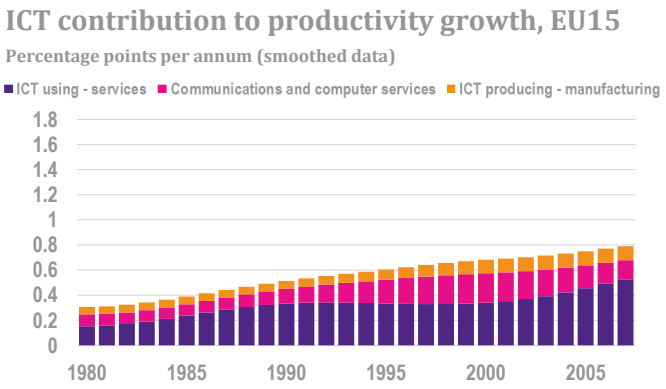
The internet is a key driver of productivity growth

Half of European productivity growth relates to the internet, and consumers capture most of the benefits

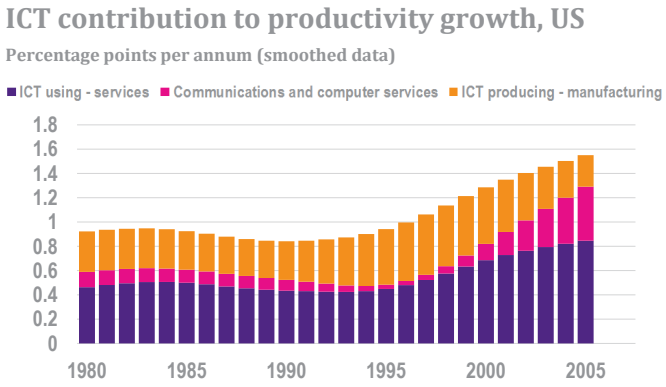
Alan Greenspan, then Chairman of the Federal Reserve Board, remarked that the productivity impact of computers arose once they were linked (via the internet):

> *"The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks…"*



Source: Plum Consulting, KLEMS

Whilst Europe has reaped substantial benefits from the internet, the contribution has been smaller than in the US.



Source: Plum Consulting, KLEMS

This difference is not because the internet comprises a larger share of the economy in the US, but because the US has been better at using the internet throughout the economy.

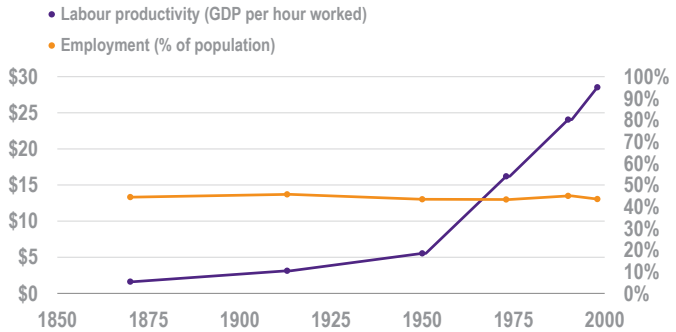
Further, not only is the greatest benefit to be had from use, but the majority of benefits are captured by consumers and citizens – irrespective of the origin of internet services.

Over the past century productivity grew 10-fold and real incomes grew 5-fold, whilst hours worked per capita halved and the employment rate remained stable

Productivity growth underpins growth in income & leisure

Over the past century productivity grew 10-fold and real incomes grew 5-fold, whilst hours worked per capita halved and the employment rate remained stable.

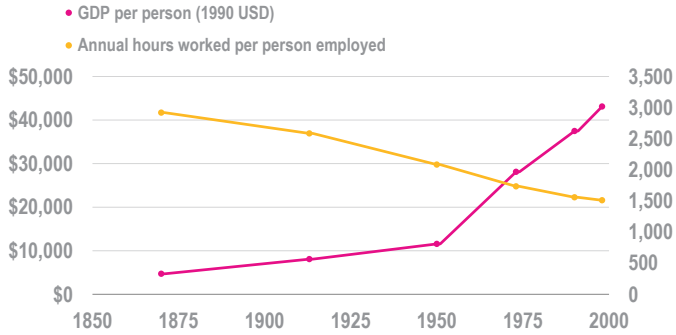
Labour productivity and employment, Western Europe



Source: Plum Consulting, OECD

* Weighted average of 12 West European countries

GDP and hours worked per person, Western Europe



Source: Plum Consulting, OECD

* Weighted average of 12 West European countries

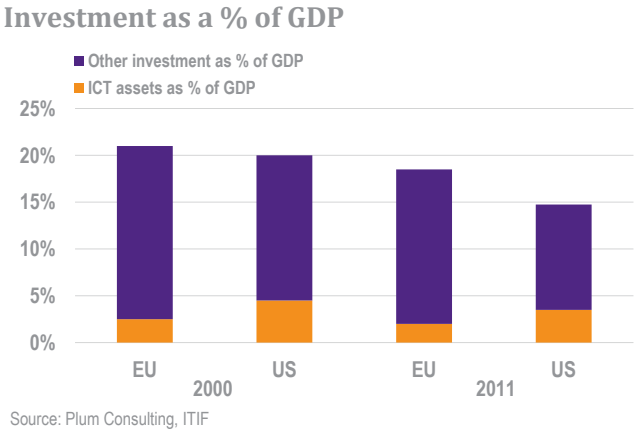
As Paul Krugman put it (1994):

> *"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."*

Europe invests more than the US overall, but less in relation to the internet

Europe underinvests in the internet, but not overall

Europe invests more than the US overall relative to GDP, but not in relation to the internet and ICT.



The new (the internet) is helping the old (everything else)

The following provides examples of European enterprise using the internet to strengthen existing services, offer new services and reach new markets.

Examples of the new helping the old

- UK newspaper the Guardian in 2009 decided to become a digital-first publication. Now, the Guardian has 110m unique browsers per month on its sites, and 6m unique visitors every day. Digital revenue has grown 29% year on year, accounting for a third of the Guardian's total revenue. During this time print circulation has fallen 6.5%, but online browsers have increased 24% year on year. Two-thirds of the Guardian's browsers are from outside the UK.
- Neuroathome, a Spanish initiative, uses Microsoft Kinect technology to help rehabilitate patients affected by neurological injuries, neurological disorders (e.g. Parkinson's) or aging. It allows clinicians to prescribe physical and cognitive exercises to patients at home, and to monitor patients remotely, allowing better health outcomes to be obtained at a lower cost.
- German wood sculptor Gerhard Schmeider is able to take orders for his cuckoo clocks from as far away as the Far East, Australia and the USA. This is crucial since the local market in the Black Forest is too small to support his business.
- Sandvik, a Swedish engineering group, has utilised the internet to offer an expanded portfolio of services. These services include mine automation (where mine vehicles are equipped with wireless communication and navigation systems and automated) and proactive maintenance (where Internet of Things technology is used to monitor equipment and predict when it will need servicing)

A new game requires new rules

The benefits of the internet are not assured – policy matters

Since the majority of the benefits from the internet come from the use of the internet rather than the production of internet related goods and services, it is vital to facilitate effective use and diffusion of internet technologies throughout the economy.

The stakes have risen with policies that limit the ability to adapt imposing a higher economic cost in the internet era. As Nobel winning economist James Heckman put it:

> *"The opportunity cost of security and preservation of the status quo – whether it is the status quo technology, the status quo trading partner, or the status quo job – has risen greatly in recent times."*

Policy and approaches which developed prior to the internet will not always be appropriate in the new environment, and policies that inhibit internet driven innovation will not 'protect' the status quo.

As the Red Queen said in Through the Looking-Glass: "*…it takes all the running you can do, to keep in the same place*". If Europe doesn't run, keeping up both in terms of policy and business innovation, it will go backwards.

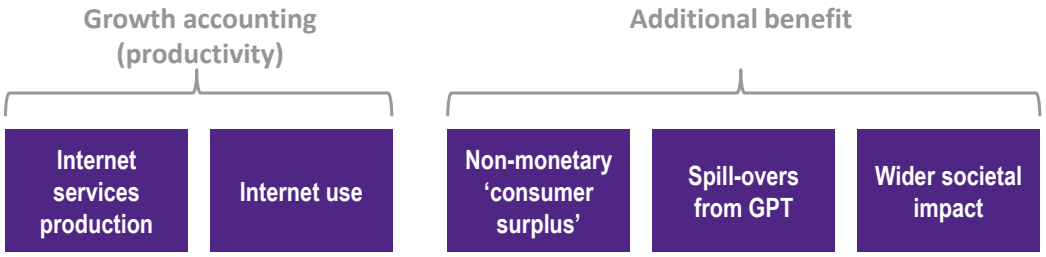
Given that the benefits of the internet depend on embedding the internet throughout the economy, an approach to reform which focusses on vertical sectors of the economy beyond the internet itself is required. This will require:

- A different institutional approach, given that responsibility for the digital economy is typically assigned in a way that promotes a focus on the supply side of the digital economy rather than on how digital services are used throughout the economy.
- The reform process will need to draw on insights from participants in both the "new" and "old" economies, whilst also maintaining a focus on consumer rather than producer interests. This is challenging, but achievable, provided the focus is clear.
- The EU Digital Single Market strategy, and national plans, should focus on facilitating the benefits of the internet throughout the whole economy, rather than focus on the digital economy *per se*.

The benefits of the internet are not assured – policy matters. As the game changes the challenge is to adapt the rules, not to apply the old rules to a new game.

1 Categorisation of the internet's diverse benefits

There are a range of benefits from use of the internet, and there different ways of measuring and assessing these benefits.



We note the following in relation to the above broad taxonomy which we develop in this paper:

- We focus on contributions over time rather than, say, GDP shares at a point in time. Sector shares of GDP are arguably not that informative with both electricity and agriculture constituting small shares of the economy, but making large contributions to our well-being, indeed survival in the case of agriculture.
- Productivity gains and GDP growth are more or less synonymous since people can only work so much. The only long-run source of per capita income growth is therefore productivity growth.
- The benefits from internet use for other businesses and consumers are significantly greater than those associated with production of internet services, and most of the benefits are ultimately captured by end consumers.
- Additional wider benefits, not reflected in measures such as GDP, include consumer time savings and time spent consuming internet services including free services, greater choice, spill-overs and reduced externalities, for example, reduced greenhouse gas emissions associated with video streaming versus DVD use.

Through the paper we use the terms the internet and information and communications technology (ICT) somewhat interchangeably, as discussed in Figure 1-1.

Figure 1-1: The internet versus ICT?

We use the terms internet and ICT somewhat interchangeably. The internet, at least the widely adopted and commercially relevant internet, is more recent than Information and Communications Technology (ICT). However, a visible impact on productivity and growth at the macroeconomic level was not apparent until the internet allowed the widespread networking of computers from the mid-1990s.

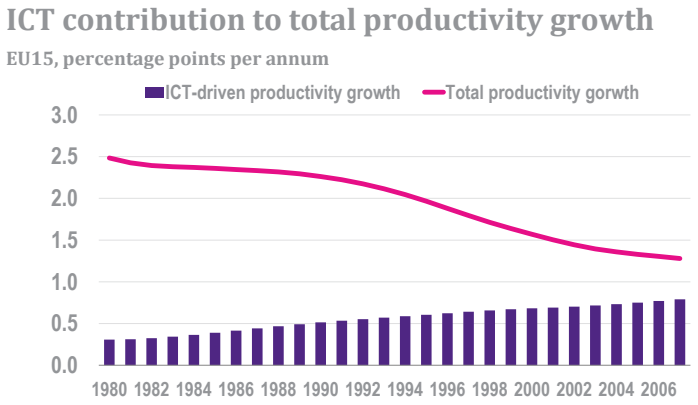
Therefore, whilst the academic literature generally refers to ICT the linkage between ICT and economic outcomes is really a story about the internet and interconnected computers, people and things. We anticipate that this linkage between the internet and productivity growth and consumer benefits will deepen over time as adoption of the mobile internet deepens the linkage of people and things to the internet.

It is also difficult to disentangle the internet from ICT more generally, as the two are intimately related. Powerful technologies tend to have a large impact but ultimately make up a relatively small part of the economy, for example electricity. The internet may also ultimately be ubiquitous, indispensable, powerful and much less visible.

2 The internet's contribution to growth

Information and communication technology (ICT) and the internet have contributed over half of recent productivity growth in Europe (Figure 2-1).

Figure 2-1



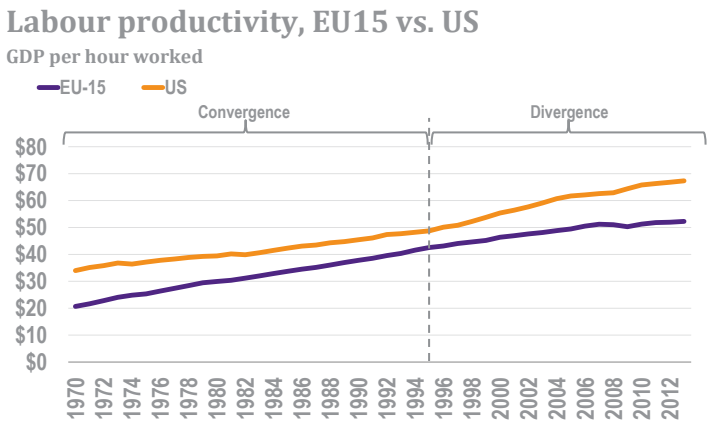
Source: Plum Consulting, KLEMS

The internet was the key to this growth contribution. As Alan Greenspan put it:[1] *"The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks…"*

2.1 Europe - no longer catching up but falling behind

However, after a period of convergence, EU and US labour productivity have diverged (Figure 2-2).

Figure 2-2



Source: Plum Consulting, ITIF

[1] Alan Greenspan. March 2000. "The revolution in information technology." http://www.federalreserve.gov/boarddocs/speeches/2000/20000306.htm

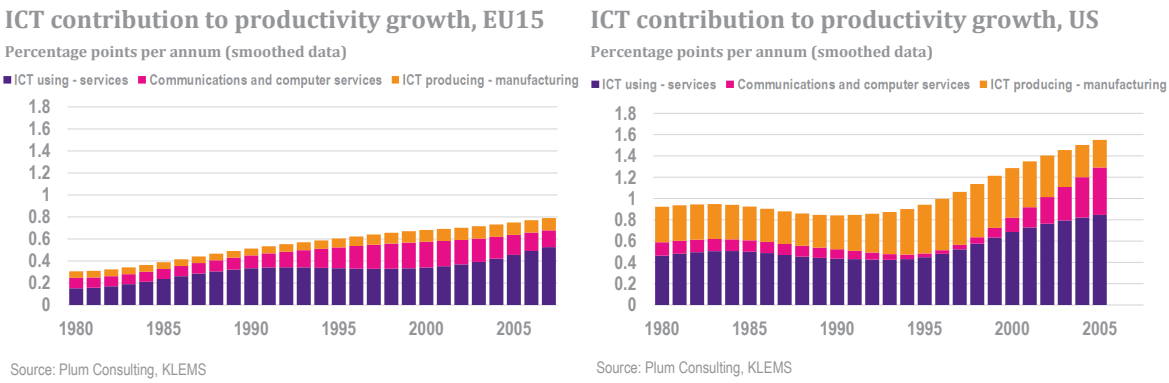
The break in the mid-1990s coincides with the emergence of the internet and networked computers. It also coincides with the first clear evidence that ICT was having an aggregate impact on productivity and GDP growth – evident both in Europe and the US (but stronger in the US).

There are two reasons Europe has failed to capitalise on internet to the same extent as the US: a smaller payoff than the US from investment in ICT and, as a consequence less investment in, and accumulation of, ICT related capital.

2.2 Europe gets a lower payoff from the internet

Figure 2-3 shows that whilst Europe's productivity growth has benefited from the production and use of ICT the payoff from ICT investment is lower than in the US[2].

Figure 2-3



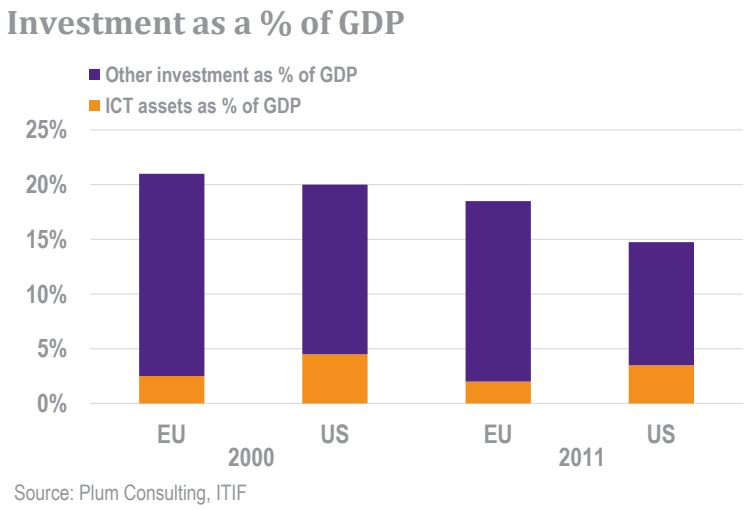
The size of the ICT sector in the EU and the US is broadly comparable and does not therefore explain the difference. It is use of the internet, and use in the largest sector of the economy – the services sector – that matters in particular.

2.3 Europe invests more than the US, but not in relation to the internet

Figure 2-4 shows that whilst Europe doesn't have a relative investment problem compared to the US, but it does have an ICT investment deficit.

[2] The Information Technology and Innovation Foundation. June 2014. "Raising European Productivity Growth Through ICT", http://www.itif.org/publications/raising-european-productivity-growth-through-ict

Figure 2-4

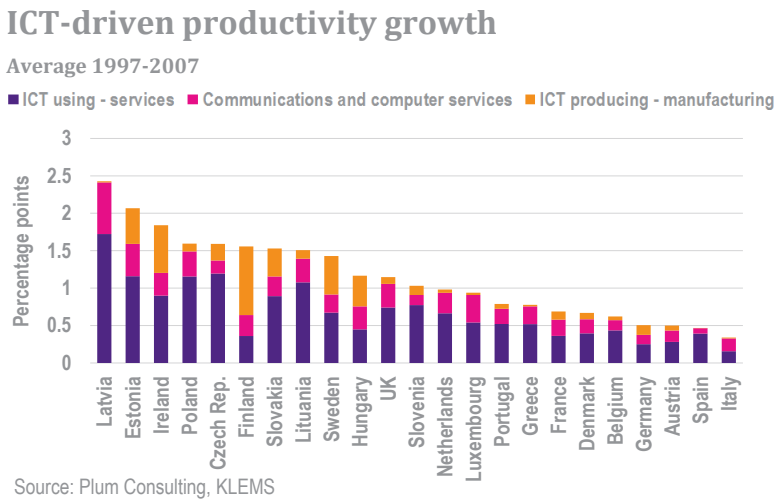


Europe gets a smaller payoff from investment in ICT than the US, arguably for structural policy related reasons, and therefore invests less. Over time this difference in annual investment has had a cumulative impact on the stock of capital related to the internet.

2.4 The internet's contribution varies substantially within Europe

Figure 2-5 shows the pronounced varition in the productivity contribution of the internet within Europe.

Figure 2-5



These numbers represent percentage point contributions to productivity growth. For instance, out of Latvia's productivity growth of 6.5%, c.2.5 percentage points was due to ICT.

The contribution is especially high in the Baltic countries. This has been attributed to the favourable policy and regulatory environment, with governments seeking to create business environments open

to innovation.[3] For example, Latvian pursued an e-Government strategy in 2005-2008, and in 1998 Estonia's government approved a plan for establishing an 'information society' including:

> *"a deliberate attempt to transform the Estonian economy from relying on cheap labor as a source of competitiveness towards an innovation-based economy with high-quality human capital and innovation systems that support R&D, and the application of new knowledge in the interest of cultural, social, and economic development. This has included the facilitation of cooperation between traditional industry and new-economy sectors and Development Strategy 2002-2006"*

Conversely, Germany experienced a productivity growth deceleration over the period. This has been linked to underinvestment in ICT in the mid-1990s, relative to the US.[4] Germany experienced a divergence between software-intensive industries and other industries – the former generating half of Germany's productivity growth 2000-2004, the latter acting as a drag on productivity.[5] In the ICT-intensive service sectors productivity growth was slower in Germany than in the US.[6]

2.5 The internet is particularly important for service-intensive economies

Since some sectors use the internet more than others the sectorial composition of an economy will affect the benefit that economy will derive from the internet: economies with a high share of services (such as the EU) both invest more in ICT and benefit more from internet use.[7]

GDP growth can be attributed to improvements in the quality and quantity of capital and labour. Focussing on the capital contribution, ICT capital typically accounts for a larger share of GDP growth attributable to capital in more developed economies (Figure 2-6). By contrast, China and India have a lower proportion of growth attributable to capital driven by ICT capital.

[3] "ICT, Innovation, and Economic Growth in Transition Economies: A Multi-Country Study of Poland, Russia, and the Baltic Countries. Washington, DC". 2007. infoDev / World Bank. http://www.infodev.org/articles/ict-innovation-and-economic-growth-transition-economies-multi-country-study-poland-russia

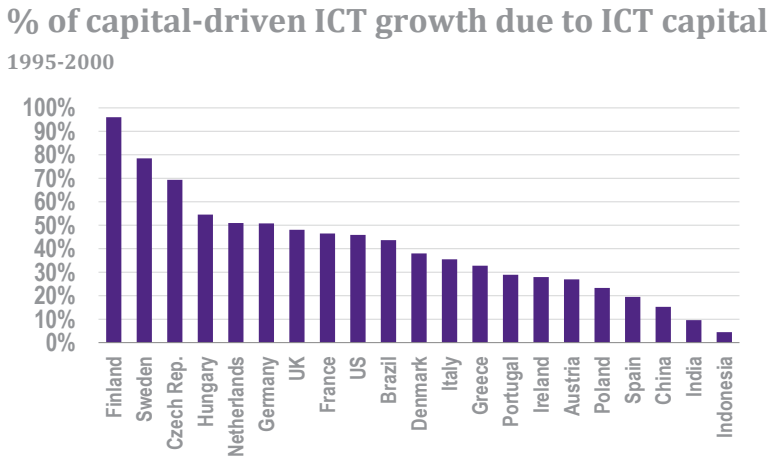
[4] Theo Eicher and Oliver Roehn. 2007. "Sources of the German Productivity Demise", CESIFO Working Paper. http://www.cesifo-group.de/ifoHome/publications/working-papers/CESifoWP/CESifoWPdetails?wp_id=14557976

[5] Theo Eicher and Thomas Stroebel. 2007. "The Rise and Fall of German Productivity: Software Investment as the Key Driver", CESIFO Economic Studies, http://www.researchgate.net/publication/46513084_The_Rise_and_Fall_of_German_Productivity_Software_Investment_as_the_Decisive_Driver

[6] OECD Economic Surveys: Germany 2008. http://www.oecd.org/eco/surveys/economicsurveyofgermany2008.htm

[7] Paolo Guerrieri and Mattero Luciani. 2010. "The Determinants of Investment in Information and Communication Technologies" Bruges European Economic Research papers, https://www.coleurope.eu/system/files_force/research-paper/beer16.pdf?download=1

Figure 2-6



Source: Plum Consulting, Vu (2005)

Europe's immediate growth prospects therefore depend more on effective internet use, compared to economies that have a relatively smaller services sector e.g. China. Therefore measures that inhibit the use of the internet in Europe will be, relatively speaking, more costly than for some other economies. For example, a data localisation requirement (i.e. obliging certain data to be stored on servers physically located within a country, or otherwise inhibiting data from leaving the country) is predicted to cost the EU28 -$193bn, compared to $63.8bn in China, $14.5bn in India and $15bn in Brazil.[8]

[8] Matthias Bauer et al. 2014. "The Costs of Data Localisation: Friendly Fire on Economic Recovery". http://www.ecipe.org/publications/dataloc/

3 The internet's contribution in a long-run context

The internet is a key driver of productivity growth. In this section we consider the internet in a longer run context both as a general purpose technology (GPT) and in terms of the long-run relationship between productivity growth, real income, employment and leisure.

3.1 General purpose technologies & the internet

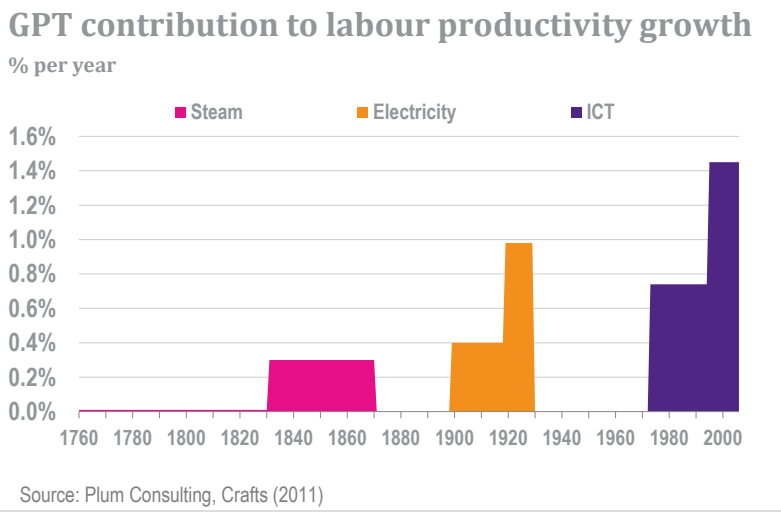
GPTs are associated with waves of productivity growth and both steam power and electricity are examples.[9] Computers coupled with the internet and open applications development constitute another GPT.[10] Figure 3-1 discusses parallels between the internet and previous GPTs.

Figure 3-1: Parallels between the internet era and earlier general purpose technologies

General Purpose Technologies (GPTs) such as steam, electricity and the internet take time to diffuse and to reach their potential. It took approximately two decades for the extent of electrification to reach 50%, but that alone was not sufficient. Initially central steam or water power sources were replaced with central electric motors, and the system of drive shafts, belts and supporting structures left intact. Only when factories were redesigned with small distributed electric motors and light weight structures did large productivity gains arise.

From the 2nd half of the 1990s clear evidence of a significant overall impact on productivity growth attributable to the internet emerged. Innovation, including new business models, only really took off when a critical mass of users had built up and with the networking of computers; particularly with the launch of the World Wide Web in 1993 which lowered entry barriers for start-ups. The internet also facilitated the use of information technology by existing businesses. A critical mass of users coupled with networked computers utilising the internet has driven innovation and social and economic benefits.

The following figure illustrates the productivity contribution of steam, electricity and the internet/ICT.



Note: the figure reflects measurement periods and does not imply that electricity had zero impact post 1930.

[9] Paul A. David and Gavin Wright. 1999. "General Purpose Technologies and Surges in Productivity: Historical Reflections on the Future of the ICT Revolution." http://www.nuffield.ox.ac.uk/economics/history/paper31/a4.pdf

[10] Carol A. Corrado. March 2011. "Communication Capital, Metcalfe's Law, and U.S. Productivity Growth." http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2117784

The impact of ICT and the internet already dwarfs the estimated impact of previous GPTs. Given the need for complementary innovation and investment in new forms of organisation to fully exploit GPTs productivity growth may come in multiple waves as ways are found to exploit different innovations:[11]

> *"History shows that productivity growth driven by general purpose technologies can arrive in multiple waves; it need not simply arrive, give what it has, and fade away forever thereafter"*

The internet is following a similar pattern with waves of innovation associated with the internet and PC's followed by a wave associated with the mobile internet, wearables, the internet of things, cloud computing and artificial intelligence. The current wave involving mobile and things has the potential to transform many areas of the economy and society including health, transport, energy and education.

3.2 Productivity growth isn't everything, but in the long run it is almost everything

> *"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker." Paul Krugman, 1994*[12]

The reason for this is that GDP per capita, and therefore income per capita, is the product of hours worked and productivity per hour worked (labour productivity). Since there is a limit to how many people can work and the number of hours they can work, the only thing that can result in sustained increases in real income is productivity growth.

3.2.1 Long-run productivity growth has not reduced employment

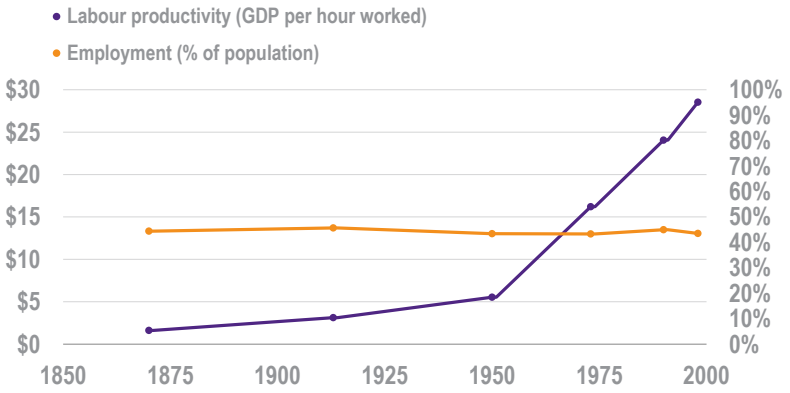
In the economy as a whole, productivity growth over the long-run does not result in unemployment. Over the past century, labour productivity has grown almost tenfold in Western Europe, while the proportion of the population employed has remained almost constant (Figure 3-2).

[11] Chad Syverson. 2013. "Will History Repeat Itself? Comments on "Is the Information Technology Revolution Over?"". University of Chicago. http://www.csls.ca/ipm/25/IPM-25-Syverson.pdf

[12] Paul R. Krugman. 1994. "The Age of Diminished Expectations." Cambridge: MIT Press.

Figure 3-2

Labour productivity and employment, Western Europe



Source: Plum Consulting, OECD

* Weighted average of 12 West European countries

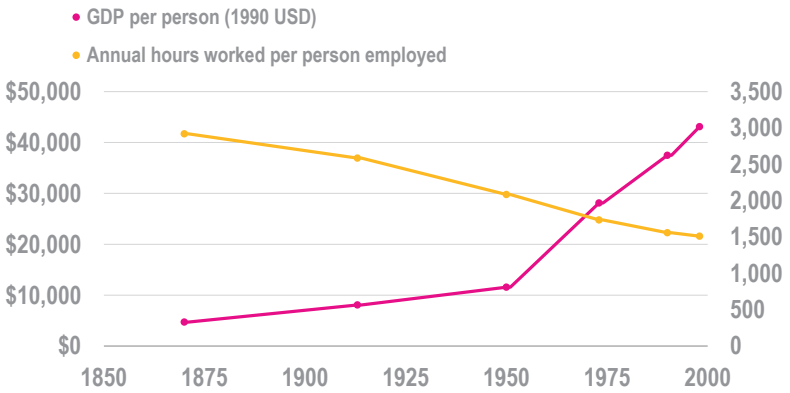
If output and working hours had remained constant over this period, then the observed ten-fold labour productivity growth would have resulted in near universal unemployment. Instead output and incomes have expanded, hours worked per person have fallen and overall employment has been maintained.

3.2.2 Long-run productivity growth has increased incomes and leisure

Figure 3-3 shows how productivity growth has translated into both income and leisure time gains. The ten-fold productivity advancement over the past 100 years has supported a halving of annual hours worked and a five-fold increase in GDP per person. Some of the productivity benefit has therefore been taken in the form of increased leisure time for the working population, and the rest has been taken as additional income.

Figure 3-3

GDP and hours worked per person, Western Europe



Source: Plum Consulting, OECD

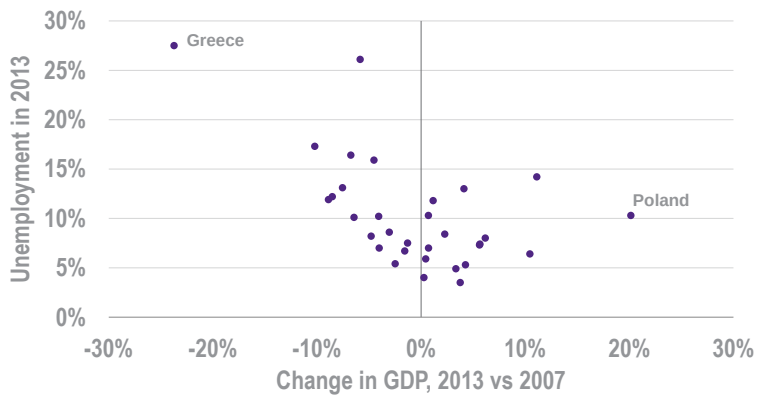
* Weighted average of 12 West European countries

3.2.3 GDP growth is associated with lower unemployment

In the shorter term GDP growth, which is linked to productivity growth, tends to be correlated with better employment outcomes, as shown in Figure 3-4.

Figure 3-4

Unemployment vs. GDP growth, EU countries



Source: Plum Consulting, Eurostat

Growing GDP and real incomes fuel demand, which drives labour demand. For example, a study of US manufacturing concluded that:[13]

> *"Overall, higher productivity has led to lower prices, expanding demand, and to higher employment, but the partial effects of rapid domestic productivity growth have been more than offset by more rapid productivity growth and price declines from foreign competitors."*

Productivity growth, which is the only long-run source of GDP growth per capita, is associated with better employment outcomes. Indeed, productivity growth is necessary for firms to maintain their competitiveness consistent with real income growth for employees.

[13] William Nordhaus. May 2005. "The Sources of the Productivity Rebound and the Manufacturing Employment Puzzle." http://www.nber.org/papers/w11354

4 Lessons regarding the benefits of the internet

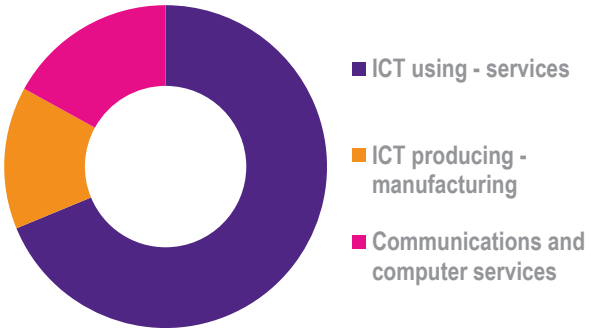
4.1 Benefits from internet use dominate those from production

Whilst some economies have a relatively large ICT producing sector (e.g. Korea) in most economies the benefits of internet use dominate over the benefits from internet service and ICT production, making up around three-quarters of overall productivity gains. In other words you don't have to make it to use it, and use dominates in terms of benefits.

Figure 4-1

Use dominates productivity growth contribution

EU27, 2007



Source: Plum, KLEMS

As Professor Crafts noted:[14]

> *"Projected ICT-use effects on long-run growth [are] generally much bigger than ICT-output [production] effects"*

4.2 You don't need to make IT to use IT

The US has a strong position in terms of the ranking of internet companies by market capitalisation globally.[15] However, the US and Europe have approximately equal GDP contributions from the ICT sector at around 5 per cent of GDP, and the share of GDP has been decreasing in recent years in nominal terms.[16] The reason the share, which increased historically, is now decreasing is that price declines are outstripping volume increases.

Figure 4-2 shows the productivity contribution from ICT use versus the ICT share of GDP for a number of European and non-European countries.

[14] Nicholas Crafts. 2011. "ICT as a GPT: an historical perspective". http://www2.warwick.ac.uk/fac/soc/economics/research/centres/cage/publications/confpapers/ictnet.pptx

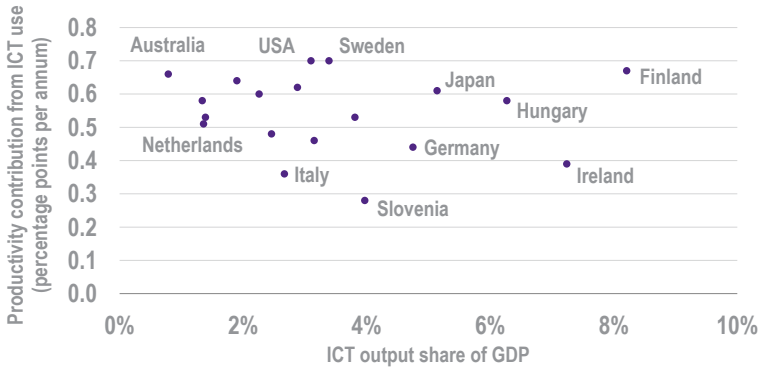
[15] The Economist. July 2014. "Daily chart - start me up". http://www.economist.com/blogs/graphicdetail/2014/07/daily-chart-6

[16] European Commission. "ICT R&D, innovation and growth." Box 1. http://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KKAH12001ENN-chap4-PDFWEB-4_0.pdf

Figure 4-2

ICT share of output vs. productivity contribution

1997-2007



Source: Plum Consulting, Oulton (2010)

Even with comparatively little ICT production, it is still possible to have a substantial growth impact from ICT e.g. Australia and the Netherlands. This suggests that you don't have to make IT to use IT effectively.

4.3 Most of the benefits of internet use go to consumers

Whilst enterprises using the internet benefit, as the Red Queen said in Lewis Carroll's Through the Looking-Glass "*…it takes all the running you can do, to keep in the same place*". Competition means that it is mostly consumers and not producers who ultimately capture the benefits of the internet.

A study by Nordhaus of overall returns in the non-farm business sector in the US concluded that:[17]

> *"We conclude that only a miniscule fraction of the social returns from technological advances over the 1948-2001 period was captured by producers, indicating that most of the benefits of technological change are passed on to consumers rather than captured by producers."*

In conclusion, benefits from internet use tend to dominate those from production of internet services, you don't need to make IT to use IT, and the benefits go predominantly to end consumers.

[17] William Nordhaus. April 2004. "Schumpeterian profits in the American economy: theory and measurement." http://www.nber.org/papers/w10433

5 Wider economic & societal benefits of the internet

5.1 Consumer surplus, time use & choice

The internet is improving the quality of life for European citizens in ways that are not necessarily measured by GDP: it is saving them time, offering them services for free and giving them access to a wider range of products and services. Although these benefits are not necessarily in monetary form (or captured in monetary measures), they are substantial.

One way of capturing the value of the internet, including some of the non-monetary benefits, is to consider the time spent using the internet. This has been rising, a trend extended via the mobile internet.

5.1.1 Welfare gain from time spent using the internet

One approach is to assess the amount of leisure time spent using the internet. In Europe, citizens spent on average 27 hours per month online in 2013, with social media the biggest activity.[18] More time is spent watching TV (an average of almost 4 hours per day across the Big 5),[19] but this time is fairly stagnant, while time spent online is growing rapidly.

In the US, Brynjolfsson and Oh use estimates of time spent online to work out the welfare gains from the internet (as opposed to other leisure activity substitutes, like watching TV).[20] They estimate a welfare gain of about $159bn (€127bn) per year. Scaling this estimate up to the EU's population gives a welfare gain of €204bn – roughly 1.5% of the EU's annual GDP. Most of this total welfare gain would be overlooked by approaches that rely on expenditures.

Subsequent to this analysis internet use, and particularly mobile internet use, has continued to grow.[21] The implied benefits have therefore also increased.

5.1.2 Time savings

The internet enables fast and ubiquitous access to a wealth of information and services. This enables internet users to accomplish a variety of tasks more quickly, such as shopping, organising finances, or interacting with the government. In turn this gives users more time to devote to work or leisure.

A 2013 study[22] assessed the value of internet search by comparing it to 'offline' search. The study involved giving a group of participants a sample of queries. One half of the group used online search and the other used 'offline' – a library. The study found that those using online search were

[18] ComScore. 2013. "Europe Digital Future in Focus," http://www.comscore.com/Insights/Press-Releases/2013/3/comScore-Releases-2013-Europe-Digital-Future-in-Focus-Report

[19] Ofcom. December 2013. "International Communications Market Report". Currently, IPTV represents a small (but growing) proportion of total TV viewing, so there is little double-counting.

[20] Erik Brynjolfsson and Joo Hee Oh. 2012. "The Attention Economy: Measuring the Value of Free Digital Services on the Internet," http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1045&context=icis2012

[21] http://www.nielsen.com/us/en/insights/news/2014/whats-empowering-the-new-digital-consumer.html

[22] Yan Chen, Grace YoungJoo Jeon and Yong-Mi Kim. March 2013. "A day without a search engine: an experimental study of online and offline searches", http://yanchen.people.si.umich.edu/papers/VOS_2013_03.pdf

significantly more likely to find an answer using the internet. For those questions where both groups found an answer, web searches took on average 7 minutes, versus 22 minutes for the corresponding offline search (not including the time and cost of going to a library) with no significant difference in answer quality between the two search types. Hal Varian[23] converts the time saved to a dollar saving, estimating search could be worth $1.37 (€1) per adult worker per day, or about $500 (€400) per worker per year.

5.1.3 Free services

Many of the most popular services on the Internet are free to the consumer – email, search, social networking, online encyclopaedias, and so on. Working out how consumers value these services is difficult, since users do not pay for them (while users might 'pay' in terms of their exposure to advertising, research from McKinsey suggests that the value consumers place on internet services far exceeds the value of the advertising[24]).

However, we note that over two-thirds of consumers' internet use is estimated to be spent using free sites and services.[25] Assuming a commensurate share of the welfare gain, free sites could provide an annual welfare gain of €135bn.

5.1.4 Enhanced choice

The internet broadens the choice of goods and services available to consumers. While markets have historically been dominated by comparatively few bestselling products, the internet is shifting consumption towards more niche products, or the 'long tail'.[26] There are two reasons for this shift:

- Firstly, the internet lowers the cost of doing business. In a shopping centre, only those firms that can afford a bricks-and-mortar store will be present, and even then firms are constrained in their product selection by limited physical space. With internet retailing, not only are there more firms, but firms can sell a wider variety of products. This facilitates greater choice and the availability of niche products.
- Secondly, the internet lowers the cost of search so that consumers can find exactly what they want. This effect holds even when the product selection is the same as it is in traditional retail – consumers make different choices when they have better information.

Access to search, comparison and review sites give access to a wider range of goods and helps people avoid poor quality products and sellers. This benefits small independent businesses. For instance, in the absence of reviews, consumers might prefer to go to chain restaurants with an established brand, rather than 'risking' an independent local restaurant that actually serves better food.

[23] http://www.economist.com/blogs/freeexchange/2013/03/technology-1

[24] http://www.mckinsey.com/insights/high_tech_telecoms_internet/internet_matters

[25] Erik Brynjolfsson and Joo Hee Oh. 2012. "The Attention Economy: Measuring the Value of Free Digital Services on the Internet," http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1045&context=icis2012

[26] Erik Brynjolfsson, Yu Hu, and Duncan Simester. January 2011. "Goodbye Pareto Principle, Hello Long Tail: The Effect of Search Costs on the Concentration of Product Sales," *Management Science.* http://pubsonline.informs.org/doi/abs/10.1287/mnsc.1110.1371

For sellers, the internet broadens their potential market and aids discoverability of their products, enables niche companies to find a market.[27]

For consumers, the ability to find exactly what they want is valuable. Brynjolfsson, Smith and Hu (2010) found that the 'long tail' of Amazon book sales has been growing over time, and that by 2008 niche books counted for 36.7% of sales. The consumer surplus generated from these niche books has increased five-fold from 2000 to 2008.[28]

In the music market, the number of new works brought annually to market has increased by 50% since 2000[29] with no reduction in quality.[30] This growth has been facilitated by discoverability mechanisms like internet radio and online music criticism. As a consequence, the internet has made it far easier for independent labels to be noticed and to achieve commercial success – independent labels' share of the Billboard top 200 selling albums has risen from 13% in 2001 to 35% in 2010.

5.2 Spillovers associated with the internet

General purpose technologies (GPTs), discussed in Section 3.1, involve effects that spread through the economy well beyond the sector that produces the GPT itself i.e. spillovers. Spillovers differ from externalities such as greenhouse gas emission discussed above since the impacts are mediated via the market rather than via a physical impact, but are diffuse.

They will ultimately show up in GDP, but over time and potentially in areas that will not necessarily be associated with the internet. GPTs ultimately have far-reaching effects upon economies, as Crafts (2003) notes that: [31]

> *"the initial impact of a GPT on overall productivity growth is typically minimal and the realization of its eventual potential may take several decades".*

5.3 Health, education & environmental benefits

The internet, by supporting productivity and GDP growth, supports broader societal benefits including better employment outcomes and healthier public finances, which in turn increases the scope to pursue other goals.

The internet supports informed democracy, better decisions by citizens and policy makers and allows services such as education and health to be more effective and more cost-effective.

[27] Glenn Ellison and Sara Fisher Ellison. September 2014. "Match Quality, Search, and the Internet Market for Used Books". MIT working paper. http://economics.mit.edu/files/10351

[28] Erik Brynjolfsson, Yu Hu and Michael D. Smith. September 2010. "The Longer Tail: The Changing Shape of Amazon's Sales Distribution Curve" http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1679991

[29] Joel Waldfogel. 2013. ". "Digitization and the Quality of New Media Products: The Case of Music". NBER. https://ideas.repec.org/h/nbr/nberch/12996.html

[30] Joel Waldfogel. 2011. "Copyright Protection, Technological Change, and the Quality of New Products: Evidence from Recorded Music since Napster". NBER http://www.nber.org/papers/w17503

[31] Nicholas Crafts. 2003. "Steam as a General Purpose Technology: A Growth Accounting Perspective", http://eprints.lse.ac.uk/22354/1/wp75.pdf

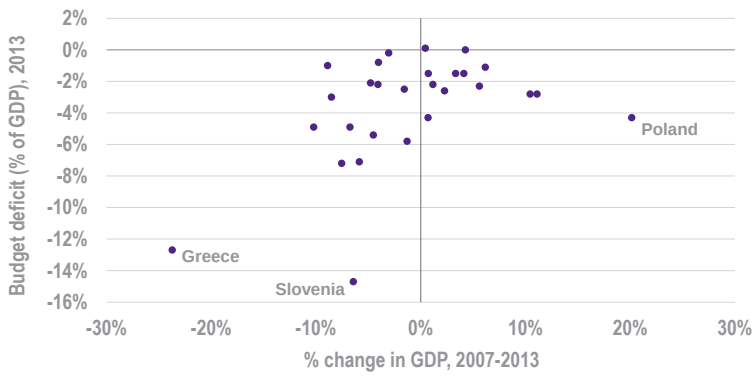
The internet also increases substitution possibilities within the economy, thereby reducing any economic trade-off involved in delivering other policy objectives including improved environmental outcomes.

5.3.1 GDP growth is correlated with improved government finances

Productivity growth supports GDP growth and employment. However, public finances also tend to be healthier in economies that are growing (see Figure 5-1). Productivity growth, by supporting GDP growth and sound public finances, underpins the scope for governments to pursue broader objectives.

Figure 5-1

Budget deficit vs. change in GDP 2007-2013



Source: Plum Consulting, Eurostat

5.3.2 Health & Education benefits

The government plays a substantial role in the delivery of health and education services in Europe, with these activities involving public expenditure of around 10% and 5% respectively of GDP out of total government service expenditure of around 20% of GDP (excluding income transfers).

The internet is increasingly a complement to health and education supporting better outcomes and more cost effective service delivery. The internet provides a complementary source of information for citizens and professionals providing these services, and the internet is increasingly built into service delivery, for example, in relation to tele-health and website and app-based language learning resources.

5.3.3 Environmental benefits

The internet can benefit the environment and society as a whole, not just the user. Examples include:

- Industry. Mass deployment of networked sensors in industry enables widespread collection of data. This in turn can be used to make factories ‘smarter’ and more efficient, benefitting the environment.

- Better decision-making. The internet facilitates the collection and dissemination of data. In turn, this allows policymakers to make better decisions on how to combat negative externalities or promote positive ones by reducing informational constraints, for example, in relation to congestion pricing.
- Substitution possibilities, for example, online collaboration rather than travel and meetings and digital for physical goods. An illustrative example of the latter is provided in Figure 5-2.

Figure 5-2: Energy & greenhouse gas emissions from video streaming versus DVDs

The energy consumed by cloud services has at times been singled out as a concern. However, taking a wider view there are good reasons for thinking that cloud services may be substituting both for less energy efficient local servers (in every enterprise) and allowing online services to substitute for physical goods. Further, the energy used per compute cycle or for a given quantity of information is steadily decreasing.

An illustrative example of the impact of cloud services on energy use is the substitution of video and audio streaming for DVD and CD ownership or rental. One study estimated the life-cycle energy cost and greenhouse gas emissions associated with video viewing through both traditional DVD methods and online video streaming.

Based on estimates for the US shifting all 2011 DVD viewing to video streaming reduces the total primary energy use to about 162 PJ and the CO2(e) emissions to about 8.6 billion kg, representing a savings equivalent to the primary energy used to meet the electricity demand of nearly 200 000 US households each year. Interestingly data centre energy use —both operational and embodied within the IT equipment— account for <1% of the total video streaming energy use. Indeed, average data centre energy use of 1.1 Watt hours per GB of data, or around 2-4.5 Watt hours for SD and HD files respectively for a 2 hour film, is equivalent to 5 minutes or less use of a 50W light.

Over time the relative advantage of streaming over physical distribution can be expected to improve.

6 How the new helps the old

6.1 The internet as the network of networks, a platform & information store

The internet provides a rich information source, but is also the network of networks, allowing information and services to work across different forms of connectivity (whereas previously services such as telephony and video were tied to particular networks). The internet is also a platform for applications and services including, for example, online markets, Facebook and YouTube.

The internet is now the go-to tool for all kinds of information, from health to shopping, research and learning, travel arrangements and news. In addition there less visible flows of information governing online payment systems, cloud computing, machine to machine communication and the internet of things. The internet also helps researchers, students and citizens by facilitating collaborative research across borders, provision of online learning tools and video tutorials for practical skills.

The internet now underpins both online and offline commerce. Easy access to reviews, product specifications and price comparison sites helps customers make better decisions. The internet can also, in particular, help SMEs to be discovered, trusted and transact.

Communication is also substantially easier in the age of the internet. The internet has not only enabled email, instant messaging, audio and video messaging and cloud-based file sharing, but has enabled the development of low cost, instantaneous translation services – especially useful in linguistically diverse regions like Europe. For example, eBay provides tools to translate full inventory details into another language in real time.[32][33]

The internet is a dynamic entity, and the way that it is used is changing rapidly. Much like how PCs with browsers supplanted information-seeking from libraries, newspapers and physical stores, mobile devices and apps are now replacing PCs and browsers. This is changing the way that the internet is used to retrieve information.

For example, location-based 'local search' (provided by Yelp, TripAdvisor, Dooyoo or Ciao) is becoming more significant,[34] Yahoo is working on methods to search for images with another image,[35] and personal 'voice assistants' (e.g. Siri, Cortana and Google Now) are becoming increasingly good at guessing what their users want.[36] More generally, the growing volumes of data handled by the internet are driving developments in artificial intelligence and new ways of intelligently managing all the data.

The internet is enabling Europe to become more productive, European industry to become more efficient and European healthcare to become more effective. It is enabling greater media plurality and allowing European artists and voices to be heard globally. And it is helping European citizens to communicate, find information, find work, buy, sell, learn, save time and energy, and be creative – in short, improving quality of life.

[32] http://www.theguardian.com/media-network-partner-zone-ebay/ebay-cross-border-trade-retail

[33] http://www.theintegratedretailer.com/news/867/russia:-ebay-launches-machine-translation-tools-to-boost-cross-border-trade/

[34] http://seekingalpha.com/article/773261-yelps-ceo-discusses-q2-2012-results-earnings-call-transcript

[35] http://arstechnica.com/business/2014/11/finding-an-image-with-an-image-and-other-feats-of-computer-vision/

[36] http://www.techradar.com/news/phone-and-communications/mobile-phones/cortana-vs-siri-vs-google-now-1243987

6.2 Labour, capital and product markets

6.2.1 Labour markets

Many people are directly employed in the provision of internet services and, via complementary demand for enhanced connectivity, in the provision of network services. However, arguably more important than these direct jobs is the employment stimulus elsewhere in the economy through the use of the internet.

One (partial) measure of the wider impact on employment is the number employment in ICT related occupations, as opposed to employment in the ICT sector. Whilst the latter reached a peak of 4.1% of employment in 2001 and has subsequently declined; the former – employment in ICT occupations – grew over the decade by 15% in the US and 16% to 30% in OECD countries in Europe, performing better than total employment through the crisis.[37]

However, whilst growth in the number of internet related jobs is important, a longer term impact of the internet may be in improving the efficiency of the labour market. By lowering search costs and improving matching the internet has the potential to improve the competitiveness of enterprises, the quality of jobs people find and potentially to raise overall employment and lower unemployment.

By making it easier to search and find opportunities, the internet has enabled jobseekers to not only find jobs, but jobs more closely suited to what they want. Businesses can use it to advertise positions and reach more potential applicants.

The internet's utility has been recognised by job seekers: as early as 2009, four in every five British jobseekers were using the internet in their job search.[38] Over 25% of Danes have used the internet in the past three months for job research or applications.[39] The German job site JobBörse has over 3 million applicant profiles and nearly 900,000 jobs.[40]

The internet is also an attractive medium for businesses looking to hire. It is lower cost than traditional advertising: in 2002 the 8 largest job boards in the US charged an average of $98 for placing a vacancy, compared to newspapers which charged $3,840 for a 30-day advertisement.[41] Furthermore, the internet allows more space for describing the role, makes it possible to retroactively change the advert and allows the business to quickly identify potential candidates.

Professional networks can take this further – they allow the discovery of jobs through mutual contacts and networking. LinkedIn is now widely used by companies and headhunters for recruitment.[42] For example:

- LinkedIn, which reports over 300 million users worldwide[43]

[37] OECD. December 2014. "Measuring the digital economy." http://www.oecd.org/internet/measuring-the-digital-economy-9789264221796-en.htm

[38] Nominet Trust. 2012. "Employment and the internet" http://www.nominettrust.org.uk/sites/default/files/NT%20SoA%204%20-%20Employment%20and%20the%20internet.pdf

[39] OECD. 2012. Internet Economy Outlook 2012.

[40] https://jobboerse.arbeitsagentur.de Figures are as of December 2014

[41] Freeman. 2002, "The Labour Market in the New Information Economy". NBER http://www.nber.org/papers/w9254

[42] http://www.washingtonpost.com/business/capitalbusiness/linkedin-has-changed-the-way-businesses-hunt-talent/2013/08/04/3470860e-e269-11e2-aef3-339619eab080_story.html

[43] http://press.linkedin.com/News-Releases/333/LinkedIn-reaches-300-million-members-worldwide

- Viadeo, which has over 60 million users, with a strong presence in France and China[44]
- XING, which has over 14 million members worldwide, with a strong presence in German-speaking countries[45]

LinkedIn also proposes extending the service beyond the knowledge worker and professional profiles and jobs that currently dominate the site to include a much broader range of individuals and companies.[46]

Professional social networks also facilitate job matching through mutual contacts. This makes it easier for SMEs to expand since they can avoid the costs of hiring via traditional job adverts or by using headhunters. These networks can be a good place to find workers with highly specialised skills, such as aircraft mechanics.[47] They have also started to expand beyond professionals to become broader job sites, offering lower-level or 'blue collar' jobs.

Other companies such as Knack, HireArt and oDesk are using analytics to more accurately profile skills and attributes, in order to create better matches in the labour market.[48] The internet is helping Europe's labour markets by helping jobseekers, recruiters and enterprises advertise, find and fill vacant positions.

6.2.2 Capital markets

The internet can make it easier for firms and ventures to raise funding. Because they are high-risk, new and innovative start-ups typically find it hard to raise finance through more traditional methods - particularly at a time when banks are under pressure. The internet offers alternative means of finding funding. Crowdfunding has been defined as "the collection of funds, usually through a web platform, from a large pool of backers to fund an initiative".[49] Crowdfunding comes in four main varieties:

- Donation-based e.g. for philanthropic or arts projects
- Reward-based, where token gifts or other non-financial rewards are offered in return for funding,
- Lending-based, where funders expect repayment of the original investment
- Equity-based, where funders receive compensation in the form of a share of the company's equity

[44] http://corporate.viadeo.com/en/

[45] https://corporate.xing.com/no_cache/english/company/xing-ag/

[46] http://www.wired.com/2014/11/next-big-thing-missed-linkedins-quest-get-job-everyone-earth/

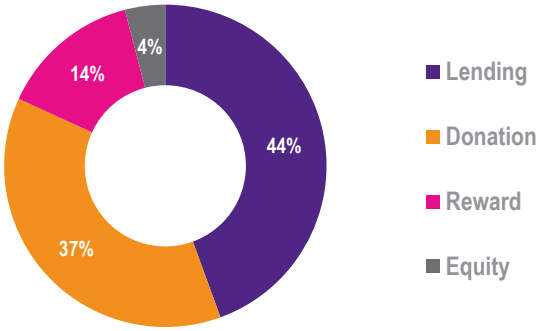
[47] http://www.economist.com/news/business/21612191-social-network-has-already-shaken-up-way-professionals-are-hired-its-ambitions-go-far?frsc=dg%7Ca

[48] Erik Brynjolfsson and Andrew McAfee. 2014. "The Second Machine Age", Norton and Co

[49] Karen E. Wilson and Marco Testoni. 2014. "Improving the role of equity crowdfunding in Europe's markets", *Bruegel Policy Contribution.*

Figure 6-1

Types of crowdfunding, by funding volume



Source: Plum Consulting, Bruegel Policy Contribtuion

The internet facilitates crowdfunding initiatives because it (a) enhances the discoverability of a particular venture, so that a wide (and possibly geographically dispersed) group of people have the opportunity to contribute, and (b) lowers the transaction costs of contribution. As a consequence, the internet enables a model where a relatively large number of people contribute a relatively small sum, which can raise a significant amount of capital.

Equity-based crowdfunding is the smallest category but is growing at 50% per annum.[50] This type of crowdfunding is facilitated by platforms such as Symbid or Seedrs. Crowdcube, a UK-based platform, has helped 165 unlisted UK businesses raise over £46m of funding.[51] These new methods of raising finance help both established and new businesses when bank lending fails. An example of one service helping businesses access finance is given in Figure 6-2.

Figure 6-2: QuickBook Financing: Quick access to finance

Some services, such as Intuit's QuickBook Financing,[52] are designed to help match businesses with potential lenders. One of the reasons small businesses struggle to obtain finance is the lack of complete data. However, if a business already uses Intuit's QuickBook accounting software, Intuit is able to send financial information instantly to its partner banks, speeding up applications for finance.

QuickBook Financing then runs the user's information against its database to find the best matches of businesses and lenders. It then displays the top lenders to the business owner, along with the terms of the loan and an estimated approval time. The user can then click through to the lender's website to complete the application. By matching lenders and businesses, QuickBook Financing aims to lower the denial rate. So far it has helped fund more than $45m (€36m) to small businesses in the year it was rolled out.

[50] ibid

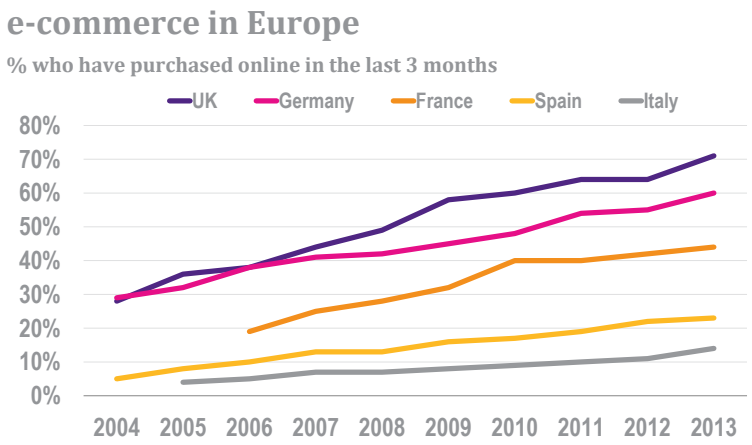
[51] http://en.wikipedia.org/wiki/CrowdCube

[52] http://www.cpapracticeadvisor.com/article/11614700/intuit-connects-small-businesses-and-lenders-with-quickbooks-financing

6.2.3 Product markets

E-commerce in Europe has been increasing in importance (Figure 6-3). In 2013, 37% of European enterprises made e-purchases, while 17% made e-sales. 14% of enterprises' total turnover came from e-commerce.

Figure 6-3



Source: Plum Consulting, Eurostat

Many smaller enterprises trade via online marketplaces such as eBay, Amazon, and Allegro. There are 190,000 registered businesses on eBay.co.uk.[53] Allegro Group has several ecommerce and auction website targeting Central and Eastern Europe; its site allegro.pl is ranked by Alexa as the 193rd most popular site globally, and the 4th most popular in Poland, as of February 2015.[54] Online marketplaces significantly reduce the barriers to entry for SMEs by:[55]

- Reducing financial barriers to trading (no need for bricks and mortar store)
- Reducing reputational barriers via feedback ratings, fulfilment and lending their brand to SMEs
- Increasing web presence and visibility
- Increasing the potential reachable market. For example: *Amazon has unified its European marketplaces, allowing you to create and manage product offers in one or more of the following marketplaces: Amazon.co.uk, Amazon.fr, Amazon.de, Amazon.it, and Amazon.es. You control what you sell and where, and you manage your European business from a single Amazon seller account.*[56]

eBay and similar platforms have enabled the "multi-micronational" firm[57] - small businesses that sell or trade internationally via the internet. Online platforms lower the barriers to selling internationally, and assist with support services (i.e. marketing, payments, delivery, and dispute resolution). 85% of US

[53] http://sellercentre.ebay.co.uk/why-sell-ebay

[54] http://www.alexa.com/siteinfo/allegro.pl

[55] Plum and Keplar LLP. June 2010. "Online markets: discussion paper". http://www.plumconsulting.co.uk/pdfs/Plum_July2010_Online_markets_discussion_paper_for_OFT.pdf

[56] http://services.amazon.co.uk/services/sell-online/one-european-account.html

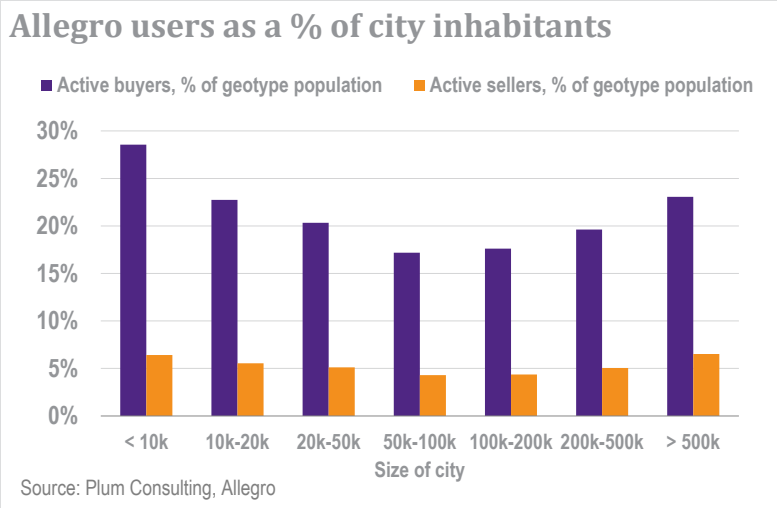
[57] http://www.oecdobserver.org/news/fullstory.php/aid/4141/eBay_and_the_rise_of_the_micro-multinationals__.html

business sellers on eBay were engaged in international trade, compared to 5-15% of their offline counterparts.

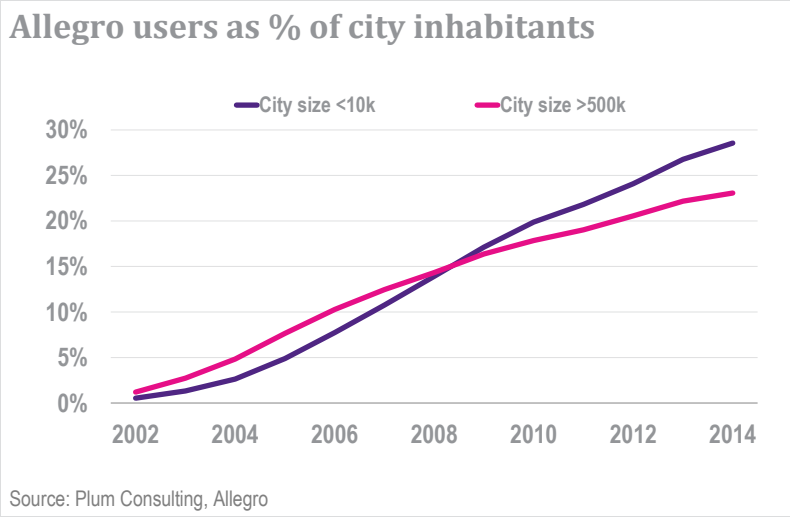
The internet helps sellers reach new markets for their products. In particular, lack of scale is no longer a barrier for small enterprises looking to engage in cross-border trade. Within the EU the internet is helping to narrow divides between urban and rural markets. Allegro.pl, an online and ecommerce site, is helping to link rural and urban markets in Central and Eastern Europe, as is discussed in Figure 6-4.

Figure 6-4: Allegro.pl and linking Europe's markets

Online marketplaces not only help bind the European economy together – they also help link urban and rural markets. Nearly 50% of Allegro's active users, buyers and sellers live in small towns and villages (even though the majority of Europe's population lives in big cities), as shown below.



This suggests that online marketplaces are especially valuable both to consumers without easy local access to a wide range of goods and services, and rural businesses which could otherwise access only a small local market. A shown below Allegro's penetration has actually been growing faster in small cities than in big cities. By linking urban and rural markets, the internet helps to integrate these economies and to secure economic convergence, rather than divergence.



Online selling can also lead to better matching of supply with demand. For example, a local bookshop might have a copy of a rare or specialist book which is not valued by anyone in the local market. By selling online, the bookshop can reach a wider pool of consumers, including consumers seeking and willing to pay more for specialist books.[58]

The growth in online commerce is underpinned by online payment systems, which allow users to transfer funds securely via the internet. These systems help to overcome consumers' wariness about purchasing online, and are especially important in cross-border trade: 25% of PayPal's total payments volume is cross-border trade,[59] and half of online shoppers use it most often for cross-border purchases.[60]

Established retailers have also employed the internet to great effect, either as an online delivery channel or in combination with bricks and mortar stores. John Lewis, a UK department store, observed online purchases up 19% in the run up to Christmas 2014; 56% of its online sales were 'click-and-collect' – where customers order online and go to the store to collect.[61]

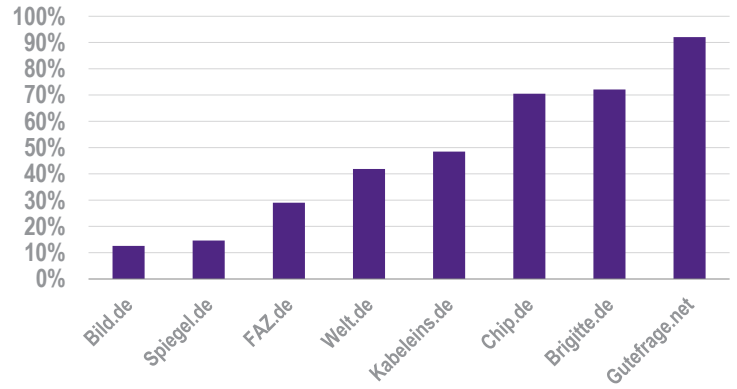
Internationally the internet helps small European enterprises. For example, the internet allows German wood sculptor Gerhard Schmeider to take orders for his cuckoo clocks from the Far East, Australia and the USA. This is crucial since the local market is too small to support his business.[62]

6.3 Media and content

Content discovery is facilitated by online portals, which in addition to providing their own content, aggregate links from a wide variety of sources. Web portals and search engines offer 'snippets' – brief excerpts and headlines from new stories – that drive traffic to publications' websites (Figure 6-5).

Figure 6-5

% of traffic to German news sites from search



Source: Plum Consulting, Yahoo

[58] Glenn Ellison and Sara Fisher Ellison. Sep 2014. "Match Quality, Search, and the Internet Market for Used Books". MIT working paper. http://economics.mit.edu/files/10351

[59] http://www.theintegratedretailer.com/news/867/russia:-ebay-launches-machine-translation-tools-to-boost-cross-border-trade/

[60] https://www.paypal-media.com/assets/pdf/fact_sheet/PayPal_ModernSpiceRoutes_Report_Final.pdf

[61] http://www.bbc.co.uk/news/business-30672179

[62] https://www.weltweitwachsen.de/erfolgsgeschichten#!/

These features are helping to rejuvenate traditional print media. Digital sales of The Economist have risen 47% in one year,[63] and over two thirds of the FT's total paying readership is online (and its digital circulation is growing 33% per year)[64], while Wired has launched a German edition.[65] The Guardian has made use of the internet to acquire new readers and reach new markets, as is discussed in Figure 6-6.

Figure 6-6: Guardian News and Media – Going global

In 2009, the Guardian decided to become a digital-first publication, on the grounds that it was the content that mattered, not how people consume it. Now, the Guardian has 110m unique browsers per month on its sites, and 6m unique visitors every day. Going digital also enables readers to engage with the Guardian's content: users write some 6,000 comments on Guardian articles every day.

The Guardian decided not to implement a paywall in order to remain open and accessible. Instead, the Guardian is funded by advertising and by offering additional services, events and content to paying users. Digital revenue has grown 29% year on year, accounting for a third of the Guardian's total revenue. During this time print circulation has fallen 6.5%, but unique online browsers have increased 24% year on year.

The internet has made news truly global, which has allowed the Guardian to launch local US and Australian editions of its paper. It now has 27m users in the US and 2m users in Australia, and both markets are growing. Two-thirds of the Guardian's unique browsers are from outside the UK.

Many media sites have also diversified and now offer, among others, careers, dating and event planning services. Established media groups are becoming increasingly internet-focussed. Schibsted, a Norwegian media group, began investing in the internet and new media in 1995. 55% of Schibsted's revenue now comes from its online business, and more than half of this comes from online classified advertising.[66]

The internet also enables many different business models for print media. For example, .týždeň, a Slovak news magazine launched in 2004, uses a paywall model, while the Polish Gazeta Wyborcza provides a mixture of metered free content and pay-to-access areas. These examples illustrate that there are numerous workable methods for monetising content in the digital age.

The internet is now established as a platform for content distribution. At the end of 2013 there were 177 IPTV services active in Europe, and 125 European IPTV operators were offering their own on-demand services. Altogether, the European Audiovisual Observatory identifies 3,088 on-demand audiovisual services in Europe.[67]

Some IPTV services provide internet access to linear content (i.e. they allow the user to watch TV as it is broadcast). Examples of these services include Magine (active in Sweden, Germany and Spain) and Zattoo (active in Germany, Spain, France, Denmark and the UK). Other services offer video-on-demand (VOD), either through a catch-up model (such as the BBC iPlayer or 4oD) or a subscription model (Hulu or Netflix).

Online media platforms, including You Tube, provide an opportunity for new content creators to reach an audience – and to profit, as discussed in Figure 6-7.

[63] http://www.economist.com/sites/default/files/theeconomist_cmrpressrelease_sept14_final.pdf

[64] http://recode.net/2014/10/01/ft-editor-lionel-barber-now-softwares-driving-the-journalism-qa/

[65] http://blogs.wsj.com/digits/2014/11/26/wired-and-buzzfeed-give-germany-a-try/?mod=ST1

[66] Schibsted Media Group. Q3 Interim Report July-September 2014. http://www.schibsted.com/en/ir/

[67] European Audiovisual Observatory. 2013 Yearbook, Volume 2.

Figure 6-7: YouTube – helping content reach an audience

YouTube benefits both the established musicians as well as newcomers, sending them more than $1 billion. With over a billion users worldwide and 100 hours of video uploaded every minute, YouTube support different types of creators from educational to comedy shows - also are finding an audience earning money in our partnership programs. More than one million channels today earn revenue through the YouTube Partner Program. Thousands of channels make six figures annually.

Similar services are available for audio content. Spotify allows users to stream music, or, if they are paid subscribers, to download it to listen to later. Radio programming can be streamed or downloaded as a podcast. At the same time, digital distribution is becoming increasingly commonplace for purchased goods such as music (the iTunes store) or software (the Steam service), providing a convenient option for consumers to purchase content they might otherwise not have bought.

6.4 Communications

The internet has vastly improved our ability to communicate, both for social and business purposes. An early development was email, which changed the way we do business. Email enables the exchange of text and image files, supports logistics and coordination and allows asynchronous communication i.e. people do not have to be in the same meeting or on the same call at the same time to coordinate.

Further developments include IP-based voice and messaging services including Skype, which was released as a public beta version in August 2003, and mobile applications such as WhatsApp launched in 2009. These services have lowered the cost of communication, in particular communication across borders, to zero.

Internet based communications tools have also evolved rapidly in comparison with conventional voice and text services to include a rich set of communication tools including video communication, and interoperability across device types and forms of connectivity, as summarised in Table 6-1.

Table 6-1: Attributes of legacy voice and text services versus OTT communications apps

	Voice	SMS	Email	WhatsApp	Skype
Personal identity e.g. photo, presence	x	x	x	✓	✓
Photo/video sharing	x	x	✓	✓	✓
Group chat/group video calling	x	x	✓	✓	✓
Phone number interoperability (by default)	✓	✓	x	x	x
Device interoperability e.g. PC & mobile	x	x	✓	x	✓
Network interoperability e.g. Wi-Fi & cellular[68]	x	x	✓	✓	✓

[68] Network interoperability is in the process of been extended to conventional messaging services. FT. September 2014. "Apple dials up WiFi calling to boost mobile coverage." http://blogs.ft.com/tech-blog/2014/09/apple-wifi-calling/

Rich low cost (or free) communication coupled with translation services is helping to integrate the European market, and helps SMEs in particular. Innovation is ongoing, with, for example Microsoft offering a preview of a Skype real time translation service.[69]

Internet-based services are also helping small businesses and sole traders and supporting their integration into extended supply chains, as illustrated by the building industry (Figure 6-8).

Figure 6-8: Benefits of rich communication for SMEs and sole traders in the building industry

One of the authors of this study completed renovations to their house and observed and spoke to the tradespeople involved about their use of the internet. Email and text messaging are used to communicate with one another, with the client and with suppliers. The ability to share photos is also utilised to show progress, as a record of work done in case of disagreement and to support decisions over choices by the client. They also use web sites and cloud photo services to showcase their work, and websites of suppliers to show clients the options available and to order materials (including onsite using connected tablets). The internet and internet banking is also used for invoicing and payment.

These changes have led to a transformation of the structure of the building industry with a move away from integrated firms offering a suite of services to more contracting amongst smaller businesses with a more specialist focus or sole tradespeople. It has also supported a change in the supply chain resulting in improved service, efficiency gains and reduced waste.

For example, windows were made locally until recently, whereas now a local installer will provide a quote and follow on installation, potentially utilising Google Street View to avoid a home visit at the quotation stage if the existing windows are visible from the street. Orders for bespoke windows are then placed with large assembly plants (in this case located in Yorkshire with materials sourced from Germany).

The aggregation of orders allows each day's orders to be optimised with, for example, wastage of glass during the laser cutting process minimised. Scale also enables energy efficiency features to be incorporated into bespoke windows which were not previously feasible. Elements of the supply chain are also beginning to see deeper B2B integration between not only factories and upstream suppliers, but tradespeople and factories processing made to measure orders.

6.5 Industry

The internet is helping manufacturing in Europe become more efficient. This is due to the proliferation of connected devices and sensors (there will be an estimated 14 billion IP-enabled devices by 2022), known as the 'Internet of Things', or (when referring to industry) the Industrial Internet or 'Cyber-Physical Systems'. Collectively the use of connected devices and systems can improve production and logistical efficiencies by optimising processes. Overall the potential impact of the Internet of Things is estimated to be between $2.7tn and $6.2tn annually by 2025.[70]

The German initiative Industry 4.0 aims to *"tap the considerable potential for optimization in the areas of production and logistics"* by supporting the Internet of Things[71]. The initiative is discussed in Figure 6-9.

[69] http://www.skype.com/en/translator-preview/

[70] http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/good_governance_matters/digital/2014-03-13_fact_figures.pdf

[71] http://www.bmbf.de/en/19955.php

Figure 6-9: Industry 4.0 in Germany

Industry 4.0 is a German project to promote and develop the use of 'Internet of Things' systems in manufacturing. The aim is "to develop completely new business models and tap the considerable potential for optimization in the areas of production and logistics". This is facilitated by the use of embedded, networked systems to allow improvements in productivity and efficiency.

One outcome of this will be the "Smart Factory", equipped with autonomous, self-monitoring machines and systems which enable optimisation and predictive maintenance. However, the project is not purely about factories. The benefits from linking together elements of the value chain, such as suppliers, SMEs, distributors and the end consumer are also being explored. Industry 4.0 is a collaborative effort between industry, researchers, industry associations and unions.

The UK has announced £73m of funding for Internet of Things research.[72] The IERC (European Research Cluster on the Internet of Things) coordinates different research projects to help *"realise IoT in Europe"*.[73] In Figure 6-10 we explore some of the ways in which the Internet of Things is being used to improve efficiency.

Figure 6-10: Examples of Internet of Things technologies in industry

Maintenance	Embedded networked sensors can notify machine operators that a part has failed or is about to fail. For example, SAP demonstrated a system for remotely managing wind turbines, where operators are notified when a specific turbine reports a problem. Operators can then drill down to find the exact part that needs replacement and remotely dispatch a technician with the right replacement part. Predictive maintenance (based on the collection and analysis of large quantities of data, facilitated by internet connectivity) can also detect potential malfunctions before they occur. This monitoring can even happen after the product has been sold, enabling proactive servicing before a fault occurs.[74]
Logistics	Creating a digital network along the supply chain can help companies maintain the optimal level of inventory. This is important since carrying too much inventory incurs additional costs, while carrying too little can create bottlenecks. A supply chain network would allow real time data collection and inventory management. RFID technology may be used in logistics to track goods and inventory on an item-level basis.[75] Integrated network connectivity will also better enable SMEs to fit into the supply chain. The European Commission has created the auto-gration project which aims to "improve the integration of automotive companies, particularly SMEs, in the sector's digital supply chains."[76]

[72] https://www.gov.uk/government/speeches/cebit-2014-david-camerons-speech

[73] http://www.internet-of-things-research.eu/index.html

[74] http://blog.bosch-si.com/categories/manufacturing/2013/02/iot-and-predictive-maintenance/

[75] http://blog.bosch-si.com/categories/manufacturing/2014/08/internet-of-things-iot-and-big-data-brought-together-in-commercial-use-cases/

[76] http://www.auto-gration.eu/

Optimisation	GE estimate there could be substantial efficiency gains from linking together multiple-component systems such as jet engines, power plants and industrial facilities.[77] A 1% efficiency gain in aviation (from efficiencies in fuel consumption) could be worth $30bn in cost savings globally. More intelligent management of production could also result in substantial energy savings for manufacturers.[78] Bosch[79] has developed smart hand-held tools, for example a nut runner that feature on-board computers, wireless connectivity, and a laser scanner. The tool chooses the correct configuration for the job and logs activity. In addition, because these tools are networked, the manufacturer can identify the location of the tools at any time, and map their proximity to workstations.
Construction	SAP and SK solutions are working on a joint project at a construction site in Dubai to help enhance worker safety, improve productivity and reduce costs through the use of sensor-based data to prevent cranes and construction vehicles from colliding.[80] Smart Structures have developed a wireless sensor designed to be embedded into concrete during construction, which is used to ensure quality and measure the forces acting on the concrete over its lifetime.[81]

The internet provides scope for standardisation across factories and supply chains, generating efficiency savings. For instance, GM has implemented a modern, standards-based network architecture at more than 150 plants worldwide. This has allowed GM to create a single team to troubleshoot network problems globally, reducing network downtime (and thus unplanned work stoppages) by 70%.[82] It also allows engineering companies to offer additional services – including logistics, maintenance and installation of systems. This is termed 'servification' and is discussed in more detail in Figure 6-11.

Figure 6-11: The 'servification' of industry

The deployment of the Internet of Things is enabling the 'servicification' of industry – i.e. industry buying, producing and selling services. For example, Sandvik, a Swedish engineering group, offers numerous services, ranging from logistics to after-sales servicing and maintenance.[83] Ericsson, in addition to manufacturing equipment, provides services installing, operating and maintaining telecommunications equipment – these services now account for 42% of Ericsson's total sales.[84] Increasing use of network sensors will broaden the scope for predictive maintenance[85] and expand companies' product suites further.

[77] http://www.ge.com/docs/chapters/Industrial_Internet.pdf

[78] http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10373

[79] http://blog.bosch-si.com/categories/manufacturing/2014/08/internet-of-things-iot-and-big-data-brought-together-in-commercial-use-cases/

[80] http://global1.sap.com/news-reader/index.epx?category=ALL&articleID=21826&searchmode=C&page=1&pageSize=10

[81] http://smart-structures-inc.us/technology/EDC-embedded-data-collector/

[82] http://www.cisco.com/web/strategy/docs/manufacturing/Cisco-AutoCaseStudy-GM.pdf

[83] http://www.sandvik.com/en/

[84] http://www.ericsson.com/thecompany/investors/financial_reports/2013/annual13/en/results/board-of-directors-report/financial-highlights

[85] Jun *et al*. 2009. "A Predictive Algorithm for Estimating the Quality of Vehicle Engine Oil." *International Journal of Industrial Engineering*. http://journals.sfu.ca/ijietap/index.php/ijie/article/view/186

The internet is therefore helping Europe's industry both directly (by making production more efficient and by enhancing logistics) and indirectly, by allowing industry to offer additional service-based products (such as predictive maintenance, IT services, logistics services and R&D).[86] The application of connected devices will fuel productivity growth in manufacturing, as well as a trend towards leaner, more flexible and more individualised production.[87] As this happens, the advantages of being closer to consumers, educated workers and the rest of the supply chain may outgrow the advantages of locating a factory in a low-wage economy.[88]

6.6 Smart cities

The internet is helping cities provide better public services, to become more efficient and to reduce their impact on the environment. A smart city is *"a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses"*.[89]

Internet technologies are an essential component of the smart city idea, which relies on the interconnection of objects, sensors, networks and users, often wirelessly. Both civic initiatives and commercial services such as Google's Waze app, which collects real-time traffic information from its users in order to provide users with live routing around avoid delays and hazards, contribute to the smart city concept.

Figure 6-12 provides an illustrative example of a comprehensive smart city scheme is provided by Santander in Spain.

Figure 6-12: Smart Santander

The Smart Santander[90] project is a city-scale experimental research facility for developing applications and services for smart cities. The project is based in Santander, Spain – a city which dates back to Roman times. Over 1,000 sensors were deployed in the city, measuring temperature, luminosity, air quality and noise.[91] The sensors were linked wirelessly to nodes in each deployment zone. The system allows continuous monitoring of environmental parameters. These parameters are also made available to citizens via real-time maps.

The system also provides real-time information on parking availability, which is then made available to citizens over the internet or by digital street signs (see photo).

[86] Magnus Lodefalk. 2010. "Servicification of Swedish Manufacturing", National Board of Trade

[87] http://www.mckinsey.com/insights/business_technology/the_internet_of_things_and_the_future_of_manufacturing

[88] Erik Brynjolfsson and Andrew McAfee. 2014. "The Second Machine Age," *Norton.* p184

[89] http://ec.europa.eu/digital-agenda/en/smart-cities#Article

[90] http://www.smartsantander.eu/

[91] http://www.libelium.com/smart_santander_smart_parking/

The collaborative economy is also helping to bring about the smart city vision. By allowing users to share their assets – e.g. their car or residence – sharing apps like Tripda or Airbnb enable a better use of resources. Regarding holiday rentals, the City of Amsterdam said:

> *"It [holiday rentals] also makes better use of the housing stock, can be a touristic economic stimulus, and apparently fills a need of today's tourists. Because of this, apartments are not empty during absence and the city's tourist offering is more diverse."*[92]

The city of Milton Keynes in the UK has created a data hub to collect data on energy use, waste and city mobility, and is building out a city-wide low power wide area network to connect wireless sensors. The city is seeing efficiency gains, for example, refuse collection trucks formerly followed a set route and schedule. Now wireless sensors under the lids of bins allow the most efficient routes for collection trucks to be determined, saving time and energy, and ensuring bins do not overflow.

6.7 Energy

Improved energy efficiency offers the prospect of more for less, and the internet has the potential to help improve energy efficiency and offer virtual services that substitute for the manufacture and transport of physical goods. Reduced energy intensity also offers potential environmental benefits.

An example of how the internet, including the mobile internet and the internet of things, can save energy is smart thermostats (including those by Hive, NEST and tado°). Smart thermostats provide heating only when required based on past behaviour, presence of people in the home, building characteristics, individual location and the weather forecasts. A study by the Fraunhofer Institute for tado° found, based on a simulation, estimated savings of up to 31%.[93]

Commercial buildings can also achieve savings through the use of sensor networks and analytics. For example, analytics might match weather patterns with different sides of the building and energy use, identifying energy leaks.[94]

Information and communications technology can also be used to improve the efficiency of electricity grids. For example, in Denmark the grid can accommodate a significant renewables share and with an even smarter grid the share could increase.[95] Sensors, computing and algorithms can also be used to divert electricity in real time from some consumers, such as factories or greenhouses, to users who need it more. By aggregating demand response "virtual generation" is made available. For example, Kiwi Power in London offers virtual power services: [96]

> *"In a control room in London's fashionable Soho district, Ziko Abram of Kiwi Power shows off a "virtual" power plant with a capacity of more than 100 megawatts (MW). Kiwi pays users for agreeing to switch off cooling and heating, pumps and other equipment when asked. A switch*

[92] http://publicpolicy.airbnb.com/good-news-from-amsterdam/

[93] Fraunhofer Institute for Building Physics. 2013. "Simulation study on the energy saving potential of a heating control system featuring presence detection and weather forecasting." https://www.tado.com/download?url=%2Fimg%2Fcontent%2Fpress%2Freleases%2FStudy_Fraunhofer_Institute_for+Building_Physics_tado_en.pdf&sqn=15a290a930ec820f1a416f10bc9a23eb

[94] WSJ. September 2014. "Big data cuts buildings' energy use." http://online.wsj.com/articles/big-data-cuts-buildings-energy-use-1411937794

[95] http://www.ienergi.dk/~/media/BFIE/Filer/Regeringens_Smart_Grid_Strategy_UK_web.ashx

[96] The Economist. March 2014. Electricity supply - Profitable interruptions." http://www.economist.com/news/business/21601887-collecting-and-trading-spare-electricity-thriving-industry-profitable-interruptions

installed on a user's premises might be programmed to cut off power to freezers, for example, when they are cold enough. In other cases, Kiwi negotiates the cutoff with the consumer. It sells the spare capacity thus created to the National Grid…Kiwi also buys the right to use standby diesel generators in hospitals, government buildings and elsewhere. Rather than waste fuel by testing these machines every week, these institutions let Kiwi's technology switch them on when the grid requires."

In the US virtual power accounts for more than 20 gigawatts (GW), or 2% of the total installed capacity. In the Europe Union, a larger energy market, capacity is only 5.4GW, but an analyst at Bloomberg New Energy Finance forecasts it will grow to 15.3GW by 2020.

6.8 Health

Institutional rigidities may have slowed the adoption of the internet to improve health care delivery, but a range of initiatives and trials suggest the potential is substantial. For example:

- In the Yorkshire Dales, a low density region in the UK, patients have access to care via telemedicine.[97] Patients with heart problems, breathing difficulties and in the last years of life are given webcams for their computers or an iPad, along with monitors that allow individuals to test their own oxygen levels. Feedback from patients has been positive and a 60% reduction in A&E visits and 45% fall in hospital admissions for people using the scheme have been achieved. Hospitals are also able to reduce the average length of stay by 9%.
- Beyond two way video other consumer technologies can be adapted to provide low cost health solutions. For example, Neuroathome uses Microsoft Kinect technology to help rehabilitate patients affected by neurological injuries, neurological disorders (e.g. Parkinson's) or aging.[98]
- The National Health Service in the UK has announced a programme to move to far greater use of online in health care, including, for example, the development, diffusion and adoption of low-cost high-efficacy apps with a particular priority on mental health services, for example for cognitive behavioural therapy.[99] Wearable devices and mobile technologies are also expected to help people manage their health better and maintain an independent life.
- Artificial Intelligence may also be applied to medical imaging enabling rapid initial diagnoses based on photos and scans. A low cost small scale application involves an app and small lens add-on that allows blood-cell analysis via a smartphone.[100] A larger scale initiative to lower the costs of medical imaging and apply AI deep learning for diagnoses received funding of $100 million in November 2014.[101]
- The internet is widely used as a source of health information across Europe.[102]

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[97] The Times. 13 November 2014. "Patients fold to go online in radical NHS reform". http://www.thetimes.co.uk/tto/health/news/article4266243.ece

[98] http://www.microsoft.com/en-us/health/blogs/kinecting-to-telemedicine/default.aspx#fbid=ZXIEaJ076lY

[99] NHS. November 2014. "Personalised Health and Care 2020 Using Data and Technology to Transform Outcomes for Patients and Citizens." https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374539/Personalised_Health_and_Care_for_All_2020_-_Final_Version.pdf

[100] http://www.bbc.co.uk/news/technology-28658155

[101] http://www.wired.com/2014/11/butterfly-network/

[102] https://ec.europa.eu/digital-agenda/en/news/europeans-becoming-enthusiastic-users-online-health-information

7 Future developments point to greater potential gains

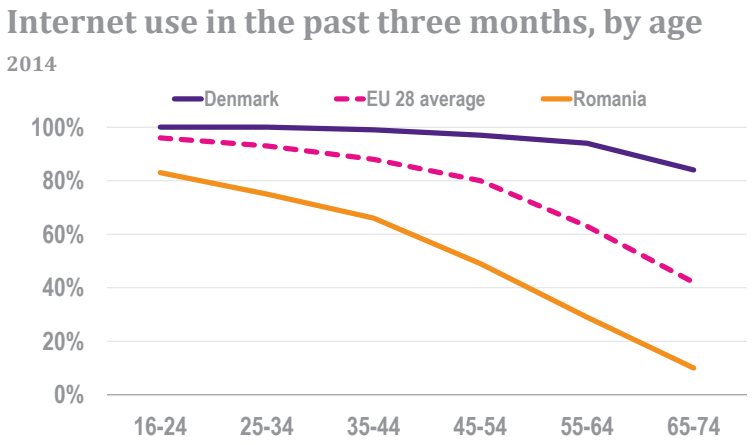
Internet services have made a substantial contribution to Europe already. However, we expect future developments and the accompanying economic and social benefits to eclipse what has come before:

- Internet adoption is steadily increasing but still far from universal
- The stock of knowledge online and accompanying analytics capabilities are expanding rapidly
- Firms that are currently slow adopters can be expected to 'catch up'
- Innovation is ongoing, for example, mobile apps, augmented reality and Internet of Things

7.1 Diffusion of the internet

Internet use is far from universal in Europe with 30% of those aged 16 and over - 126 million people - offline in Europe in 2014 (counting those who have not used the internet in the past 3 months as offline).[103] Non-use increases by age with substantial variation between countries, as illustrated in Figure 7-1. Internet use falls well short of other more established services such as telephony or terrestrial broadcasting.

Figure 7-1



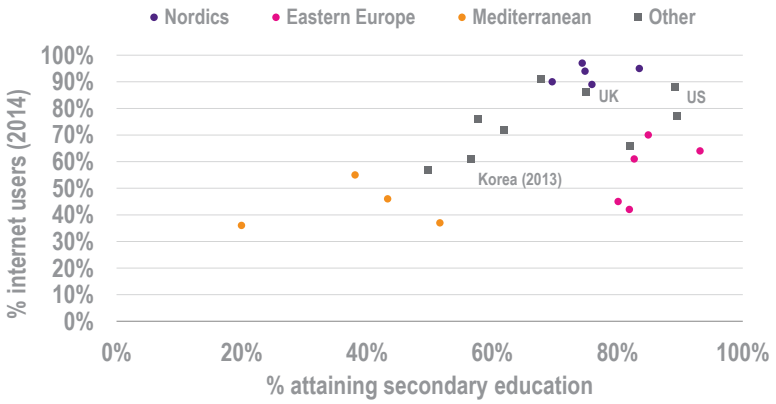
Source: Plum Consulting, Eurostat

Focussing on differences in adoption by older cohorts, where cross country differences are greatest, we find that the level of education of 55-64 year olds is correlated with adoption, as illustrated in Figure 7-2.

[103] Estimated based on Eurostat data for 2014

Figure 7-2

Secondary education and internet use, 55-64s



Source: Plum Consulting, Eurostat, OECD, KISA, Pew

Mediterranean countries and, to a lesser extent South Korea, had comparatively low levels of education historically, when their relative GDPs were low. Other countries, including the UK, US and the Nordics, had comparatively high levels of education amongst the over 50s, and correspondingly high levels of internet adoption by this age group.

An outlier is Eastern Europe's comparatively low levels of internet usage relative to education levels for those aged 55-64 which are comparatively high. This may in part be due to later development of broadband availability. However, it suggests potential for comparatively rapid catch-up in terms of internet adoption in these countries.

As internet use grows new users will benefit, existing users will benefit via network effects and application developers will have a larger market for their services. High levels of adoption will also make online only services more viable, particularly for government.

Mobile broadband capabilities and coverage are also improving with 4G and network extension. [104] Smartphone adoption is also increasing rapidly and has passed the 50% threshold in a number of countries in Europe.

7.2 Growth in the stock of knowledge and analytics

The stock of knowledge online is also growing rapidly, with IBM estimating that each year more data is added than all previous data. This growth in the stock of data is not measured as investment, yet it will enable new insights and services.

[104] For example, Vodafone project that their 4G coverage in the markets they serve in Europe will increase from 59% to 91% between September 2014 and March 2016. Page 18: http://www.vodafone.com/content/dam/vodafone/investors/financial_results_feeds/half_year_30september2014/p_halfyear2014.pdf

7.3 The catch-up potential of firms

The range of applications people and businesses utilise also varies widely, with ongoing diffusion in terms of use of a given application.

Similar to countries, the productivity of individual firms varies. This implies scope for catch-up over time, as the less productive firms:

- Learn and adopt the practices of the most productive firms (and become more productive)
- Merge with the more productive firms
- Shrink and exit the market

ICT has tended to increase the productivity dispersion of firms: Bartelsman finds increased productivity dispersion in sectors that are relatively ICT-intensive.[105] This implies that the scope for catch-up is greater – i.e. that some firms are further ahead in terms of productivity. Resources will be reallocated to the more productive firms, while best working practice will diffuse to the less productive.

One might think of this as a natural process that occurs over time that leads to a continuously increasing of productivity. However, barriers to reallocation will slow or stop this reallocation of resources, impeding productivity growth. For instance, barriers to entry and exit may mean that poorly-performing firms stay in the market too long or are not able to adjust their labour force without exiting.

7.4 Ongoing innovation including the mobile internet

In addition to diffusion, accumulation of knowledge and catch up there is ongoing innovation in relation to internet technology and services. Areas of innovation include mobile, sensors and the internet of things, cloud computing and artificial intelligence and wearables. These innovations are constantly disrupting the provision of internet services, whilst enhancing their value for the rest of the economy.

A key development in recent years has been the extension of the internet to mobile with smartphones now passing 50% adoption in a number of countries and a large and growing range of applications.[106] Mobile allows access to the internet almost anywhere, supports real time information services and allows online and previously offline worlds to blend.

Smart mobile devices are seeing growing integration into existing businesses with the use of maps, email and calendars on the go early examples. However, a deeper integration is now underway across vertical segments on the economy with specialist applications and services. An illustrative example of ways in which new mobile applications are helping existing vertical segments is provided by the applications developed via a partnership between Apple and IBM which include the following:[107]

- Advise & Grow (Banking and Financial Markets) puts bankers on premise with their small business clients, with secure authorisation to access client profiles and competitive analyses,

[105] Bartelsman. April 2013. "ICT, reallocation and productivity." http://ec.europa.eu/economy_finance/publications/economic_paper/2013/ecp486_en.htm

[106] BCG. December 2014. "The mobile internet economy in Europe." https://www.bcgperspectives.com/content/articles/telecommunications_digital_economy_devices_mobile_internet_economy/

[107] Apple. December 2014. "Apple and IBM Deliver First Wave of IBM MobileFirst for iOS Apps." https://www.apple.com/uk/pr/library/2014/12/10Apple-and-IBM-Deliver-First-Wave-of-IBM-MobileFirst-for-iOS-Apps.html

gather analytics-driven insights to make personalised recommendations, and complete secure transactions.

- Incident Aware (Government) converts an iPhone into a vital crime prevention asset, presenting law enforcement officers with real-time access to maps and video-feeds of incident locations; information about victim status, escalation risk, and crime history; and improved ability to call for back-up and supporting services.
- Pick & Pack (Retail) combines proximity-based technology with back-end inventory systems for transformed order fulfillment.
- Plan Flight (Travel and Transportation) addresses the major expense of all airlines—fuel—permitting pilots to view flight schedules, flight plans, and crew manifests ahead of time, report issues in-flight to ground crews, and make more informed decisions about discretionary fuel.

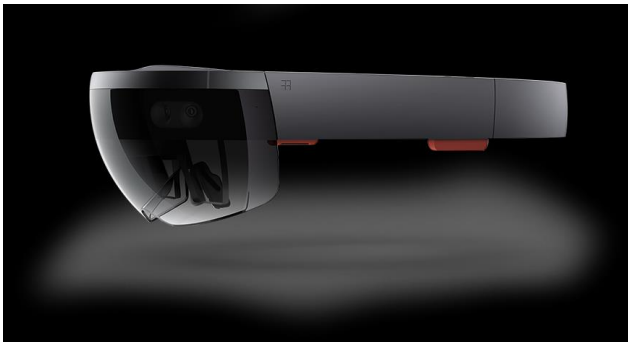
The mobile internet also provides a platform for development of a range of internet of things applications which relate directly to an end user, from smart thermostats to the use of Bluetooth beacons for micro location which range of applications including logistics management.

Artificial intelligence and big data is also augmenting the internet and the mobile internet. An illustration of the power of big data and analytics is IBM Watson which offers flexible analytical capabilities and a more natural human-machine interface.[108] Cloud based artificial intelligence is also supporting services such as language translation and initial medical diagnoses based on pattern recognition.

The power of the mobile internet will also be extended with wearable technology. For example, the Daqri augmented reality helmet is intended for use in industrial environments (Figure 7-3)[109], and Microsoft Hololens glasses which augment reality with a 3D rendered objects and information (Figure 7-4).

Figure 7-3: Daqri augmented reality helmet

Figure 7-4: Microsoft Hololens



The combination of diffusion, knowledge accumulation, catch-up and ongoing innovation implies that the potential of the internet has only just begun to be tapped – provided the policy environment is supportive.

[108] http://www.ibm.com/smarterplanet/us/en/ibmwatson/

[109] http://hardware.daqri.com/smarthelmet/

8 How to facilitate the new helping the old

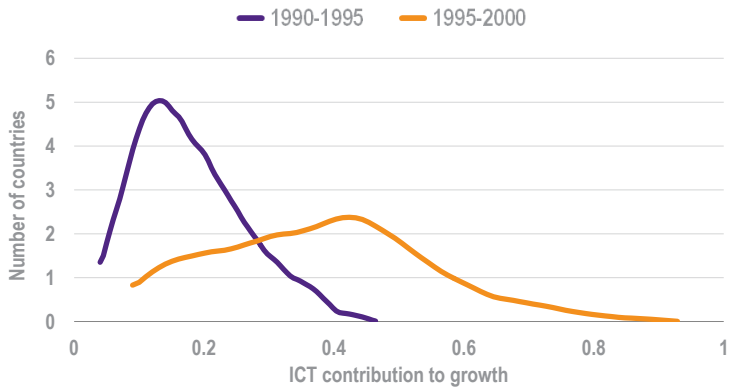
The aim of this paper is not to provide a policy prescription but to better understand how the internet is interacting with the economy (the new helping the old) and where and how benefits are arising. However, having concluded that the internet has been a positive force within the economy and that future developments are expected to see this linkage deepen, a natural question is how good outcomes can be supported. We touch on this at a high level.

8.1 The benefits of the internet are not assured – policy matters

Globally the contribution of ICT to growth rose on average between the first and second half of the 1990's, but the variation in the contribution across countries also increased, as shown in Figure 8-1.[110]

Figure 8-1

ICT contribution to growth



Source: Plum Consulting, Vu (2005)

Given that the internet is global and ICT technology is tradable this suggests that local factors - complementary inputs including human capital and policy play a key role in terms of benefiting from internet use. Indeed these local factors would appear to matter more to outcomes than they did pre-internet. As Nobel winner James Heckman put it:[111]

> *"The opportunity cost of security and preservation of the status quo – whether it is the status quo technology, the status quo trading partner, or the status quo job – has risen greatly in recent times."*

In other words policy matters.

[110] Vu. October 2005. "Measuring the impact of ICT investments on economic growth." http://www.hks.harvard.edu/m-rcbg/ptep/khuongvu/Key%20paper.pdf

[111] Heckman. September 2002. "Flexibility, Job Creation and Globalization: The Case of Italy". http://jenni.uchicago.edu/WJP/papers/Italy_Job_Creation_2002.pdf

8.2 Inhibiting internet innovation cannot protect the status quo

The changes unleashed by the internet will continue to play out globally. As the internet complements and transforms other sectors the quality and diversity of their output will rise, as will their productivity. Globally this will happen irrespective of what Europe does.

The status quo is therefore an option, but not an attractive option. "Protecting" the status quo, either explicitly or through a failure to adapt old rules to allow new ways of doing things, would see the competitive position of firms deteriorate and productivity, and therefore real incomes, stagnate or even decline. It is therefore preferable to anticipate and adapt, addressing the challenges of change rather than allowing change itself to be stifled.

8.3 To maximise benefits facilitate internet diffusion & use

An important conclusion is that the majority of the benefits from the internet come from the use of the internet rather than the production of internet-related goods and services. The value and success of a number of internet businesses tends to capture our attention, but quietly and in a diffuse way throughout the economy the services they provide are bringing significantly greater benefits to other businesses and European citizens. We also observe large differences in the estimated contribution of the internet between countries that imply that other factors - complementary inputs and the policy - are particularly important to outcomes.

How everything else is regulated and governed is likely to matter at least as much as how the internet and digital services are governed. Policy and approaches which have developed prior to internet will not always be appropriate in the new environment. For example, in the US medical practitioners must be licensed in each state in which they provide services, this coupled with the variation in registration requirements, limits the scope for telemedicine.[112] Europe, in this instance, does have rules compatible with a single market in telemedicine developing. In other areas reform will be required.

In order to successfully implement the required reforms road blocks need to be identified and rectified. Given that this involves the review of existing rules throughout the economy prioritisation will be essential. Further given that use of the internet, embedding the internet throughout the economy, is central to achieving benefits an approach which focusses on vertical sectors of the economy beyond the internet itself is required. This will require:

- A different institutional approach, given that responsibility for the digital economy is typically assigned in a way that promotes a focus on the supply side of the digital economy rather than on how digital services are used throughout the economy.
- The reform process will also need to draw on insights from participants in both the "new" and "old" economies, whilst also maintaining a focus on consumer rather than producer interests. This is challenging, but achievable, provided the focus is clear.
- The EU Digital Single Market strategy, and national plans, should focus on facilitating the benefits of the internet throughout the whole economy, rather than focus on the digital economy *per se*.

As the game changes the challenge is to adapt the rules, not to apply the old rules to a new game.

[112] The Economist. October 2014. "Telemedicine – Stuck in a waiting room." http://www.economist.com/news/international/21623710-long-touted-health-care-revolution-may-last-be-about-arrive-stuck-waiting