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ICT FOR GROWTH: A TARGETED APPROACH

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Highlights

- This Policy Contribution assesses the broad obstacles hampering ICT-led growth in Europe and identifies the main areas in which policy could unlock the greatest value. We review estimates of the value that could be generated through take-up of various technologies and carry out a broad matching with policy areas.
- According to the literature survey and the collected estimates, the areas in which the right policies could unlock the greatest ICT-led growth are product and labour market regulations and the European Single Market. These areas should be reformed to make European markets more flexible and competitive. This would promote wider adoption of modern data-driven organisational and management practices thereby helping to close the productivity gap between the United States and the European Union.
- Gains could also be made in the areas of privacy, data security, intellectual property and liability pertaining to the digital economy, especially cloud computing, and next generation network infrastructure investment. Standardisation and spectrum allocation issues are found to be important, though to a lesser degree. Strong complementarities between the analysed technologies suggest, however, that policymakers need to deal with all of the identified obstacles in order to fully realise the potential of ICT to spur long-term growth beyond the partial gains that we report.

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THE DIGITAL AGENDA FOR EUROPE is a prime example of an initiative to promote EU growth, and as such is more relevant now than ever (European Commission, 2010). One of the Europe 2020 strategy's seven flagship initiatives, it focuses on information and communication technologies (ICTs) as a spur for sustainable and inclusive growth. The Digital Agenda also identifies several obstacles that keep European businesses and organisations from making greater use of ICT, holding them back from potential productivity improvements and growth. These obstacles include low investment in network roll-out, a fragmented European digital market, ill-adapted copyright legislation and the lack of interoperability and digital skills. This Policy Contribution critically assesses these and other obstacles in the way of ICT-led growth in Europe, and identifies in broad terms the policies that can unlock the highest value.

We first identify four broad technology categories within ICT and collect from academic literature and practitioners' reports estimates of their potential economic impact in Europe. The categories are: i) social networks/Web 2.0, ii) cloud computing, iii) machine-to-machine (M2M) communication (including smart grids), and iv) data-driven organisational technology (including e-government). The choice of these technology categories was motivated by the desire for them to be broad enough to be classified as **general purpose technologies** (GPTs), which have a non-trivial economic impact, and narrow enough so that the mechanisms leading to productivity improvements within each category can be understood. Once these mechanisms have been understood we can identify the obstacles that hamper the deployment of each ICT category. By linking these obstacles to the economic impact of the technologies that they obstruct, we can also identify the areas in which policies could have the biggest impact in terms of promoting ICT-led growth in Europe.

ICT-ENABLED GENERAL PURPOSE TECHNOLOGIES

The GPT framework is helpful to distinguish between radical innovations that have a profound impact on GDP and organisation of the entire economy, and marginal innovations, which do not. According to Bresnahan and Trajtengerg (1995), who coined the term, GPTs are enabling technologies that provide a platform for subsequent applications, rather than being in themselves complete solutions. The complementary natures of the platform and the applications, and of the applications, are driving forces behind the impact of GPTs. This leads to a virtuous circle, in which the platform benefits from an increasing number of applications, which triggers more investment in the platform followed by more applications and so on. The total impact of a GPT in any given point in time is much greater than the direct productivity impact of its individual applications. The impact tends to grow substantially over time, eventually reshaping large parts of the whole economy.

Semiconductors are a good recent example of a GPT. Lipsey *et al* (1998) give other examples including printing, steel processing, electricity, the internal combustion engine and mass production. They define a GPT as a technology that exhibits the following features: i) scope for improvement, ii) a range of uses in different sectors, iii) a

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significant range of uses in most of these sectors, and iv) complementarities with existing and potential new technologies. The technology categories that we assess in this Policy Contribution share these four features and therefore can be expected to have a profound impact on the European and world economies.

Table 1 shows the most relevant estimates from academic literature and practitioners' reports of the economic impact of the four technology categories. In choosing the estimates we focused on the impact measured by macroeconomic indicators or efficiencies that benefit the users of those technologies rather than suppliers' revenues, as reported in the 'measurement' column of Table 1. In this way we aim to come as close as possible to the added value each technology can generate for the economy. Clearly, from the perspective of the whole economy, new technologies displace some existing economic activity, making their revenues a poor estimate of the added value. In contrast, the macroeconomic measures that we report, such as the unemployment rate or GDP growth, take the displacement effect into account. Also, the efficiencies that users derive from the deployment of ICTs in terms of net cost savings are a good measure of the value to the economy. They may, however, under- or over-estimate the value depending on the price elasticity of the ICT usage and general equilibrium effects. Infrastructure investment in technologies such as cloud computing, smart buildings, or smart grids, which may cause the reported cost savings in Table 1 to deviate substantially from the net cost savings, is discussed separately as an obstacle hampering deployment of the technologies. In the following

Table 1: Estimates of the economic impact of the chosen four technology categories

Technology category	Application	Estimate	Unit/measurement	Region	Timespan	Source
Social networks	**General**	1.5% of GDP	Reduction in unemployment rate through better job matching caused by more efficient information transmission	US		Mayer (2011)
	Facebook	€15.3bn	Value added (net of displacement of existing economic activity)	EU-27	2011	Deloitte (2012)
Cloud computing	**General**	0.1 - 0.3% of GDP	Contribution to GDP growth rate due to lower entry barriers for SMEs	EU-25	after 5 years	Etro (2009)
	General	€23-€32bn	Estimated annual productivity gains (ie added value) resulting from cost savings through adoption of cloud computing by all SMEs	EU-27		Hatonen (2011)
M2M	**Smart buildings**	€187bn	Energy saved by improved building design	Global	by 2020	The Climate Group (2008)
	Smart Grids	€61bn	Electricity saved by reduction in transmission and distribution losses	Global	by 2020	The Climate Group (2008)
	Smart motor system	€54bn	Electricity saved due to optimised motors and industrial automatisation	Global	by 2020	The Climate Group (2008)
	Smart logistics	€33bn	Fuel, electricity and heating energy saved due to optimisation of logistics networks	EU-27	by 2020	The Climate Group (2008)
	Personal location data	US$700bn	Cumulative value to consumers and business end users due to, for instance, fuel and time saved	Global	2011-2020	Mckinsey Global Institute (2011)
Data-driven organisational technology	**General**	US$452.5bn (4.3% of GDP)	Cumulative cost savings due to deployment of Internet business solutions	US	2001-2011	Varian *et al* (2002)
	General	US$81.9bn (1.1% of GDP)	Cumulative cost savings due to deployment of Internet business solutions	UK, France and Germany	2001-2011	Varian *et al* (2002)
	E-government	0.5% of GDP	Annual public sector productivity growth	EU OECD economies		Mckinsey Global Institute (2011)

Source: Bruegel.

sections, we assess the four chosen ICT technology categories, focusing on how they generate value and the potential obstacles to their deployment.

SOCIAL NETWORKS

Social networks on the internet, known also as Web 2.0, can be defined as virtual user communities, the members of which interact, share content and collaborate online. The crucial feature of Web 2.0 is user-generated content, in contrast to content that can only by passively accessed on the traditional Web 1.0. Facebook and Wikipedia are two examples of Web 2.0 applications, which have attracted millions of users and contributors worldwide.

By allowing people to create and share knowledge, social networks create economic value in a variety of ways. Most of this value is very difficult to quantify, because it is realised by dispersed communities of often anonymous users, who do not pay any monetary price for it, as exemplified by Wikipedia. Attempts to quantify this value include Deloitte (2012), which estimates that the value that Facebook created in Europe in 2011 amounts to some €15 billion. For a service that started to proliferate in 2007, this means an average growth in value of €3 billion a year. The figure includes the value created by various businesses through the advertising of their brands on Facebook, gaming applications such as Wooga and King.com running on the Facebook platform, and additional sales of devices and broadband capacity to facilitate the use of Facebook. Very importantly, this figure represents added value net of displacement effects due, for instance, to shifts between advertising platforms.

Many academic articles also point to social networks' potential to facilitate more efficient processes of matching employers and employees. The stylised facts suggest that job searches conducted via networks of family and friends are more productive than searches conducted by other means, and about half of workers find their jobs through social contacts (Ioannides and Loury, 2004). Mayer (2011) estimates that when the US economy fares moderately well, the unemployment rate declines from 6.5 percent to 5 percent due to the influence of social networks. According to the estimates of Eurofound (2011), which account for social benefit payments and foregone earnings, such a drop in unemployment could bring additional GDP growth of 0.13 percent, or €16 billion, to Europe. These numbers reflect the traditional offline networks to a great extent. The question of how much Web 2.0 could contribute is still open. Some companies, however, successfully encourage their employees to post job vacancies on their Facebook pages, suggesting that online friendships could be leveraged to find a job as much as offline friendships (Zeidner, 2007).

Given the huge success of online social networks in terms of adding users over the last ten years, it seems that there are no obstacles to their future growth and productive use. Privacy concerns that surfaced more recently, however, show that many users of social networks, especially younger people such as college students, were unaware of how their profile information could easily be disclosed to others, including potential employers (Smith and Kidder, 2010). The lack of well-functioning privacy laws could lead to a reluctance to share private information with a large network of online friends, thereby undermining the long run viability of social networks as job-search facilitators.

CLOUD COMPUTING

Cloud computing provides online storage and computing capacity as a service on a pay-per-usage basis. This is particularly attractive for small and medium enterprises (SMEs), which can avoid large up-front investment costs and can flexibly scale their ICT capacity according to the market's needs (Etro, 2009). Cloud computing can also bring substantial savings to companies

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with batch-oriented tasks, which need large computing capacity only infrequently. How important are cloud computing solutions in business practice? Ambrust *et al* (2010) cite Friendster as an example of a company that declined in popularity relative to competitors Facebook and MySpace as a consequence of user dissatisfaction with slow response time due to the under-provision of servers. In contrast, Animoto, an online video slideshow maker, was able to cope with a demand surge requiring an extension from 50 servers to 3500 servers in just three days, by using Amazon's cloud computing services.

As these examples demonstrate, cloud computing has the potential to dramatically change the ways in which software and hardware are provided. Etro (2009) estimates that it could boost European GDP growth by up to 0.3 percent by 2014 due to lower entry barriers for SMEs. Cloud computing can also generate substantial savings on IT infrastructure maintenance for existing companies in virtually all sectors. The value of these savings could be up to €32 billion annually, if all European SMEs adopt cloud computing (Hatonen, 2011).

What are the obstacles preventing the realisation of these gains? Cloud services can be delivered via broadband networks. SAP, Amazon, Microsoft and other market leaders already offer cloud services. Because the existing coverage of broadband in Europe is generally good, it does not seem to present a critical obstacle. Investment in fibre optic next-generation networks (NGNs) is, however, instrumental for more advanced cloud computing applications, which require higher speeds (Hatonen, 2011). In comparision to broadband networks, there is underinvestment in NGNs in Europe (Credit Suisse, 2012). With NGN deployment requiring years, and data traffic growing at 32 percent per year (Cisco, 2011), setting the right incentives to invest in NGNs must be done now.

The other big obstacles for cloud computing deployment are intellectual property (IP), data security and liability issues. The storage of data in the cloud raises new questions about who actually owns the data and what rights are attached to it. Lerner (2011) finds that the resolution of legal uncertainties around the IP rights pertaining to cloud services spurred substantial venture capital investment of up to $1.3 billion in US cloud companies. In a similar vein, the security of commercially sensitive data must be safeguarded if the potential of cloud computing is to be fulfilled. The current legal position in Europe assigns this responsibility to the user of cloud services (Widmer, 2009). This may create a substantial hurdle for SMEs, which may find it difficult to make the providers of cloud services liable for data security lapses.

MACHINE-TO-MACHINE COMMUNICATION

We use the term machine-to-machine communication (M2M) to describe *"devices that are connected to the internet using a variety of fixed and wireless networks and communicate with each other and the wider world"* (OECD, 2012). Other closely-related terms include internet of things and embedded wireless. The applications that have recently gained a lot of attention include smart grids, smart metering and smart cities. Common to all M2M applications is the collection of data through various sensors – temperature sensors, motion detectors, level indicators, etc – and transmission of this data through the internet to a centre that automatically processes and responds to the data (Galetic *et al*, 2011).

The most prominent M2M applications are listed in Table 1. This suggests that considerable value could be generated by this category of technologies. M2M applications, however, differ widely in terms of their potential benefits and the obstacles they face. In particular, in the case of smart buildings, the business case is not clear, because the high building-automation costs relative to energy savings often make the payback periods long. Therefore, immediate gains are likely to be offset by the cost. Large up-front investment and no proven economic viability are also problems for smart grids. Keeping this caveat in mind, we estimate – based on the figures in Table 1 – that smart grids and smart buildings can generate some €50 billion of annual energy savings in the EU by 2020. The additional added value of these technologies will possibly come from complementarities between smart buildings, smart grids and other technologies such as electric cars. Also, the experience with smart-grid deployment in Silicon Valley shows that the smart grid-related industries outperform other industries in terms of employment growth, and give a significant boost to the local IT industry (Silicon Valley Smart Grid Task Force, 2011).

The combined value for Europe of the remaining smart technologies shown in Table 1 – smart motor systems and smart logistics – is estimated by us at €40 billion by 2020. These technologies face different obstacles to those faced by the previous ones. Smart motor systems seem to be held back by low awareness of the business case. Smart logistics are difficult to implement because of the high degree of fragmentation of the road-freight industry, but recent consolidation – for instance in France – suggests that industry participants are gaining in scale, which will create greater scope for efficient use of smart ICT solutions (The Climate Group, 2008). The expected increases in energy costs should trigger deployment of these technologies, even in the absence of specific policy incentives.

Personal location data applications based on technologies such as GPS are probably the most spectacular of the M2M communication technologies. We are already experiencing the benefits of navigation systems in our cars and smartphones, and there are many more emerging opportunities. The automotive industry is a prime example. OECD (2012) lists a number of ongoing M2M projects ranging from eCall, an EU initiative for systems enabling communication between cars and the emergency services, to theft protection, pay-as-you drive insurance and dynamic road pricing. Smart routing based on real-time traffic information is also spreading rapidly and is estimated to generate savings of about $500 billion worldwide between 2011-20 (McKinsey Global Institute, 2011). The value generated by automotive M2M technologies and mobile phone location-based services would increase this to $700 billion, a large chunk of which can be captured in Europe. Privacy and security is, however, a big concern for personal-location data services. Clearly, consumers perceive data about their behavioural habits to be sensitive, and need to be reassured that they will retain full control over their data. So far, privacy laws in different EU member states have not been sufficient and are not fully harmonised.

For many M2M applications, insufficient standardisation is also problematic. Because of their huge scale, this is especially true for smart grids (SmartGrids, 2012). It is important to stress here that European companies face huge competitive pressure from US companies, which enjoy economies of scale in a big national market, and already invest heavily in smart grids, for instance in Silicon Valley. Well-designed Europe-wide standards could counter this advantage by reducing uncertainty and better coordinating the innovative efforts of local market players in different EU member states.

Finally, cellular networks are perceived to be well suited for realising M2M communication, but may soon become a bottleneck for M2M growth. The automotive industry benefits most from increased wireless M2M connectivity, accounting for about 40 percent of connections in 2009 (Galetic *et al*, 2011). In general, M2M poses new challenges to wireless spectrum allocation policy, because it may lead to the use of spectrum not foreseen by regulators and further congest the unlicensed frequency bands (OECD, 2012). Thus, the efficient allocation and use of the available spectrum becomes a central aspect of policies to support the development of M2M, especially smart logistics and personal location data applications.

DATA-DRIVEN ORGANISATIONAL TECHNOLOGY

We use the term data-driven organisational technology to describe *"innovative management techniques, business models, work processes, and human resource practices, which complement and amplify their [ie firms'] ICT investment"* (Brynjolfsson, 2011, p61). Organisational technologies are usually not considered as GPTs, but, as pointed out by Lipsey *et al* (1998), there are many examples of organisational technologies that clearly fulfil the GPT criteria including factory systems, mass production and flexible manufacturing. We believe that data-driven organisational technology should also be considered a GPT, and it will fundamentally reshape the organisational structures of companies in wide range of sectors, including the public sector (e-government).

How does data-driven organisational technology change companies and make them more innovative? Essentially the large amount of data that modern firms collect and store in their ICT systems can enable a shift from intuitive management to more objective data-driven decision making (Brynjolfsson, 2011). Data-driven management can easily experiment with new business ideas and quickly implement successful ones. For example, Amazon's 'A-B' experiments, in which the company offers two versions of the same website to two samples of users, allows for testing various elements of the website on a daily basis. Amazon and Google are examples of digital companies that excel in this type of experimentation, but so do leading companies in retailing (eg Tesco, Wal-Mart), consumer finance (eg Capital One, Fidelity) and hospitality (eg Marriott) (Brynnjolfsson, 2011). Thus, although ICT alone generates productive efficiencies by allowing firms to better measure the business activities and share information, it is ICT coupled with data-driven organisational innovation that brings an entirely new quality to management. The fact that US companies have been much more successful in implementing this new organisational technology than EU companies can explain a significant part of the EU-US productivity gap. The productivity statistics suggest that the EU has been slower to invest in ICT, and that the productivity of EU ICT investment has also been lower (Ortega-Argiles, 2012).

This raises the question of what the value is of the missed opportunity due to sluggish uptake of data-driven organisational technology in Europe. Based on Varian *et al* (2002) survey results, US firms expected to achieve a cumulative cost saving of $452.5 billion (4.3 percent of GDP) as a result of the adoption of internet business solutions, whereas British, French and German firms expected savings of only $81.9 billion (1.1 percent of GDP) over ten years. The internet business solutions in this study are defined as *"initiatives that combine the internet with networking, software and computing hardware technologies to enhance or improve existing business processes or create new business opportunities"* (Varian *et al*, 2002, p2) and exclude cloud computing, web 2.0 and M2M applications, which were largely absent before 2001 when the survey took place. Taken together these internet business solutions inform us well about the combined impact of early ICT on companies, and organisational technology investments. Assuming that European companies adopt data-driven organisational technology at the same pace as their US counterparts, Europe could achieve an additional 3.2 percent of GDP over a decade – roughly 0.3 percent extra growth each year. These figures include the public sector and appear conservative compared to more recent estimates of savings that could be achieved from a switch to e-government, which imply a 0.5 percent annual productivity increase in the European public sector (McKinsey Global Institute, 2011).

A more detailed analysis of the Varian *et al* (2002) survey data shows that the smaller expected impact of internet business solutions in Europe compared to the US is primarily due to lower ICT adoption rates in Europe. When technologies were adopted, the expected cost savings were virtually identical on both sides of the Atlantic. US companies, however, increased their revenues more than their European counterparts, which suggests that they benefited from a stronger competitive effect of the investment. Greater competition in the US markets compared to the European markets is a likely explanation of the observed ICT and ICT-related organisational technology investment gap. Barrios and Burgelman (2008) reach a similar conclusion from an analysis of correlations between ICT productivity statistics and indicators of market rigidities in EU member states. Other studies have also corroborated this result, pointing in addition to flexible labour-market regulations, which reduce the cost of investing in new organisational technologies (Enterprise LSE, 2010; Copenhagen Economics, 2010). We con-

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clude that rigid product and labour-market regulations and the lack of European single market, especially the digital market and the market for services, significantly hamper the deployment of data-driven organisational technology and ICT solutions, thereby slowing European growth and contributing to the US-EU productivity gap.

COMPLEMENTARITIES AND SCOPE FOR IMPROVEMENT

As the goal of this Policy Contribution is to identify 'low hanging fruit' rather than to predict the development of the ICT technology categories in their full complexity, the complementarities are only mentioned here to illustrate the full GPT character and potential additional gains. These additional gains are very difficult to quantify and come on top of the more direct gains, which we have assessed.

Potential complementarities exist, for instance, between data-driven organisational technology and cloud computing, because applications in the cloud are modified and improved more frequently compared to on-site ICT systems. More frequent updating enables even faster feedback loops between ICT and organisational innovation. Similarly, data-driven organisational technology can be complemented by social networks by transforming the ways people collaborate within organisations.

It is also important to stress that ICT technologies offer enormous scope for improvement and further productivity gains. The estimates presented in this paper are only the directly foreseeable consequences of these technologies. More speculative estimates include Hanson (2001), who predicts that the economic growth facilitated by machine intelligence – perhaps the next stage of M2M technologies – will be greater by an order of magnitude than the growth of developed economies to which we are accustomed. It is also predicted that a third industrial revolution is under way (after the revolutions started by the steam engine and mass production), led by digital manufacturing (*The Economist*, 2012). The digital manufacturing era is likely to be shaped by mass customisation, enabled by a set of mutually-complementing technologies: ICT, novel materials, smart robots and new processes such as three-dimensional printing.

Thus, the GPT framework tells us in general that the existence of strong complementarities between different information technologies and between ICT and other technologies, calls for an effective policy to address all the obstacles we have identified, so that there is a long-run impact beyond the immediate gains that we estimate.

EU POLICY IMPLICATIONS

Table 2 on the next page puts together various areas of industrial policy that hold back the development of ICT technologies, together with the value that each of these technologies can generate in the EU. These values are taken from the literature, as outlined in the previous sections, and are summarised in Table 1, and calibrated for the EU. To allow for comparison of different technologies, each value is expressed as an average annual contribution to growth between 2012 and 2020. Obviously, a significant margin of error should be taken into account when looking at these estimates, but they should give a good sense of the order of magnitude. A critical review of the literature outlined in the previous sections also allows us to assess the severity of various obstacles for the EU as a whole. In Table 2 a significant obstacle is shown in red, a minor obstacle in yellow and no obstacle in green. Assigning obstacles to the red category, which is the focus for our policy conclusions, means that a given policy area has been rated as a significant barrier in at least two independent studies.

Overcoming the obstacles identified in Table 2 calls for significant political effort, alongside public and private investment in ICT infrastructure. In light of the need for fiscal discipline, a distinction can be made between possible measures that could tackle these obstacles on the basis of their budgetary consequences. Stimulating growth by investment in infrastructure may require large-scale public investment, which will pay off only after a number of years. Improvements in other areas, for instance data security laws and product market regulations, may meanwhile unlock significant growth driven by increased competition and private sector entrepreneurship.

Table 2: Economic value in Europe of selected technologies, and the obstacles to realisation of this value

	Additional annual added value (€ bns)	Privacy and data security	Intellectual property and liability	Investment in infrastructure	Standardisation	Spectrum allocation	Product and labour market regulations	European single market
Social networks	5	yellow	green	green	green	green	green	green
Cloud computing	33.5	red	red	red	green	green	yellow	yellow
M2M/smart buildings	5	green	green	red	green	green	green	green
M2M/smart grids	1.5	green	green	red	yellow	green	green	green
M2M/smart motor systems	1	green	green	green	green	green	green	green
M2M/smart logistics	4	green	green	green	yellow	yellow	green	red
M2M/personal location data	14	red	green	green	yellow	yellow	green	yellow
Organisation technology	60	green	green	yellow	green	green	red	red

Legend	red	Significant obstacles in this area
	yellow	Some obstacles in this area
	green	No obstacles in this area

Source: Bruegel based on figures presented in Table 1.

If we just consider the significant obstacles (shown in red), Table 2 suggests that it is the insufficiently complete European single market that is the greatest obstacle to ICT technologies, in terms of holding back the realisation in the EU of the greatest value (€64 billion annually), followed by restrictive product and labour-market regulations (€60 billion annually), privacy and data security concerns (€47.5 billion annually) and insufficient intellectual property and liability laws, jointly with next generation network (NGN) investment (€33.5 billion annually in each case). These numbers are rough estimates of the direct effects that each of the areas could generate through their potential impact on the roll-out of the ICT categories. Nevertheless, we believe that they correctly represent the pecking order. Improvements in these areas will unlock growth by stimulating the deployment of data-driven organisational technologies, cloud computing, personal location data applications and smart logistics.

In light of the above results, policies promoting product-market competition – in particular, by strengthening the European Single Market – and labour-market flexibility – for instance by implementing reforms similar to Germany's Agenda 2010 in other member states with less flexible labour markets – will be instrumental in stimulating ICT-led growth[1]. No less importantly, data security and privacy should be reformed and harmonised across the EU to protect the users of cloud solutions without creating unnecessary hardship for companies. The European Commission's proposal to comprehensively revise the EU data protection framework[2] is a step in the right direction. Alongside the data security issues, intellectual property questions about the data stored in the cloud, and the liability of those processing the data, especially in an international context, should be resolved, giving business legal certainty that can underpin the development of new cloud applications.

Investment in NGN infrastructure is also an important lever for stimulating growth, both in the short run, through private investment, and in the longer run, by maintaining the viability of new data-intensive online services. In particular, investment in NGNs is likely to be a factor in achieving substantial benefits from cloud computing and data-driven organisational technologies. This investment should be encouraged through appropriate incentives for European telecom and cable operators.

1. Among other changes, Agenda 2010 included a 25 percent reduction in the basic rate of income tax and a big cut in unemployment benefits.

2. Proposal published in January 2012. See Communication COM/2012/09, available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do? uri=CELEX:52012DC0009:en:NOT

However, it is counterproductive if individual EU member states change the regulatory framework with the declared purpose of alleviating pressure on government budgets when, simultaneously, the EU is seeking to stimulate infrastructure investment for growth using inter alia European taxpayers' money (eg through the EIB). Investors require a certain stability in the economic and legal framework.

Standardisation and spectrum allocation may also give a push to ICT-led growth, especially through smart logistics and personal location data applications, as shown in Table 2. Accordingly, the efforts of the European Telecommunications Standards Institute, which develops standards for M2M communications including for automotive and other applications, should be more strongly supported. In addition, collaboration between industry players, standard-setting bodies and regulators should be encouraged to build on the success of the GSM Association, which was able to promote the GSM standard worldwide thereby helping the European mobile phone industry to develop a strong competitive edge in the previous generation of mobile phones. Spectrum allocation policies should further be scrutinised in order to allow for a more liberalised spectrum market, in which allocation is driven by the economic viability of the applications that are competing for its use. In the longer term, a market mechanism for the use of unlicensed spectrum – for instance by wi-fi applications – should be considered once the unlicensed spectrum band becomes overcrowded.

In summary, according to the estimates presented in this Policy Contribution, the policies that can unlock the most growth from the use of ICT are in the areas of product and labour-market regulation and the European Single Market. These areas should be reformed to make European markets more flexible and competitive. The evidence we put forward suggests that this would promote more widespread adoption of modern data-driven organisational and management practices, thereby helping to close the productivity gap between the EU and the US.

Privacy, data security, intellectual property and liability pertaining to the digital economy, especially cloud computing, are also identified as areas for action. Investment in NGN infrastructure will bring further benefits by making the internet ecosystem viable in the long term, and needs to be spurred by proper incentives for the private sector. Very importantly, overcoming obstacles to growth in these critical areas requires political and regulatory effort rather than fiscal stimulus. Standardisation and spectrum allocation are also found to be important, albeit to a lesser degree than other areas. The GPT character of the analysed ICT technologies suggests, however, that policymakers need to address all the obstacles identified here in order to fully achieve the potential of ICT to spur sustainable long-run growth that goes beyond the immediate gains that we estimate.

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