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EUROPE'S ICT CHALLENGE: SETTING THE STAGE FOR THE "AGE OF CONNECTIVITY"

There are few really uncontroversial issues in the modern debate about what governments can do to boost competitiveness and growth. Certainly one of them is that Information and Communications Technology (ICT) has become one of the most important determinants of the capacity of a country to compete internationally, and also a key driver of prosperity and quality of life for citizens. In the United States, in 2009 the ICT industry contributed $1 trillion to U.S. GDP, or 7.1% of GDP, including $600 billion from the sector itself and $400 billion in benefits to other sectors that rely on ICT (Andersen and Coffey, 2011). The National Research Council found that the ICT industry accounted for 25% of U.S. economic growth from 1995 to 2007 measured as real change in GDP (PCAST, 2007). Over the last two decades, the development and use of ICT has accounted for as high as 60% of annual U.S. labor productivity

gains, and estimates imply that a 1% increase in broadband deployment can create as many as 300,000 new jobs. In the European Union, the ICT sector represented in 2009 roughly 4% of EU GDP, a share that has remained stable over the last few years (EC, 2009). ICT employs 6.1 million people, i.e. 2.7% of total EU employment. The ICT sector is one of the most research-intensive sectors in the EU economy. With a ratio of 5.3% in 2009, the R&D intensity of the ICT sector was more than four times the average ratio of 1.2% in the EU economy.

A recent study by Oxford economics estimated that by 2020, if Europe were able to increase its ICT capital stock to the same level (relative to the size of the economy) as that of the US, the result would be impressive: GDP would increase by 5% on average—equivalent to about €760 billion for the EU as a whole, or €1500 per person (Oxford Economics, 2012). In emerging economies, the trend is even more evident: A recent study estimated that by 2020 China's ICT sector will account for 7.2% of the economy, contributing 8.6% of overall economic growth over the current decade (ITU, 2011). A recent study by Spiezia found that ICT producing industries account for no less than two-thirds of total factor productivity (TFP) growth in Germany, Slovenia and the UK, about 60% in the US and just below 50% in France and the Netherlands. In Denmark, the Czech Republic and Italy, TFP increased in the ICT producing industries

whereas it decreased for the total business sector (Spiezia, 2012).

Overall, however, it is important to note that ICT has become for Europe at once the main driver of productivity, but also the main determinant of the widening productivity gap with the US. The relative under-development of ICT in Europe has now been denounced not only by scholars, but also by policymakers themselves: suffice it to quote Vice President Neelie Kroes, who – in presenting her new proposed regulation on a "Connected Continent" on September 11, 2013 observed that "the telecoms sector hasn't had its Lehman moment yet. But with declining revenues, rising debt, dated business models, I worry about that happening. And I worry about the consequences if it did. Consequences for European ICT companies. For the governments who might have to bail them out. For the economy that critically depends on broadband connectivity" (Kroes, 2013c).

Kroes also recalled that today, connectivity always underpins competitiveness. As a matter of fact, a world-class broadband infrastructure is not anymore a guarantee for a thriving telecoms and IT sector: it is a precondition for competing at the global level, in all sectors of the economy. The main reason for this can be found in a double process of convergence, which follows the already-seen integration of telecoms, media and IT into the Internet ecosystem: first, the convergence

between the physical and virtual critical infrastructure of our economies; second, the inevitable convergence between the physical and the virtual worlds as we experience them.

Many examples could illustrate the importance of future ICT applications for the economy as a whole, ranging from cloud computing to smart cities to the evolution of 3D printing, the Internet of Things, wearable technologies and the non-military application of drones. Below, I choose two of the least-quoted examples to show that even when we do not imagine that ICT is about to change our lives, in fact it is.

The future of science, marketing and policy: entering the "big data" age

A first example of how ICT can improve every aspect of our daily lives is the use of big data in science and law enforcement: this is now possible since increased reliance on the digital infrastructure is leading us to leave traces of what we do on the Internet – suffice it to think about credit card transactions, store and online purchases, preferences expressed or revealed on social networks, etc. As it is estimated that 90% of all data we have today has been produced in the last couple of years, and the production of data is accelerating at a breath-taking pace, what we could do with data in the future is hard to imagine with precision.

Think about what is happening already in large cities like Los Angeles, where thanks to the advice provided by Professor Jeff Brantingham, an analytic software named PredPol helped the police achieving unprecedented levels of deterrence, leading to a drop in burglaries of 27% and an overall 14% reduction in crime in areas in which the software was used[9]. As a matter of fact, PredPol uses big data analytics to formulate predictions as regards the areas of the city in which a crime is most likely to occur: accordingly, policemen can be put in greater numbers where the risk is greatest. The power of big data analytics is well known to IT giants such and to supermarkets that are trialing the so-called "intelligent shelves" to be able to customize, to an extent unknown today, the service they provide to their customers and create the maximum potential to raise advertising and product placement revenues (Cheng, 2013). But big data analytics is much more than this: scientists that took a decade to codify the Human Genome can now do it in just one day; and insurance companies can set their premiums almost looking into the future through statistics and analytics.

Perhaps the least quoted application in this promising new field is in policymaking. The OECD recently

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[9] See www.predpol.com for more information. For a non-technical introduction, see the article published in The Economist on predictive policy, "Don't even think about it", available at http://www.economist.com/news/briefing/21582042-it-getting-easier-foresee-wrongdoing-and-spot-likely-wrongdoers-dont-even-think-about-it.

reiterated the need, for developed economies, to perform ex ante analysis of policy proposals and engage in risk-based inspections, rather than randomized controls, when enforcing them (OECD, 2012). However, as policymakers are discovering it, the risk-based inspections era might already be coming to an end, and be replaced by a data-based inspections era. The use of big data can (at least partly) replace randomized tax control, customs controls and other forms of interaction between governments and market players, leading to lower administrative burdens and greater government effectiveness over time. The use of regressions and other statistical tools to cross-check available data could make tax evasion a tale of the distant past. And predicting future policy impacts and adjusting over time to make policies more effective will become perhaps the dominant skill a policymaker is expected to have. Not surprisingly, the mayor of New York City Michael Bloomberg has appointed a "director of analytics", Mike Flowers, who started exactly by revolutionizing the way inspections were carried out in the Big Apple (Mayer-Schönberger, Viktor and Kenneth Cukier, 2013).

To be sure, the future development of big data is very much linked to what policymakers do in terms of striking the balance between individual privacy ad anonymity, and the need to make data on individual behavior available for analytics and predictive policy. Key ingredients of this development will be the availability of resilient, ubiquitous infrastructure and the

implementation of a smart, not too permissive, not too restrictive data protection policy. The trade-off between privacy and efficiency here is likely to emerge with unprecedented urgency: countries that will advance more quickly in striking the right balance between these two public policy objectives are likely to advance in information society more speedily than others.

The future of healthcare: confusing physical with virtual?

Big data and always-on connectivity also have great consequences for healthcare looking ahead. Experts already look at little-known concepts such as “stratified” medicine, or “personalized medicine”, which merges the scientific knowledge we have accumulated for centuries with the joint processing of data such as genetic information, standard clinical information, information from phenotype projects, etc. to identify those patients that are most at risk of a specific disease, or more likely to respond to a particular treatment.

But there’s more that ICT can and will do for healthcare. Combining technology with connectivity, it is already possible to monitor the basic health conditions of patients remotely and relying on computers to detect sudden, unpredictable changes. For people living in remote areas, this might make a huge difference in terms of timeliness of intervention: a change in blood

pressure or heartbeat can be detected in real time and lead to immediate reaction by medical staff. For the elderly, this also means avoiding hours of queues and long intervals between visits. The more sensors will evolve and nanotechnology will enable the placing of connected sensors on our bodies, the more we will generate data, the more these data will be processed with the others, and the more doctors will be precise in their diagnoses. For an ageing society like the European Union, this can prove decisive to cut the costs if healthcare, and at the same time improve its efficiency.

In the future, healthcare is one of the sector that has more to gain from the integration with ICT: think about nanotech and synthetic biology applications coupled with grid computing and big data, which promise to eradicate cancer, chasing or even anticipating pandemics, and replace parts of the human body with bionic "spare parts". Or think about the already developed contact lenses with augmented reality: not only they will likely replace the (still upcoming) Google Glass: but they might be able to eliminate defects in eyesight and even blindness in the medium-to-long term.

Scholars and engineers are getting ready for this exciting new age of science: but is Europe ready for it?

Conclusion: can Europe leverage ICT to restore growth?

Currently, it is fair to state that Europe is not in good shape to catch the train of connectivity and big data. In particular, none of these developments can actually take place absent a well-developed, ubiquitous, high-speed, high-capacity infrastructure; nor it can take place without the availability of legal rules that allow for the creation of "specialized services" that have a guaranteed, minimum Quality of Service (QoS). In this respect, the following problems are emerging:

- Europe lags behind the US and many Asian countries in terms of deployment of both fixed (fibre) and mobile (LTE) broadband infrastructure: these are the basic layers of the emerging Internet and cloud ecosystems (Granieri and Renda, 2012). These are: (i) a precondition for the migration towards ubiquitous e-government, e-health, tele-work, etc.; a key precondition for research and innovation: modern clusters are now disseminated around the globe, and need to communicate seamlessly to share expertise, knowledge and skills; and (iii) an essential precondition for securing a space in the emerging global value chains, in which multinational companies select the locations for the production of their products' components based, mostly, on the availability of outstanding connectivity: the increased use of 3D printing in developing

prototypes will make this an even higher priority (Renda, 2012; Renda 2013).

- The EU has not clarified to date whether specialized services will be possible on broadband platforms: the recently proposed rules on net neutrality are still too vague and seem to limit the possibility of setting up managed, guaranteed QoS services (at least, this is how the market seems to perceive them).
- Cloud computing, big data, future healthcare and all other disruptive applications that are being developed around the world desperately need resilient networks. This implies that we deploy secure and smart networks, but also redundant networks, which are able to solve outage problems avoiding domino effects in an age in which critical infrastructure displays unprecedented degrees of inter-dependency. Unfortunately, Europe is very far from reaching this goal: the state of the electricity grids, and that of the telecoms network, are simply disastrous in some countries. This means that absent a "grand project" aimed at restoring Europe's critical infrastructures, the whole continent might be unable to compete.
- Skills seem to be missing in key areas: not only are EU-based universities, with few exceptions, largely missing at the top of international rankings: but in emerging sectors such as cloud computing the European Commission now expects that there will

be 900,000 unfilled jobs in 2015 due to lack of skills (EC, 2013a).

- Data protection rules must be made compatible with these developments. In particular when it comes to healthcare applications, big data and personalized medicine can lead to accurate results, but also to undesirable uses of personal information. A debate has to be started immediately on this issue in order to avoid that future providers cannot use data for virtuous, privacy-neutral applications; and at the same time they cannot engage in data manipulation and natural-selection-like behavior in the future. A tough balance to strike, since empowering end users leaving them the choice to opt-out of data collection might significantly slow down the advancement of these technologies in Europe; and even if this choice is made, few individuals will decide to opt out, given the enormous advantage of getting customized service (how often do you say no to cookies?).

In summary, the fundamentals of future ICT development in Europe are, together with skills, a smart, integrated and resilient infrastructure, and a suitable data policy that strikes a good balance between privacy and predictive policy. There seems to be very little of this happening, unfortunately, and Europe seems doomed to lag behind other countries in the ICT revolution, unless a major new set of forward-looking reforms are launched.

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