Boosting European Prosperity Through the Widespread Use of ICT

BY ROBERT D. ATKINSON | NOVEMBER 2007

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After a long period over which Europe was catching up to the United States in productivity, Europe has fallen back since 1995. For Europe to prosper in the future, especially in the face of its rapidly aging population, raising productivity growth rates to or above pre-1994 levels will be crucial. The evidence strongly suggests that the key factor in engineering such a productivity turnaround will be the ubiquitous use of information and communication technologies (ICT) throughout the European economy and society. This brief discusses why higher productivity is critical for the future of Europe; examines the relationship between ICT and productivity in the United States and Europe; describes the impact of ICT on European economies; and lays out five key policy principles for attaining digital prosperity.

To achieve the ubiquitous use of ICT, policymakers at the European Union (EU), national and subnational government levels will need to put digital transformation at the front and center of their policies. This means they will have to (1) focus on raising productivity across the board, particularly through greater use of ICT; (2) use tax incentives and tariff reductions to spur ICT investment; (3) actively encourage digital innovation and transformation of economic sectors; (4) encourage universal digital literacy and digital technology adoption; and (5) do no harm to the digital engine of growth.

EU AND U.S. PRODUCTIVITY TRENDS

For most of the post-war period, productivity was growing faster in Europe than in the United States. Yet, after 1995 the trend reversed. Indeed, while productivity growth in the United States has accelerated in the last decade, from an average of 1.6 percent per year from 1980 to 1994 to 2.7 percent since then, productivity growth in Europe has gone in the other direction, declining from 2.3 percent per year to 1.4 percent (see Figure 1). Indeed, since the mid-1990s, while the United States experienced a structural shift in upwards in productivity growth because

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of ICT, Germany, Italy, France, and Spain experienced a structural shift downward in productivity growth.[1]

Comparing the period after 1995 to the early 1990s, about half of 56 U.S. industries saw a productivity acceleration, compared to about 20 percent of industries in the EU showing acceleration.[2] Much of the growth acceleration in the United States was driven by ICT producing sectors and service sectors, especially wholesale and retail trade, banking, and other financial services. As a result, the labor productivity gap in the EU-15 relative to the U.S. has widened by 4 percentage points from 96 percent of the U.S. level in 1995 to 92 percent in 2002.[3] The gap between the EU-27 and the U.S. is even greater, at 74 percent of U.S. levels.[4]

For individual EU nations, however, recent trends have been mixed. In 2005, productivity increased 1.4 percent in France and 1.3 percent in Germany. In other countries, though, productivity grew less than 1 percent: Spain (0.9 percent), the United Kingdom (0.7 percent), and Italy (0.4 percent).[5] However, in 2006 EU productivity did grow slightly faster than U.S. productivity, 1.5 percent vs. 1.4 percent, representing though, less of a increase in EU productivity, and more of a slowdown in U.S. However, U.S. rates have doubled so far in 2007, to slightly more than 3 percent.

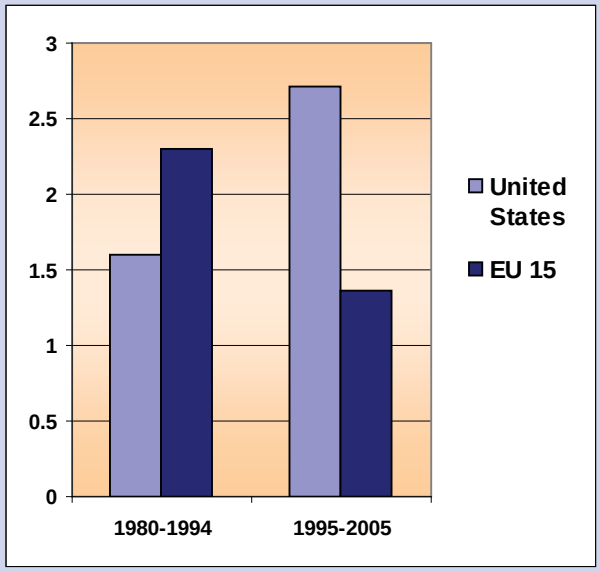
WHY EUROPE NEEDS TO ACCELERATE PRODUCTIVITY GROWTH

Higher productivity is central to ensuring robust economic growth. To see why, consider the fact that because productivity growth accelerated in the United States after 1995, its gross domestic product (GDP) today is more than $1.9 trillion greater than it would otherwise be. If the EU-15 nations had just been able to maintain through 2006 the productivity growth they enjoyed from 1980 to 1994, their GDP would be over 1.1 trillion euros greater today. To see how important productivity is to future prosperity, consider that if EU labor productivity were to grow over the next 25 years at its 1980-1994 average of 2.3 percent per year, real output per capita would increase by roughly 75 percent. On the other hand, if Europe's current low productivity growth rate persists, real output per capita will grow just 41 percent.[6]

One reason that boosting productivity is especially central to the future economic health of the EU is that the labor participation rate in the EU is lower than that in the United States because a significantly greater share of the EU population than of the U.S. population is older and not working. In 2005, for example, 17.4 percent of the population of the EU-15 nations was age 65 and older—much higher than the comparable figure of 12.4 percent of the population of the United States. By 2050, the gap will grow even larger, with 28.8 percent of the EU population age 65 and older and 20.6 percent age 65 and older in the United States. In the face of this generational storm, if Europeans are to enjoy a growing standard of living, they will have to raise the rate of productivity growth.

There is a second pressing imperative for boosting productivity in Europe—to be able to afford the investments needed to combat global warming. The only path to a growing global economy that emits dramatically less carbon dioxide is to develop and deploy radically cleaner technologies. Such technologies, at least in the short and moderate term, will not be cheap. Higher productivity will enable European (and other) nations to more easily afford these investments while still enjoying a growing standard of living. Some might argue that because ICT boosts growth—and by exten-

FIGURE 1: AVERAGE ANNUAL LABOR PRODUCTIVITY GROWTH



sion, carbon emissions—it is part of the problem. Yet there is considerable evidence that in its direct impacts, ICT allows resources, including energy, be used more efficiently.

Although the United States is using more energy than it did 20 years ago, it would be using even more without the efficiencies that ICT enables. From 1996 through 1999, for example, the United States experienced an unprecedented 3.2 percent annual reduction in energy intensity (energy used per unit of GDP)—four times the rate of reduction in energy intensity of the previous 10 years. During the same period, the EU-25 experienced a 2.9 percent annual reduction in energy intensity.[7] Although several factors may account for the superior U.S. performance, including the shift in the U.S. economy toward less energy-intensive sectors, the considerably higher rate of the incorporation of information technology (IT) into business practices in the United States than in the EU appears to be a key source of this improvement.[8]

ICT AND THE U.S. PRODUCTIVITY MIRACLE

The digital economy is more than an economy conducted on the Internet. Rather, it represents the pervasive use of ICT—hardware, software, applications, and telecommunications—in all aspects of the economy, including internal operations of organizations (business, government, and nonprofit); transactions between organizations; and transactions between individuals, acting both as consumers and citizens, and organizations. ICT has enabled the creation of a host of tools to create, manipulate, organize, transmit, store, and act on information in digital form in new ways and through new organizational forms. And its impact is pervasive, for ICT is being used in virtually every sector from farming to manufacturing to services to government.

There now is compelling evidence that it was ICT that led to the U.S. productivity rebound during the last decade. Economists strongly concur that the ICT revolution was responsible for the lion's share of U.S. productivity growth. In a conclusive review of more than 50 scholarly studies published between 1987 and 2002 on ICT and productivity, Dedrick, Gurbaxani, and Kraemer found that "the productivity paradox as first formulated has been effectively refuted. At both the firm and the country level, greater investment in ICT is associated with greater productivity growth."[9]

In fact, nearly all scholarly studies since the mid-1990s have found positive and significant effects of ICT on productivity.[10] As Harvard economist Dale Jorgenson writes, "Despite differences in methodology and data sources, a consensus is building that the remarkable behavior of IT prices provides the key to the surge in economic growth."[11] Economists have studied the impacts of ICT on the productivity of firms, industries, and economies. In all three cases, they have found that ICT has been the major driver of increased productivity.

The United States is the country that has perhaps seen the biggest impact from ICT. ICT was responsible for two-thirds of total factor growth in U.S. productivity between 1995 and 2002 and for virtually all of the growth in U.S. labor productivity.[12] Because of the ICT revolution, annual GDP in the United States has been more than $1.9 trillion greater than it would be otherwise.

Moreover, there are strong indications that ICT has the potential to continue driving growth for the foreseeable future. The "ICT engine" does not appear likely to run out of gas anytime soon. The core technologies (memory, processors, storage, sensors, displays, and communication) continue to get better, faster, cheaper, and easier to use, enabling new applications to be introduced on a regular basis. Moreover, the adoption of digital technologies by organizations and individuals continues to grow.

Why has the use of ICT been the key driver of growth? A principal reason is that it has a greater impact on productivity and growth than non-ICT capital. Gilchrist, Gurbaxani, and Town found that accelerated investment in IT generated increases in productivity more than three times greater than would be the case if it were other kinds of capital investment.[13] Maliranta and Rouvinen found that ICT investment in Finland has higher productivity impacts than other kinds of capital.[14] Plice and Kraemer found that in developed nations, ICT capital showed five to eight times higher return on investment than non-ICT capital.[15] Like-

wise, Wilson finds that of all types of capital, only computers, communications equipment, and software are positively associated with multifactor productivity.[16] In other words, ICT capital produces productivity gains beyond what would be expected from just adding more capital equipment.

There are at least four possible reasons why ICT has stronger effects on productivity than other capital. First, because IT capital equipment innovations are new, they are able to pick off the "low hanging fruit" of relatively easy to improve efficiencies. Second, ICT doesn't just automate tasks; it has widespread complementary effects, which include allowing companies to fundamentally reengineer processes. Third, ICT has what economists call "network externalities," which are the "spillovers" from adding additional users to a network. Simply put, increasing the user size of a network makes all current users better off. Fourth, ICT collapses time and space and globalizes resource and impacts, spurring competition and more efficient global division of labor, which in turn enable economies to be more efficient and innovative. Put all of these factors together, and it's not surprising that ICT has had such a bit impact.

THE IMPACT OF ICT ON EUROPEAN ECONOMIES

Europe is a study in contrasts when it comes to ICT. On the one hand, some European nations are leaders in some ICT application areas, including broadband, e-banking, mobile commerce, smart cards, and e-health. Denmark, Finland, Iceland, the Netherlands, and Sweden are among the world leaders in broadband.[17] With projects in London and Stockholm, Europe is leading in the use of ICT for road congestion pricing. The Netherlands and Denmark have made significant advances in e-health. Europe as whole has developed innovation business-to-business applications, like the Pan European Fish Auction, which directly links fish retailers to fish-harvesting companies in real-time auctions.[18]

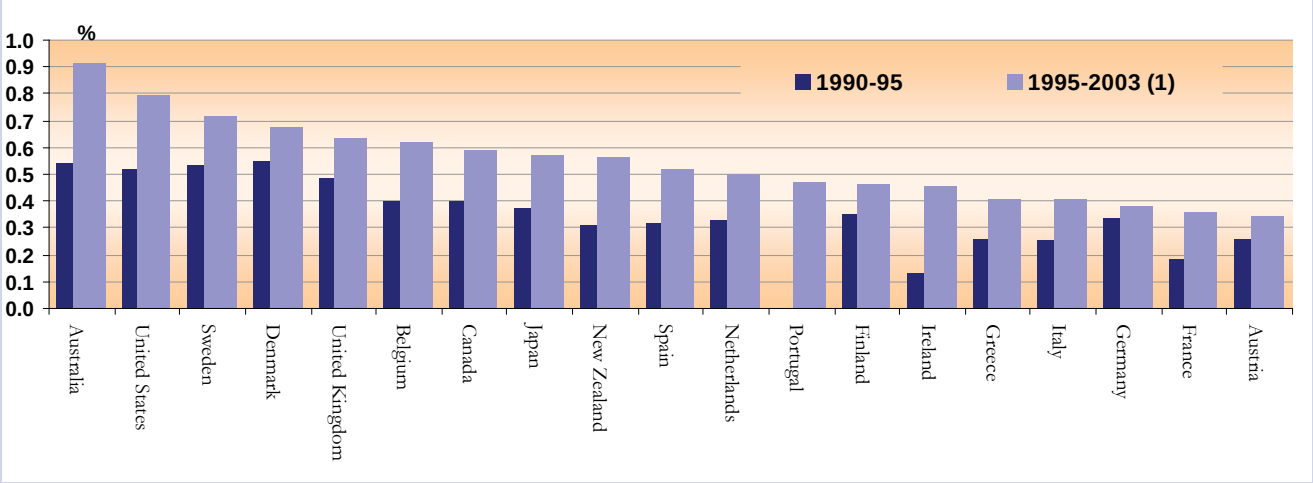
Notwithstanding these innovations, most European nations have not experienced the same level of benefit from the ICT revolution as the United States has. For example, in intensive ICT using sectors, productivity growth in the EU-15 was relatively stable between the early 1990s and the period since, while in the United States there was a very large acceleration in productivity in these sectors.[19]

Even though European nations have not experienced the same level of benefit from the ICT revolution as the United States, ICT has had a positive impact on productivity in European countries. In looking at ICT's impact in individual countries, economists have found significant impacts. A study in the United Kingdom, for example, found that an additional 10 percent of workers using computers resulted in a 2.2 percent gain in productivity in older firms and 4.4 percent in new firms. Internet usage had an even bigger impact, with a 10 percent increase in Internet usage resulting in a 2.9 percent gain for older firms.[20] Another U.K. study found that the use of computer networks by firms increases total factor productivity by 5 percent.[21] For every 10 percent of employees using personal computers, a firm's productivity increased 2.2 percent; Internet-enabled computers boosted productivity 2.9 percent.[22] Firms that also heavily used telecommunications had even higher productivity gains, particularly in retail and wholesale sectors. Firms engaged in e-procurement enjoyed 7 percent higher value-added than firms that did not, while firms engaged in e-selling had 4 percent lower prices.[23]

Firms in Europe, particularly service firms, have invested less in ICT than their counterparts in the United States.

Greenan, Mairesse, and Topiol-Bensaid analyzed data on French firms' ICT investments and found that greater ICT investments led to faster productivity growth.[24] Milana and Zeli found that although Italian productivity growth has not been robust, it would have been even slower without the investment in ICT.[25] ICT investments were found to have similar effects in Finland, Germany, and Switzerland.[26] The European nations that have seen the most benefit from ICT investments include Sweden, Denmark, the United Kingdom, and Belgium. But all European nations have seen an increase in growth from ICT investments, and the impact was significantly greater from 1995 to 2003 than it was from 1990 to 1995. (See Figure 2)

FIGURE 2: CONTRIBUTIONS OF ICT INVESTMENT TO GDP GROWTH, 1990-95 AND 1995-2003[27]

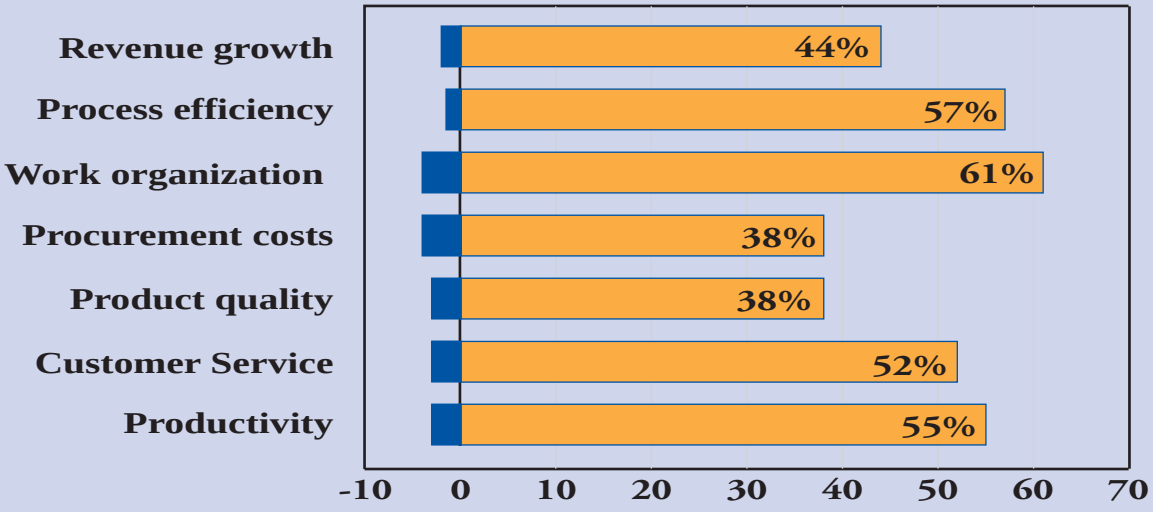


Cross-national comparisons have produced similar results. While EU-4 nations (France, Germany, the Netherlands, and the UK) see lower acceleration of productivity growth in intensive ICT using sectors than the United States, they still experienced a pick up in growth rates.[28] Schreyer found that ICT made a positive contribution to productivity and economic growth in all G7 nations from 1990 to 1996.[29] Gust and Marquez found that nations whose ICT expenditures rose sharply in the 1990s experienced a pickup in productivity growth.[30] In contrast, countries where spending on ICT fell or only grew marginally saw no productivity acceleration.

Moreover, ICT doesn't just lead to higher productivity; it enables firms to be more competitive and innovative. Van Leeuwen and van der Wiel found, for example, that Dutch firms that invested more in ICT not only enjoyed faster productivity growth but also produced more innovations.[31] In the EU, 32 percent of companies reported innovations, with ICT enabling half of the product innovations and 75 percent of the process innovations.[32]

The views of European business executives are consistent with the results of these studies. A survey of European executives shows that most executives thought ICT had a beneficial impact, not just on productivity (55

FIGURE 3: PERCEIVED ICT IMPACT ON EUROPEAN BUSINESSES[33]



percent) but also on work organization (61 percent), product quality (38 percent), and customer service (52 percent) (see Figure 3).

WHY HAS EUROPE BENEFITED LESS FROM THE IT REVOLUTION?

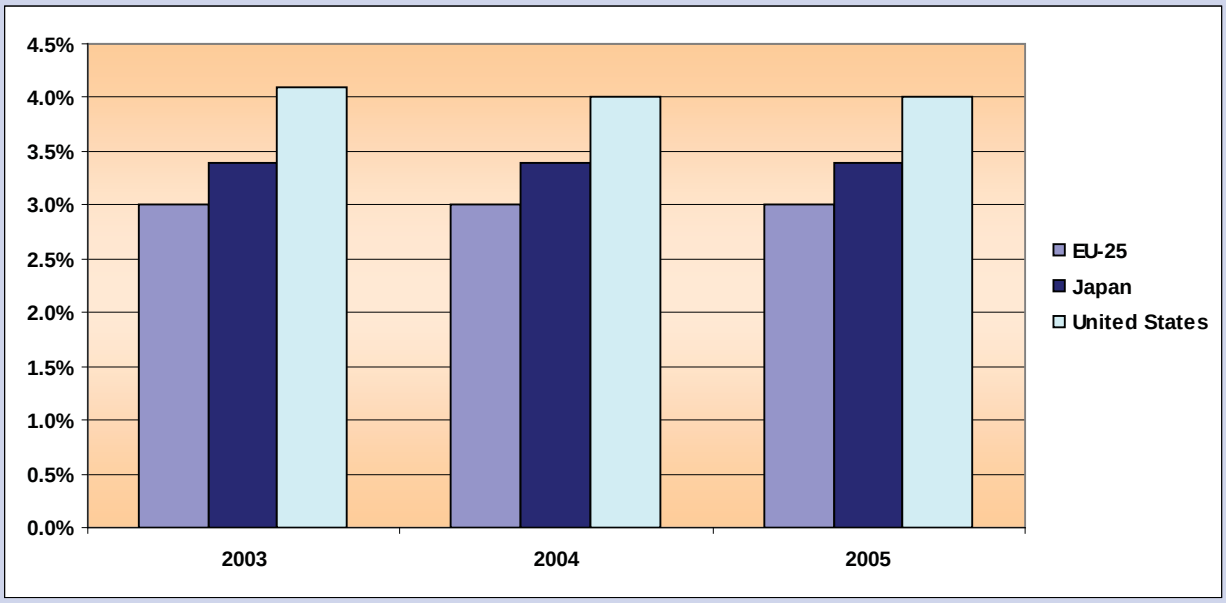
Given the importance of ICT to productivity growth, the key question is why has Europe not benefited as much as the United States. Some have argued that the U.S. has benefited more from ICT because of different timings of the business cycle. But a thorough analysis found that there is no significant effect on productivity growth differentials between the two regions due to the timings of the business cycle.[34]

There appear to be two key reasons why Europe has benefited from the ICT revolution less than some other nations, including the United States. First, firms in Europe, particularly service firms, have invested less in ICT than their counterparts in the United States.[35] (See Figure 4) Among 19 Organisation for Economic Co-operation and Development (OECD) nations, the United States ranked second, behind Finland, in investment in hardware, software, and telecommunications as a share of fixed capital investment, with rates 50 percent or more above other nations.[36] (See Figure 5) The United States ranked second of 28 nations, behind Australia, in computers per white-collar worker. In fact, ICT investment as a share of total non residential investment is almost twice as much in the United States as in the EU-15 (29.9 percent vs. 15.8 percent).[37]

Moreover, investment in ICT grew faster in the United States than in other large OECD nations (France, Germany, Italy, and the United Kingdom). While growth in ICT capital led to increased productivity in the EU-4 in the period from 1995 to 2000 compared to 1990 to 1995, the growth effect was significantly less than in the United States.[38] From 1995 to 2000, ICT investment in constant prices increased at 21.3 percent per year in the United States but by 17.6 percent in the EU 5 (France, Germany, UK, Finland, and Italy).[39] The result is that in the 1990s, ICT contributed nearly twice as much to labor productivity growth in the United States as in the EU.[40]

The second reason why Europe has not benefited from the ICT revolution as much as the United States is that European countries have been slower to make the process and organizational changes that would allow them to achieve the full benefits of ICT. For organizations—and by extension, national economies—to get

FIGURE 4: ICT INVESTMENTS AS A PERCENTAGE OF GDP[41]



the full benefit from ICT investments, it appears that such investments must be accompanied with organizational changes and process reengineering

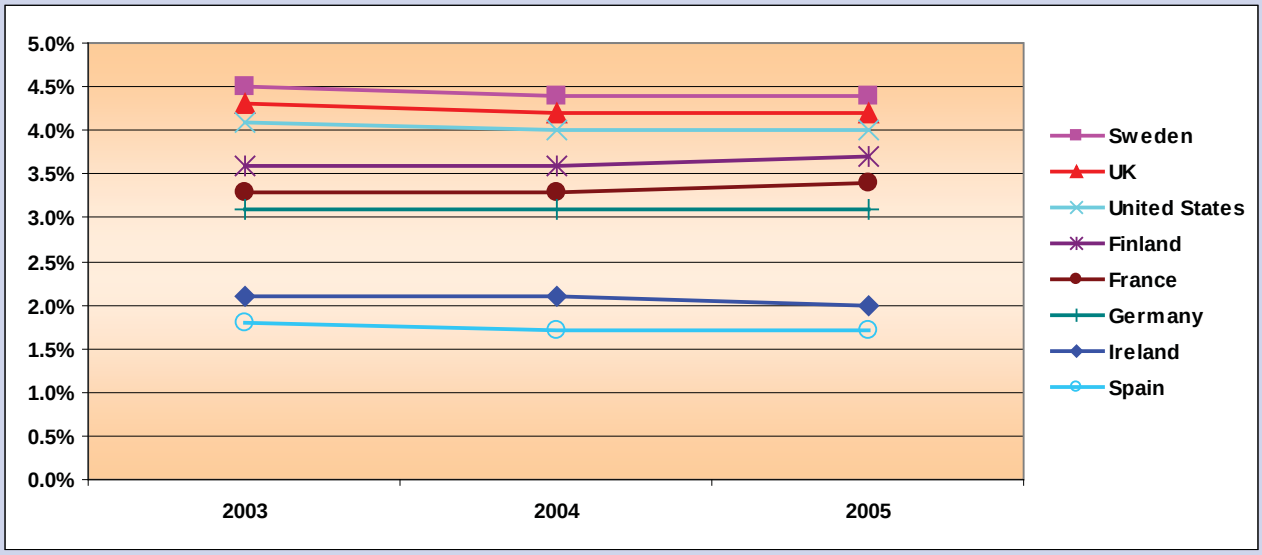
Bresnahan, Brynjolfsson, and Hitt found that firms that invest significantly in ICT and at the same time embrace "new economy" management practices (e.g., decentralized decision making) outperform other firms.[42] As they note, "Firms do not simply plug in computers or telecommunications equipment and achieve service quality or efficiency gains. Instead they go through a process of organizational redesign and make substantial changes to their service or output mix."[43] Laser scanners, for example, have the potential to do far more than allow retailers to boost checkout clerks' productivity; they enable retailers to reengineer their entire supply chain.

The OECD found that ICT "seems to offer the greatest benefit when ICT investment is combined with other organizational assets."[44] Business executives agree that both ICT and organizational changes are needed, as 97 percent believed technology alone would not raise productivity in their firm to the highest level achievable unless it was accompanied by organizational changes.[45] These secondary effects end up letting firms make more significant productivity gains than they would achieve simply by using it to make an individual process more efficient.

Indeed, ensuring that the EU fully benefits from the potential of the ICT revolution will require that policymakers devote the same, if not a higher, level of attention to ICT than they currently give to more conventional economic policy areas, such as managing the business cycle.

Such organizational and process changes are often large and costly upheavals, and progress in making such changes may have been slower in Europe because of its regulatory and cultural constraints to adopting U.S.-style business practices. Although there is limited analysis of this issue, some analyses suggest that EU firms take less advantage of these organizational opportunities enabled by ICT. For example, Gust and Marquez found that ICT adoption and productivity growth are significantly negatively associated with restrictive regulatory practices.[46] Mason, O'Mahoney, and van Ark find that in the period from 1995 to 2001, annual growth in total factor productivity growth in the United States was almost twice as much (0.80 vs.

FIGURE 5: ICT INVESTMENTS AS A PERCENTAGE OF GDP[47]



0.46) than in the EU.[48] Changes in total factor productivity – in other words, productivity increases that cannot be accounted for my more capital equipment or higher skilled workers – are one measure of such reengineering and organizational benefits.

Studies in the United Kingdom point to these organizational and management issues as a factor in their lower productivity growth from ICT. One study found that U.S. multinational enterprise subsidiaries in the United Kingdom achieve larger productivity gains from use of computers than do U.K. firms. U.S. multinationals in the United Kingdom use about 40 percent more ICT capital per worker than average; non-U.S. multinationals use only about 20 percent more; and purely U.K. firms use much less ICT capital per worker than the average. This study, controlling for variables such as industry sector and firm size, found that output per employee in U.S.-owned multinational enterprise subsidiaries was 40 percent higher than output per employee in U.K. firms. More than 80 percent of the advantage in productivity for U.S. owned subsidiaries was explained by these firms' better use of ICT, not the overall amount of ICT they had.[49]

So why did U.S. firms in the United Kingdom get more out of ICT than European firms? Although the authors did not pinpoint the exact causes, they did point out that U.S. firms had more "aggressive" human resources practices, promoting good performers quickly and getting rid of weaker performers. Moreover, U.S. firms devolved greater managerial autonomy in the implementation of IT systems to local plants rather than trying to run everything centrally. A study of ICT adoption in Germany found similar results—that firms that adopted ICT that had made organizational innovations experienced a significantly greater productivity benefit than firms that had not made these organizational changes.[50]

WHAT DOES EUROPE NEED TO DO?

Europe's greatest economic challenge over the next quarter century will be to raise productivity growth rates so that it can support a growing share of the population that will not be in the labor force and increased investments in environmental protection. Its greatest opportunity will be to take advantage of the ICT engine to shift to a higher productivity path.

To take advantage of this opportunity, European policymakers will have to make digitally enabled transformation a key economic policy priority. Indeed, ensuring that the EU fully benefits from the potential of the ICT revolution will require that policymakers devote the same, if not a higher, level of attention to ICT than they currently give to more conventional economic policy areas, such as managing the business cycle.

Although it is beyond the scope of this report to lay out a detailed ICT policy blueprint, European policymakers need to follow five key principles if their nations are to fully benefit from the worldwide digital revolution.

1. Focus on Raising Productivity Across the Board Through Greater Use of ICT

EU economic policymakers need to make a key strategic choice as to whether to focus their strategies on targeting a few key technology sectors for growth, in part through trade policy and higher tariffs on imports, or on spurring the digital transformation of all sectors in the economy. To understand why, consider the fact that a nation's productivity can increase in two ways. One way is for a nation's existing firms to become more productive, usually by using new technologies that raise productivity and lower costs (e.g., self-service kiosks in airports). The second way is for firms in low-productivity sectors to be replaced by firms in higher productivity sectors. Thus, for example, a nation might lose jobs in a call center (which normally has low productivity) but replace them with jobs in a software firm (which normally has high productivity).

Both ways of increasing productivity—growth in across-the-board productivity (the growth effect) and shifts in the mix of establishments toward more productive ones (the mix effect)—will contribute to an increase in a nation's productivity and average incomes. But which strategy—growth or mix—is the best path to higher per-capita incomes?

The answer depends on the size of a nation's economy. The larger the economy, the more important the growth effect is; the smaller the economy, the more important the shift effect is. To see why, consider an insurance firm in a small city. If it shifts more to e-commerce strategies and invests in ICT, a large share of the benefits will flow to the firm's customers

throughout the region or nation in the form of lower prices. In contrast, if the city attracts or grows a high-productivity firm to replace a lower productivity firm that moved away, most of the benefits will accrue to the residents in the form of higher wages. This means that for most nations—and certainly for as large an economy as the EU as a whole—productivity growth across the board, rather than a shift to higher value-added sectors, will account for the majority of per-capita income growth.[51]

This does not mean that nations and the EU as a whole cannot pursue both the across-the-board growth strategy and the mix strategy. Indeed, the Lisbon Strategy includes both.[52] One of its six key priorities, for example, is to create eEurope, which if effectively implemented is likely to boost productivity across the board. But the Lisbon Strategy also places a significant emphasis on gaining greater global market share of high value-added, innovation-based sectors.

Gaining the full benefits of the digital revolution requires that regions and nations accept, and ideally embrace, the kinds of transformation and restructuring that IT enables, for it is only through this that the full economic benefits are realized.

But what happens when a particular policy supports one of these goals but conflicts with the other? A case in point is the recent decision by the European Commission to reclassify some IT imports so that they are no longer covered by the World Trade Organization's Information Technology Agreement that was supposed to eliminate tariffs on IT products. In particular, the European Taxation and Customs Union has chosen to interpret the 2004 revisions to the Harmonized Tariff Schedule by the World Customs Organization in a way that enables EU member states to apply tariffs as high as 14 percent on multifunction printers, set-top boxes, and liquid crystal display (LCD) computer monitors, and it is considering adding other products, such as digital cameras. The policy goal for this action, besides perhaps attempting to raise revenue, is to boost the production of these ICT-related products in Europe and gain the jobs associated with their production.

In this case, the key question facing European policymakers is whether there is more value in expanding their IT industry or in applying IT to other sectors of the economy—and whether promotion of the former through higher tariffs on ITA-covered products will be detrimental to the latter. Even if raising tariffs might lead to some offsetting production of the good or service in Europe, raising tariffs on ICT goods and services is a particular problem because it makes ICT more expensive and reduces ICT investment by firms and other organizations.

As noted above, lower levels of ICT investment is already a key problem in most European nations. Because tariffs raise the price of IT products, it would be expected that they would reduce demand. And this is exactly what research has found. Gurbaxani has estimated that for every 1 percent drop in price in IT products, there is a 1.5 percent increase in demand.[53] A study of tariffs on IT products in India found that tariffs reduced domestic IT investment.[54] In a cross-national study of countries in the Asia-Pacific region, Kraemer and Dedrick show clearly the benefits of IT use, and the high costs of policies, including tariffs on ICT products, which would depress demand for ICT.[55] As Kraemer notes, "One of the best ways to promote IT use is to not create barriers to use. Any government policy that makes computers more expensive will discourage use and reduce the possible benefits of IT. Simply lowering tariffs and taxes, eliminating other trade barriers, and encouraging competition in distribution channels will help promote use as much as any specific efforts to encourage use."[56] The Commission appears to agree stating, "openness to trade can play an important role in raising productivity growth."[57]

If Europe is to turn around its productivity slump, greater use of ICT by European companies, governments, nonprofit organizations, and individuals will be the key. Imposing higher tariffs on a host of ICT-based products is a path to lower, not higher, productivity.

2. Use Tax Incentives and Tariff Reductions to Spur ICT Investment

Although ICT innovation is important, it is only through investment in ICT—hardware, services, software and telecommunications—that ICT innovation

is diffused throughout the economy. Research has conclusively shown that organizational investment in ICT powers growth. In fact, as described above, ICT seems to be "super capital" that has a much larger impact on productivity than other capital.

Thus, public policies should focus on spurring additional investment in newer generations of ICT. This means, as discussed above, that policymakers should avoid taxing ICT investments, particularly broadband telecommunications. They should also avoid placing tariffs on ICT imports as tariffs reduce ICT consumption. But they should also allow companies to more rapidly depreciate ICT investments for tax purposes.

Some economists might question such policies, arguing that such tax incentives should only go to investments in areas like R&D where companies seldom capture all the benefits. There is emerging evidence, though, that because ICT transforms organizations and leads to innovations within other organizations, it operates in the same way as research and knowledge, with high spillovers that may be taken advantage of by other organizations. In such an environment, the socially optimal amount of investment in ICT will lag behind actual investment. In these cases, it makes sense for the tax code to spur additional ICT investment, or at least to avoid having the tax code and tariff rules penalize ICT investment.

3. Actively Encourage Digital Innovation and Transformation of Economic Sectors

The private sector will drive much of digital transformation, but government can and should play a supportive role. Economists have long argued that business underinvests in research. Thus, government can play a key role by supporting earlier stage research in emerging ICT research areas, either through boosting direct funding or expanding R&D tax incentives.

Economists have also documented significant market failures, including network externalities and "chicken-or-egg" issues, which slow digital transformation absent smart and supportive public policies. The health care industry, which is approaching 10 percent of GDP in Europe, is perhaps the leading example of market failure due to a "chicken-or-egg" situation, but it is by no means the only such market failure. Success for any individual health organization that embraces a digital business model depends on other health organizations, including patients, also embracing the digital model. The EU should be congratulated for its e-health alliance, and transatlantic cooperation with United States, but more needs to be done in both regions.

Such chicken-or-egg and network externality issues exist in a host of industries other than health care, including transportation, real estate, government, and education, as well as in a host of technology industry areas such as high-speed broadband telecommunications, smart cards, radio frequency identification devices (RFID), geographic information systems, mobile commerce, and the new Internet Protocol Version 6.[58]

In all these cases, EU governments should use a wide array of policy levers, including tax, regulatory, and procurement policies, to spur greater ICT innovation and transformation. Moreover, government officials at all levels can and should lead by example by leveraging their own ICT efforts to achieve more effective and productive public sector management and administration. This means, among other things, that government should not only actively promote e-government but also should look to how ICT can be used help solve a wide array of pressing public challenges, such as traffic congestion, to take just one example. In this regard, ICT can now be a key public policy tool, alongside tax, procurement, and regulation.[59]

4. Encourage Universal Digital Literacy and Digital Technology Adoption

The benefits and promise of the digital revolution are immense. Moreover, as consumers become digital "prosumers"—that is, consumers who also use ICT to become producers by doing things like paying bills online—ensuring that the ICT revolution is fully taken advantage of will require that a large majority of citizens participate in the digital economy. To succeed in today's economy, people need basic familiarity and understanding of computer and Web skills. Governments need to do more in partnership with the for-profit and nonprofit sectors to spur digital literacy and take-up.

5. Do No Harm to the Digital Engine of Growth

Forty years ago, noted economist John Kendrick wrote: "technological changes upon which productiv-

ity gains rest are bound to have a more or less disruptive influence on individuals and institutions." It's no different today. Gaining the full benefits of the digital revolution requires that regions and nations accept, and ideally embrace, the kinds of transformation and restructuring that IT enables, for it is only through this that the full economic benefits are realized. Yet, too many firms, civic groups and policy makers in Europe appear to want the benefits of the ICT revolution without the disruption. Catching up the U.S. in productivity growth will require an acceptance, and even an embrace, of change. Among other things this means dismantling laws and regulations protecting powerful offline incumbent entities against competition from emerging online competitors. It means making sure that labor market rules do not thwart firms making ICT-enabled organizational restructuring. It means ensuring that firms, especially firms serving customers online, have access to all the European market. This is particularly important because ICT gives firms unprecedented economies of scale, but only if they have market access to take advantage of them. Yet, Europe product markets are still not fully integrated, making it harder for EU firms to use IT to gain the scale economies U.S. firms enjoy.[60]

It also means avoiding harm to the digital engine of growth. Notwithstanding the progress that ICT transformation enables, well-intentioned EU policymakers all too often consider laws and regulations that would slow digital transformation. EC efforts to over-regulate Internet privacy will limit the emergence of dynamic business models that can provide consumers considerable benefits. EC efforts to regulate radio frequency identification technology (RFID) under the guise of privacy protection would slow deployment of a technology that promises dramatic productivity improvements, particularly in two sectors where Europe lags: wholesale and retail distribution.[61] Proposals to regulate Internet telephony and Internet video content (the "Television without Frontiers Directive") akin to the way circuit switched telephony and over-the-air TV, respectively, are currently regulated, would have similarly deleterious effects on the deployment of these applications.

Although the emerging digital economy has produced enormous benefits, the best is yet to come. The job of policymakers in the EU, and elsewhere, is to ensure that the policies and programs they put in place spur digital transformation so that all their citizens can fully benefit.

Endnotes

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