

Transatlantic technologies: Why did the ICT revolution fail to boost European productivity growth?

 voxeu.org/article/why-ict-revolution-failed-boost-european-productivity-growth

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The benefits of the ‘ICT revolution’ are readily seen in labour productivity statistics for the US, but a similar acceleration of productivity growth was not seen in Western Europe. This column argues that most of the 1995-2005 US productivity growth revival was driven by ICT-intensive industries producing market services and computer hardware. In contrast, the EU10 experienced a 1995-2005 growth slowdown due to a paucity of ICT investment, a failure to capture the efficiency benefits of ICT, and performance shortfalls in specific industries. After 2005 both the US and the EU10 suffered a growth slowdown, indicating that the benefits of the ICT revolution were temporary rather than providing a new permanent era of faster productivity growth.

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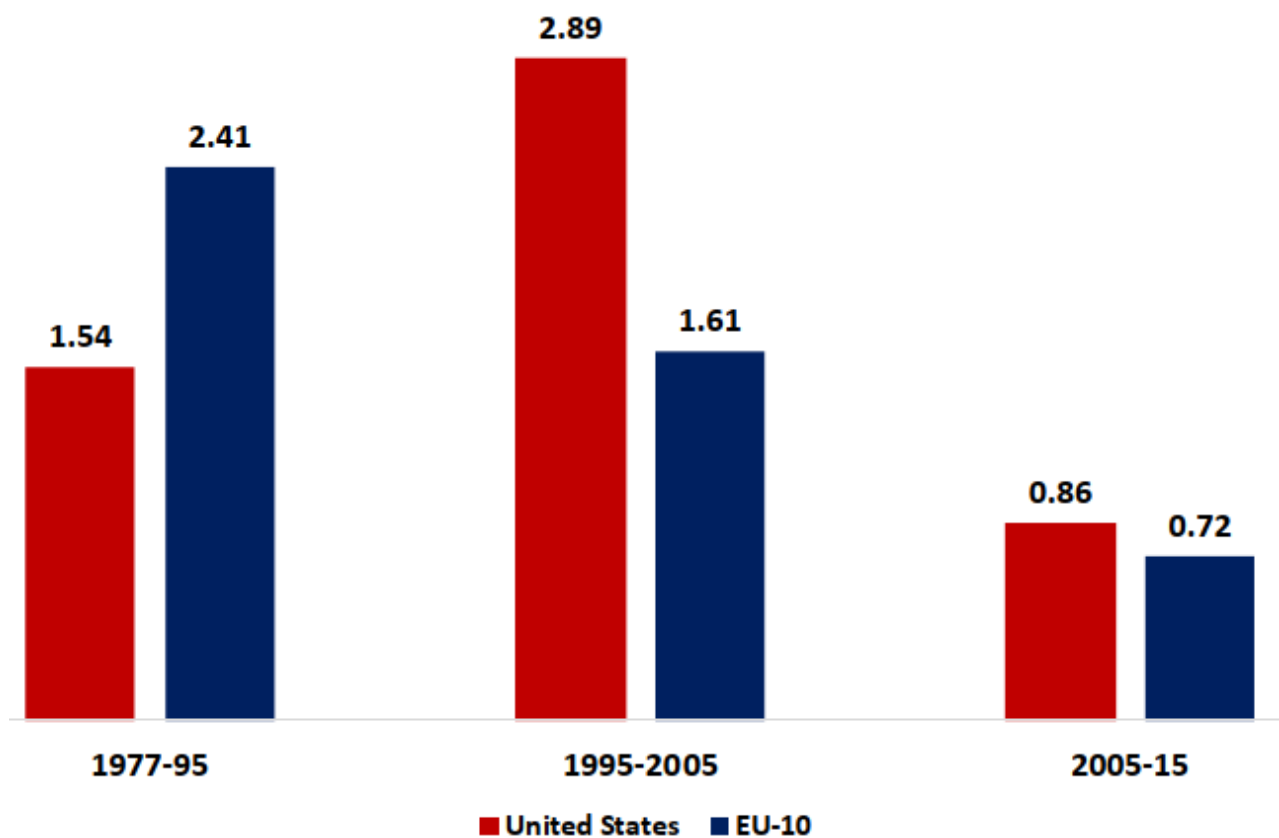
Growth in information-communications technology (ICT) during the mid-1990s to the mid-2000s — marked by the arrival of web services like Google and Amazon, as well as the integration of the internet and information systems into workplaces — is often lauded as signalling a new era of economic growth. Indeed, the benefits of this ‘ICT revolution’ are readily seen in labour productivity statistics for the US, where the average annual rate of productivity growth in the private market economy almost doubled from 1.54% per year during 1977-95 to 2.89% during 1995-2005.

Since the technology of the ICT revolution was diffused with a short lag around the world, we would have expected a similar acceleration of productivity growth in Western European nations as they adopted the same workplace computer hardware, software, and internet services. Moreover, with continued innovation in personal and mobile computing, especially with the introduction of tablets and smartphones, we would also have expected the buoyant 1995-2005 performance of US productivity growth to continue on both sides of the Atlantic well into the 2010s.

And yet we do not observe in the data these two phenomena — neither a post-1995 productivity growth acceleration in Europe nor rapid post-2005 growth on either side of the Atlantic. Figure 1 shows labour productivity growth data for the US and for an aggregate of 10 Western European nations (the ‘EU10’) broken into three time intervals (1977-95, 1995-2005, and 2005-15). US productivity growth is displayed in red; that of the EU10 in blue. Far from enjoying a post-1995 acceleration to match the US, EU10 growth slowed down both after 1995 and again after 2005. Moreover, after 2005 the US

productivity growth advantage over Europe was almost completely wiped out, with the US growth rate dropping precipitously to little more than half of its already slow pre-1995 growth performance.

Figure 1 Market sector productivity growth, US vs EU10, 1977-2015



This historical record presents us with two puzzles:

- Why did US productivity growth accelerate so much during 1995-2005 before crashing down after 2005 to below its pre-1995 rate?
- Why did Western Europe fail to benefit from ICT adoption when it had available the same new technologies that were adopted by the US?

These puzzles form the core questions of our recent paper (Gordon and Sayed 2020). As in our previous work (Gordon and Sayed 2019), we answer these questions by studying industry-level KLEMS data for the US and EU10 to pinpoint industries responsible for accelerations and slowdowns in productivity growth.

The answer to the first part of our puzzle — the temporary nature of the US productivity growth revival — lies in our interpretation of the ICT revolution as a temporary technology shock. The economy continuously benefits from temporary shocks — improvements in management techniques and equipment design that boost productive capacity from one level to another, thus temporarily raising the growth rate of productivity. These temporary shocks contrast with persistent technology shocks that continuously alter techniques and design, yielding a permanent change in the rate of

productivity growth. In our view, the failure of the growth benefits of ICT adoption for the US to persist after 2005 warrants the verdict that this shock, however large, was temporary. This view of ICT as a ‘temporary shock’ is also shared by Fernald (2015).

Most of our paper is dedicated to addressing the second question: why did Western Europe fail to reap the benefits of this temporary ICT shock? To sort out the sectors of the economy most responsible for the transatlantic difference in performance, we take the 27 industries in our dataset and divide them up into three groups based on the role of ICT:

- The first is ‘ICT-producing industries’, including software development, telecom, and electronics manufacturing industries, all of which engage in producing or developing ICT.
- The second is ‘ICT-use industries’, which are the top half of our industries ranked by the extent of their investment in ICT.
- The third residual group consists of ‘non-ICT industries’.

We can also partition our industries into ‘commodities-producing industries’ — comprising sectors like agriculture, manufacturing and construction — and ‘services-producing industries’ — which include the remaining industries, for instance the wholesale and retail trade, finance, administrative, and transportation sectors.

Combining the three ICT groupings with the commodities/services distinction yields six industry categories for us to analyse.

In Figure 2 we show the contributions of these six categories to the change between 1977-1995 and 1995-2005 in productivity growth in the US and EU10. Contributions are calculated by taking the change in productivity growth in each industry and weighting it by its share in the value added of its category. Thus while some industries might have particularly rapid or slow growth, this would have little influence on the performance of an overall category if that industry’s value-added share is small.

Figure 2 Contribution to post-1995 changes in productivity growth, US vs EU10

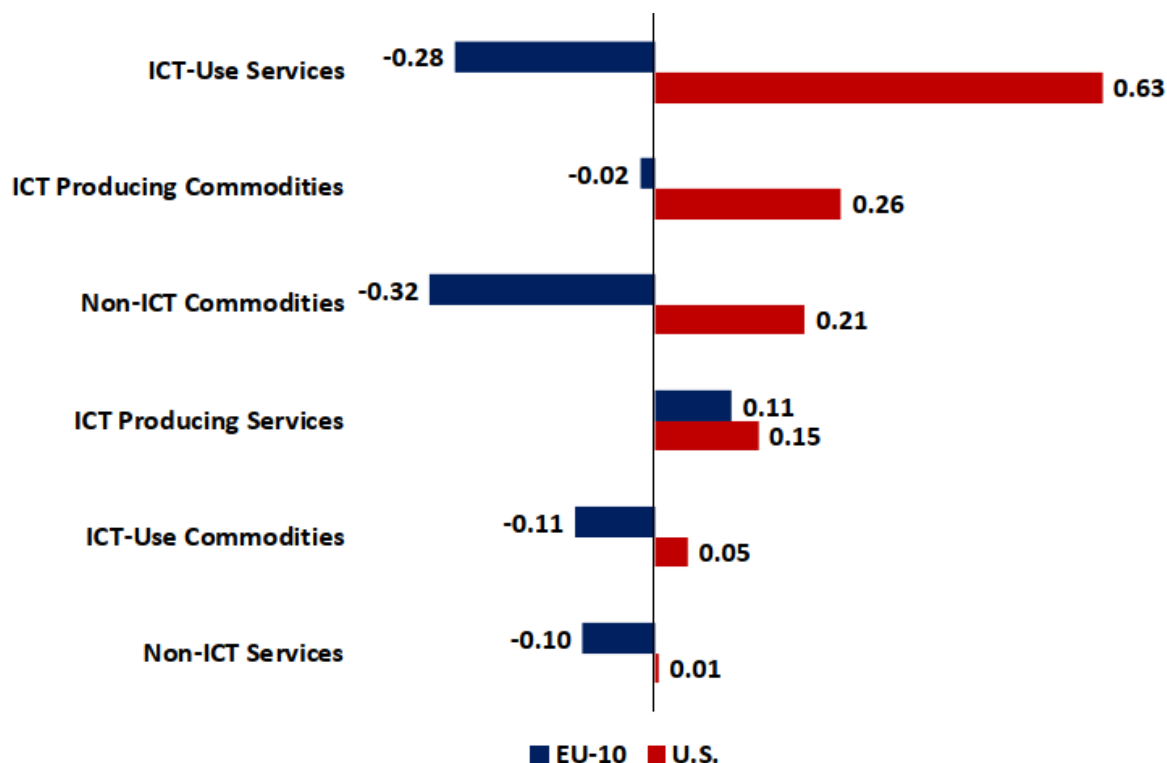


Figure 2 ranks the six categories in decreasing order by their contribution to the post-1995 US productivity revival. ICT-using services industries account for nearly half of the surge in US productivity growth, while non-ICT services (the bottom bar) make no contribution. ICT-using services industries most notably include wholesale and retail trade industries that benefitted in the US from barcode scanning, computerised inventory management, and the transition to the ‘big box’ retail format. European trade industries were handicapped in capturing the benefits of ICT due to small inner-city retail locations and land-use restrictions that prevented ‘big box’ expansion in suburban and exurban locations.

The second bar in Figure 2 shows that the next largest contributor to the post-1995 US acceleration is the ICT-producing commodities category that produces ICT hardware. Despite accounting for only 3% of market economy value-added, electronics manufacturing made a big contribution as its productivity growth accelerated after 1995 by over 7 percentage points. The late 1990s were a period of rapid innovation and price decline in the production of semiconductor chips as the pace of Moore’s Law (that the number of transistors embedded in a computer chip doubles every two years) temporarily accelerated. The same industry in Europe experienced much slower productivity growth and no post-1995 acceleration, indicating that European producers were unable to reap the benefits of this wave of semiconductor innovation.

The third set of bars indicates that non-ICT commodities industries in the U.S. make a substantial to the post-1995 US growth. This is due in part to the 6+ percentage point acceleration of the petroleum industry in the US, and indeed we find no statistically significant evidence to suggest that most industries in the non-ICT commodities group helped drive the US growth resurgence. This qualifies the frequent assertion in the literature that the ICT revolution was entirely responsible for the post-1995 US growth

revival. On the flip side, non-ICT-using commodities industries in Europe are, along with ICT-using services, the main culprits of the post-1995 deceleration in European growth.

The fourth set of bars, ‘ICT-producing services’, includes the information and communications/telecoms sector. These industries both make similar positive contributions to productivity growth changes in the US and EU10, recording high productivity growth that rode on the growing demand for internet and mobile services. Thus, while Europe did not match the US performance in producing computer hardware, it matched the US in achieving rapid productivity growth in developing software and other ICT services. This category is the only set of industries that exhibits similar behaviour in the US and the EU10

The second-to-last set of bars suggests that only 0.04 points of the U.S. growth acceleration were attributable to ICT-using commodities, confirming that the US gains from ICT were mostly concentrated in services. Thus the channels by which ICT contributed to the overall US productivity growth revival are to be found in the workplace of services —inventory and employee management, Internet communications, and data analysis — rather than in the manufacturing plants or construction sites that characterise commodities production (with the notable exception of ICT hardware production itself).

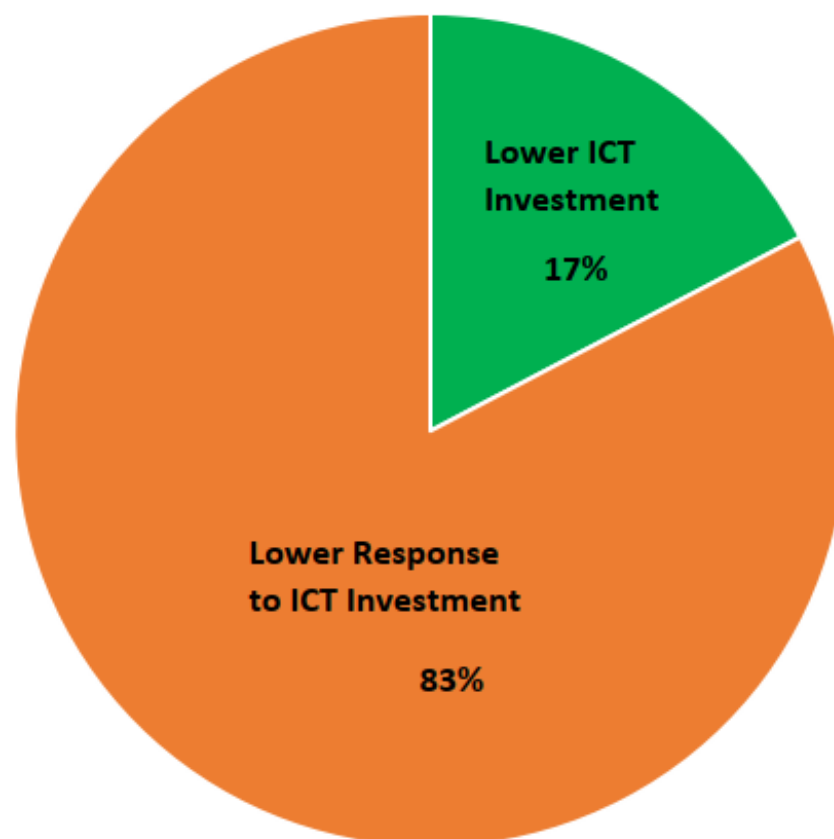
In Europe, ICT does appear to have helped in a modest way. The ICT-using commodities group contributed 0.11 points of the aggregate EU10 slowdown, which is much smaller than the 0.32 points attributed to the non-ICT commodities group. This may suggest a slight buoying effect of ICT investment in European commodities production — growth still decelerated, but it would’ve been far worse had these industries failed to invest in ICT. In contrast to ICT use in commodities, which helped moderate the EU10 productivity growth slowdown, ICT use in services did not help much at all, given the large -0.28 point contribution of the ICT-using services group.

Up until this point, we have marked an industry as ‘ICT-using’ if it has above-median investment in ICT. But underlying this discrete indicator is a continuous variable that measures the quantity of ICT investment itself. We find that US industries on average have higher ICT investment, so the concept of ‘above average’ is fundamentally different on the two sides of the Atlantic. By stripping away the discrete ICT-use indicator, we can ask the question: did the EU10 fail to reap the productivity benefits of ICT because it did not invest enough in ICT, or because the EU10’s fundamental response to ICT investment was lower?”

As shown in Figure 3, we find that differences in raw ICT investment explain under 20% of the difference between the US and EU10 productivity growth rates during 1995-2005. That is, if EU10 industries had poured as much investment into ICT as did the corresponding US industries, this would only explain 0.2 percentage points of the nearly 1.3 percentage point gap between aggregate US and EU10 productivity growth during 1995-2005 recorded in Figure 1 above. This suggests that some deeper,

structural forces prevented Western Europe from reaping the benefits of the ICT investment that did occur. Possible causes include the flexibility of labour markets, competitive environments, and the lack of a truly integrated EU marketplace that prevented particular industries from operating at the scale obtained in the US.

Figure 3 Share of transatlantic productivity gap due to level of ICT investment and response to ICT investment



Our paper answers some outstanding puzzles regarding transatlantic differences in productivity growth. We suggest:

- The ICT revolution was a technological shock that we brand as temporary due to its failure to maintain rapid US productivity growth after 2005.
- The 1995-2005 US revival of productivity growth was entirely achieved by the electronics manufacturing industry and ICT-using services.
- The failure of the EU10 to reap the benefits of ICT was due more to a structural lack of response to the ICT investment that did occur rather than to a sheer absence of ICT investment itself.

Further research at the level of individual industries is needed to flesh out our suggestions of the causes of the EU10's lack of response to ICT investment, including structural barriers to the growth of modern retailing and insufficient market size to reap economies of scale inherent in ICT adoption.

References

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Topics: Productivity and Innovation

Tags: ICT revolution, productivity growth, US productivity, transatlantic productivity gap

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