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ICT AND PRODUCTIVITY IN THE SECOND HALF OF THE 1990S: WHAT WAS THE DIFFERENCE BETWEEN THE US AND THE EURO AREA – AND WHY?

The acceleration in US labour productivity in the second half of the 1990s has by now almost become a stylised fact. Most studies examining this fact focus on the non-farm business sector, where output per hour worked between 1995 and 2000 grew at an average annual rate that was clearly higher than in any earlier such time-span since the 1970s. The consensus seems to be that this had to do with the large-scale emergence of new information and communication technologies (ICT). And there also seems to be widespread consensus that the productivity boost from ICT was much less pronounced in the euro area.[2] The focus here is on developments in a specific period, but it will be interesting to see to what extent the consensus survived the past economic downturn and how matters proceed in the current recovery.

It is not appealing but strictly necessary to start the discussion with the caveat that productivity comparisons across economies are especially fraught with both measurement and methodology problems. The issue of differences in price measurement and in the statistical recording of software, for instance, features prominently in the productivity debate. Moreover, whether productivity is measured per person or hours worked, and whether its developments are compared over full business cycles rather than just the second half of the 1990s affects the results. The caveats suggest considerable caution when comparing across countries the actual numbers for productivity growth in the second half of the 1990s. At the same time, they do not upset the finding that within the individual economies, however measured, productivity decelerated in the euro area while it accelerated in the US. It is these different directions that are discussed below.

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2. See, for instance, the proceedings from the "Symposium on New technologies and Monetary Policy", held at the Banque de France in November 2001.

When discussing the impact of ICT on productivity it is useful to distinguish the question *what* happened from *why* it happened. What happened is mostly explained in the context of conventional growth accounting exercises where ICT affects labour productivity via capital deepening and changes in total factor productivity. Capital deepening is associated with the accumulation of investment goods and therefore essentially the *use* of ICT. Total factor productivity is a catch-all for technological and organisational improvements. It captures the technical progress in the *production* of ICT, plus the positive spillovers or externalities to the economy as a whole that may derive from the use of ICT as a so-called general-purpose technology. In practice, it mostly also includes any quality changes in the labour and capital employed.

So what do growth accounting exercises tell us? Research by the US Federal Reserve System – and others – suggests that the acceleration in US labour productivity in the second half of the 1990s reflects developments in industries that produce ICT and those that actually use it.[3] Industries that did neither the one nor the other made no visible contribution to the productivity acceleration, which raises some doubt about positive spillovers. As for the euro area, our own research for the second half of the 1990s suggests that productivity per person employed accelerated only in the ICT producing industries while it decelerated somewhat in the remainder of the manufacturing and business services sectors.[4] This implies that, as in the case of the US, there was no clear evidence of positive spillovers from ICT.

From an accounting perspective, there are thus two causes for aggregate labour productivity in the euro area not to accelerate in response to ICT, while it did in the US. First, the euro area missed an acceleration of productivity in ICT user industries – despite signs for the economy as a whole that the stock of ICT capital grew increasingly more quickly than hours worked. Second, the contribution from accelerating productivity in ICT producing industries was not strong enough to compensate for the subdued performance in other industries. Nevertheless, it is important to note that ICT *did* have a discernible impact on aggregate euro area labour productivity – just that the impact was weaker than in the US and much too weak to offset the impact of factors that decelerated aggregate productivity via lower growth in total factor productivity.

What can we say about the underlying reasons why the production and use of ICT in the euro area apparently did not have a similarly strong impact on aggregate productivity as in the US? An important factor was that in the mid-1990s the share of the ICT-producing

3. See for instance Oliner, S.D. and Sichel, D.E., "Information Technology and Productivity: Where are we now and where are we going?", Federal Reserve Bank of Atlanta, *Economic Review*, Third Quarter 2003, pages 15-44. Stiroh, K.J. "Investing in Information Technology: Productivity Payoffs for US Industries?", Federal Reserve Bank of New York, *Current Issue*s, June 2001, pages 1-6.

4. See Vijselaar, F. and Albers, R., "New technologies and productivity growth in the euro area", European Central Bank Working Paper No.122, February 2002.

manufacturing industries in the total economy was already much larger in the US than in the euro area. The worldwide technical progress in these industries thus translated into higher contributions to aggregate productivity gains than in the euro area. With Silicon Valley almost a synonym for ICT, the US industries set global standards and benefited disproportionately from the self-enhancing innovations in the field of ICT. The euro area hosts leading manufacturers of semi-conductors and mobile phones, and it also witnessed strong innovations in the ICT-producing services industries such as telecoms, but the overall scale of ICT production is clearly lower than in the US.

Both the innovation and the use of ICT depend on the regulatory practices that affect the general functioning of the economy. In this respect, rigidities in product and labour markets may have inhibited businesses in the euro area from fully exploiting the opportunities provided by the new technologies. As regards product markets, progress has been made in the regulatory reform of network industries and a large part of ICT investment in the second half of the 1990s accrued to these industries. But there remains much scope for further product market reforms and for lowering entry and exit barriers. This could give rise to a higher degree of start-ups and experimentation, which may be essential for the adoption and diffusion of new technologies. As regards labour markets, the euro area is still characterised by a relatively high degree of employment protection. If the use of ICT is biased towards higher-skilled labour, barriers for businesses to adjust their workforce accordingly may prevent them from implementing and efficiently using new technologies, and from creating the new jobs that come with them.

No doubt, the factors determining the relationship between ICT and productivity in the second half of the 1990s will partly remain a black box. But what is clear is that the productivity performance in the euro area reflects more than a lack-of-ICT story. What is needed is a competitive and flexible business environment as an independent contribution to higher growth in total factor productivity. The jury is still out on the question whether the rapid growth of aggregate productivity in the US can be sustained, but the surprising resilience during the recent recession has provided additional support to all those believing that the mid-1990s actually constitute a structural break. Whether the euro area eventually sees a similar development is a different question. It may be that the US simply started earlier to accumulate a critical mass of ICT capital, facilitated by favourable institutional conditions. With the necessary structural reforms the developments in the euro area could thus follow those in the US with some delay. However, it is precisely the black box nature and the uncertainty implied by these questions that is relevant for policymaking.

Productivity growth and monetary policy: what is the link – and was it visible?

The productivity acceleration in the US in the second half of the 1990s raised two types of questions for monetary policymakers. The first is related to the implications that a perma-

nently higher rate of growth in productivity and potential output has for monetary policy, and the second whether this calls for a new monetary policy. In answering these questions recourse is often made to theoretical *steady state* considerations, while a full answer explicitly needs to take into account that monetary policy operates in *real time* and under *uncertainty*.

Starting with theory, classical economics postulate that an economy which experiences a higher productivity growth will – in the long-run equilibrium or steady state – also show a higher return on capital. In addition, the equilibrium real interest rate, which is determined by the equilibrium between savings and investment, will follow the rise in the return on capital. A permanently higher trend rate of productivity growth would thus tend to be associated with a higher equilibrium real interest rate. In the long-run, monetary policy is neutral and thus cannot affect the equilibrium real interest rate. Other things equal – and in particular with inflation evolving at rates consistent with price stability – this implies that, in a regime characterised by permanently higher productivity growth, the central bank needs to ensure that nominal short-term interest rates are at the (higher) level consistent with this new equilibrium. It goes without saying that such policy involves a clear view about the level of the real equilibrium interest rate. In this respect one should also take into account that in a world of international capital mobility the long-run real interest rate, would tend to be influenced by worldwide conditions of productivity growth.

While the long-run effects of a permanent increase in productivity growth are rather unambiguous, the short-run effects are unfortunately not. This is – among other things – due to the fact that in the transition period the appropriate path of policy rates critically hinges on the relative strength and timing of supply and demand effects. If demand and supply effects emerge at the same time and are of the same magnitude, actual and potential output accelerate simultaneously. Other things equal, monetary policy would essentially need to increase short-term rates along the path of the increase in the equilibrium real interest rate brought about by the permanent increase in potential growth. If supply effects were to dominate in the short-run, e.g. because consumers smooth their expenditure or credit-market imperfections constrain them to borrow against (higher) future expected income, the central bank could keep interest rates lower than the path determined by the equilibrium real interest rate for some time as long as potential GDP temporarily expands more rapidly than demand.

In practice, the uncertainty regarding statistical constructs like the real equilibrium interest rate, the natural rate of unemployment or the growth in potential output can, at least at times, be quite considerable. This is aggravated by the fact that the new regime can easily render existing models of the transmission mechanism unreliable. In such a situation, giving more weight to new incoming data, and reacting in an activist or even hectic manner involves a clear risk since economic data are notoriously volatile, are easily affected by a variety of special factors and often subject to major revisions, so that some time usually

passes before longer-term trends become clear. In other words: the fog the central banker is facing will be considerably denser than at normal times.[5]

In such an environment of increased uncertainty, monetary decision-making calls for great caution and any kind of mechanistic reactions should be avoided, even more as the information content of some indicators will be affected and might deteriorate. All indicators should be analysed carefully, investigated against the background of possible structural breaks in historical relationships and, on this basis, cross-checked for their information regarding future price developments. This touches not only upon the issue of monetary policy decision-making but also, more widely, upon the issue of the monetary policy strategy.

The selection of a strategy is of great importance for a central bank, because it represents both a structure for the filtering and processing of information as well as a guide for external communication with the public. The ECB's monetary policy strategy was designed to ensure that in the assessment of risks to price stability no relevant information would be lost and that appropriate attention would be paid to different analytical perspectives. Its two-pillar approach is a way of conveying to the public the notion of a diversified analysis and of ensuring robust decision-making in an environment characterised by high uncertainty.[6] The inflation process can be broadly decomposed into two components, one associated with the interplay between demand and supply factors at a high frequency, and the other connected to more drawn-out and persistent trends. The latter component is empirically closely associated with the medium-term trend growth of money. Against this background of its strategy, the Governing Council of the ECB always carefully assesses incoming data, taking into account different interpretations.

In the past, the Governing Council assessed potential changes in trend productivity growth and the possibility of a "new economy" in the context of the reference value for monetary growth. The conclusion in December 2001 was that there is no decisive evidence of measurable and lasting increases in productivity growth in the euro area that would warrant an upward revision to trend potential growth.[7] The Governing Council therefore opted in favour of a rather cautious attitude and, with the benefit of hindsight, was correct to do so – thus avoiding a possible policy mistake. Against this background, for the euro area the ans-

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5. See Issing, O., "Monetary Policy in a World of Uncertainty", *Économie internationale* 92, 2002.
6. See European Central Bank, "The two pillars of the ECB`s monetary policy strategy", *Monthly Bulletin*, November 2000 and European Central Bank, "The outcome of the ECB`s evaluation of its monetary policy strategy", *Monthly Bulletin*, May 2003.
7. See ECB Press Release from 6 December 2001. "*... The Governing Council believes that the potential upward impact on trend output growth from structural reforms and technological innovation could be large. However, while some progress has been made in the field of structural reform, significant further steps – especially in the labour and goods markets – need to be taken in order to achieve a permanent and significant increase in potential output growth in the euro area. Against this background, the Governing Council will continue to monitor the evidence with regard to developments in productivity growth in the euro area, and the ECB's monetary policy will take such evidence into account as appropriate.*"

wer as to whether there is a need for a new monetary policy is a simple no. Quite the opposite. The ECB's monetary policy strategy has demonstrated its reliability and robustness also in the context of the "new economy" debate.

O. I.[8]

8. I would like to thank Dieter Gerdesmeier and Thomas Westermann for their valuable contribution.