Changing Patterns and Determinants of Growth

Thomas Andersson*[1]

The concept of a "new economy" gained enormous attention in the late 1990s with the US boom which, late in the business cycle, occurred with a virtual absence of inflationary pressure and at levels of unemployment far below what used to be viewed as compatible with price stability. US monetary policy adjusted to a partly new set of conditions. More recently, the concept has taken on rather different connotations as the value of technology stocks has crumbled along with a general economic downturn. What then was the new economy concept built on, and is it of any lasting relevance?

In terms of macroeconomic performance, the US surge of the 1990s was truly spectacular. The duration of the boom outlasted any previous experience, and unemployment fell to about 4 percent without giving rise to inflationary pressures. Although it had already attained the highest productivity levels in most respects, the United States further increased its gap to most other countries. There were signs of dynamism elsewhere as well. Central banks around the world sensed the presence of change in micro-macro relationships and there was talk of an enhanced potential for long-term growth. However, there never was evidence of any general uptake in productivity growth. Of course, growth may now be more difficult to measure, e.g. as the service sector has become more prominent and because of rapid quality improvements and shifts towards new products. The fact remains that, as far as we can measure, irrespective of whether one controls for the cycle or not, only about a fourth of the OECD countries displayed higher growth rates in the 1990s on average than they did in the previous decades. The US belonged to this group, but its record was actually only marginally better than it had been in the 1980s.

The concept of a "new economy" was in any case doomed from the start. What is "new" today will be "old" tomorrow, and what could be viewed as "new" in the first place appears a *philosophical* rather than an *economic* question.[2] What does matter is to what extent, and in which respects, significant changes are occurring in the fundamentals of growth, and what these entail for individual countries. This applies not least to the EU, which belongs to the most advanced economic regions of the world but has experienced generally sluggish growth for decades. Partly building on recent work at the OECD (OECD, 2001a; OECD, 2001b), this article offers some reflections on these issues.

Are significant changes recurring in the fundamentals of growth?

Patterns of growth

An examination of growth performance in OECD countries, and how it has evolved in recent years, indicates that two types of major changes are indeed taking place. One is in the area of growth patterns. Since World War II, countries at initially lower income levels have generally been observed to grow faster, i.e. they are "catching up" through learning effects and the transfer of technologies from those countries that are leading the race (Fagerberg, 1994). Broadly speaking, however, the spread of growth rates in GDP increased across the OECD in the 1990s, as some of the leaders surged further ahead. Within the EU the trend was more varied, with growth picking up in several small, fairly advanced countries, notably Denmark,

* Thomas Andersson is senior advisor to "The Swedish Agency for Innovation Systems" (VINNOVA) and "The Swedish Institute for Growth Policy Studies" (ITPS), and a professor (adjunct) at the Stockholm School of Economics. He previously was Deputy Director for Science, Technology and Industry, OECD.

[1] The author is grateful to Dirk Pilat of the OECD, for assistance with examination of data.

[2] This was a focal point already for some of the earliest Greek philosophers. Thales (545 BC.) believed that everything emanates from an essential substance (water) which never changes; it simply takes on new shapes. Herakleitos (540–480 BC.), on the other hand, perceived the world as being in a state of constant flux.

Ireland, the Netherlands and Norway, while slowing in France, Germany and Italy. Towards the end of the decade, Finland, Iceland and Sweden also experienced a revival in growth.

With respect to the composition of growth, it is true that traditional considerations such as labour utilisation – and unemployment – remained important in the 1990s. In the United States, the number of persons employed grew by 1.3% a year over the 1990s, a level matched only by the Netherlands and Ireland among the countries in the EU. Whether countries grew rapidly or not, however, the largest part of growth in per capita income came from higher labour productivity, which depends on capital deepening, i.e. the services provided by capital to each worker, and on multi-factor productivity (MFP).[3] Capital deepening played a significant role in the 1990s, but occurred in a limited number of sectors. Despite measurement problems, MFP stood out as the most important determinant of labour productivity growth. This was increasingly so towards the end of the decade, and precisely in that rather small group of countries whose performance rose markedly from already high productivity levels.

Higher labour productivity growth due primarily to MFP and use of ICT

ICT in growth

The other significant change concerns the factors in growth. It has long been recognised that traditional investment and labour input could explain only a minor part of the overall variation in growth rates. Solow (1957) lumped together the remaining factors in a residual referred to as "technical progress", viewed by many as a black box of undefined, exogenously determined factors. While some studies showed the importance of better measurement of the various inputs of growth (Jorgenson and Griliches, 1967), and other work, such as the "new growth theory" (Romer, 1990) explicitly sought to unravel endogenously determined processes, the problem of capturing the fundamental determinants of growth has remained, and in some respects has become even more difficult to solve. Psacharoulos (1994) found that a sizeable share of cross-country variation in growth performance over the last decades could be put down to education. In the 1990s, however, several studies (Barro and Lee, 1996; Nehru et al., 1995) cast doubt on the robustness of this relationship.

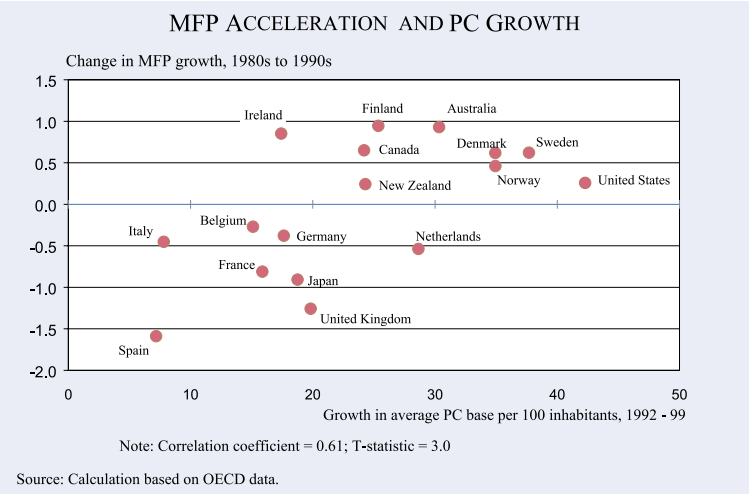
Solow's remarks in the 1970s that information and communications technology (ICT) seemed observable "everywhere except in the productivity statistics" might thus not have been surprising. In recent years, however, the focus on the evasive influence of ICT was replaced by a conviction that it played a major role in an acceleration of US productivity growth which gave rise both to higher employment and lower inflation. New data and methodologies suggested that the impacts came not only out of production, but from the use of ICT as well (Ohliner and Sichel, 2000; Whelan, 2000). Meanwhile, a first cross-country examination controlling for differences in measurement methodologies (Schreyer, 2000), found an increasing impact of ICT investment on output growth during the 1990s in all G7 countries. In Canada, the United Kingdom and the United States, ICT equipment was responsible for about half of the entire growth contribution of fixed capital during 1990–96. In France, Germany and Japan, the effect was smaller, but remained significant. The fast pace of ICT investment brought widespread substitution for other kinds of investment, implying a rise in the marginal returns to other production factors. On the other hand, and although evidence from several countries indicates that the underlying productivity growth has remained strong in the subsequent downturn, there can be no doubt that, in retrospect, some of that investment in ICT turned out not to be well spent.

There has been much discussion about whether the impacts of ICT are on a par with what was observed in earlier "technological revolutions", such as those of the railways or electricity. Kranzberg (1985) noted that the development of new technology is always evolutionary in the sense that its point of departure is existing technology. A technological "revolution" is characterised by a series of complementary innovations accompanied by processes of social and institutional adaptation. David (1990) and Freeman and Perez (1990) argued that, in the past, such revolutions were characterised by stepwise developments in which productivity growth remained low for many decades – generally half a century or more – before taking off. ICT may be viewed as fitting this pattern, since partial impacts have been observed for decades whereas an up-take in overall productivity

[3] Multi-factor productivity (MFP) can broadly be defined as the overall efficiency with which labour and capital are employed in the economy, see further OECD (2000a).

growth was identified only in the late 1990s. For various reasons, ICT may gradually come to exert a more rapidly accumulating impact than what has been seen in connection with new technologies in the past. There has clearly been an unprecedented fall in prices and increases in quality. Also, ICT is diffused with greater speed, particularly through the Internet, creating a potential for rapid network growth with associated externalities. Effects may become visible once certain thresholds of use have been passed. On the other hand, sceptics (Gordon, 2000) argue that ICT and the Internet have little content of their own and merely replace other technologies.

Figure 1



Note: Correlation coefficient = 0.61; T-statistic = 3.0

Source: Calculation based on OECD data.

Complementary factors

While ICT appears to have a potential for significant reduction of transaction costs in markets and bottlenecks in economies, this impact may not be readily available. Above all, some aspects, such as the Internet and electronic commerce, are still in their infancy. Internationally agreed and transparent regulatory conditions need to be put in place and be implemented in order to enable secure transactions and well-functioning markets.[4] Apart from such direct influences, the effect of ICT so far has been interrelated with the structural changes in labour markets which took place notably in the US but to a varying extent elsewhere as well. Likewise, regulatory reforms in financial and product markets, along with globalisation, increased competition, pushed restructuring and put downward pressure on prices. This occurred in most OECD countries, including in the EU, but more so in some than in others.

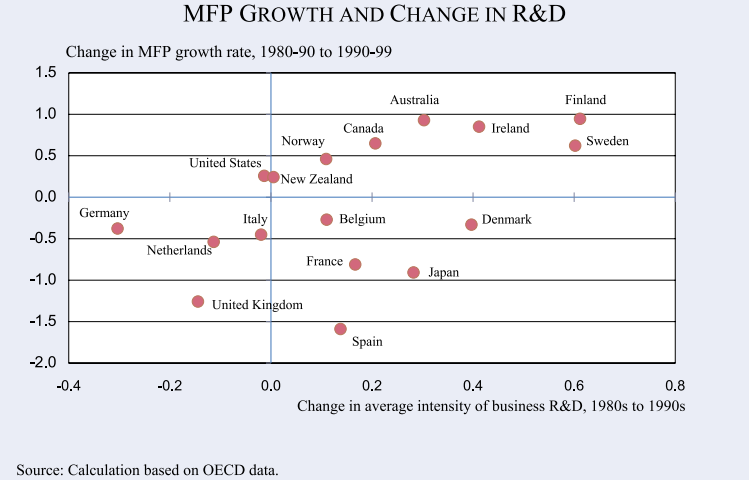
Innovation and technological change more broadly must further be taken into account. The selective acceleration of MFP in the 1990s provides indications of what has occurred. Examining the correlation between the growth in MFP and that in the PC base across countries for the 1990s, as illustrated in Figure 1, a strongly significant relationship emerges. Countries found high up along the vertical axis include both those with large ICT-producing sectors, such as Finland and the United States, and those with almost no such production, notably Australia. As illustrated by Figure 2, however, there is a positive relationship also between R&D and MFP growth.[5] Furthermore, rather than aggregate R&D, it is important to consider innovation, and how different elements interact in shaping innovative capacity. Noteworthy changes are under

Innovation and technological change push up MFP

[4] See, e.g., OECD guidelines for cryptography, for security of information systems, and for consumer protection.

[5] The relationship is statistically significant for various measures of R&D – including stocks, intensities and growth rates – and MFP (cf. Bassanini et al., 2000).

Figure 2



Source: Calculation based on OECD data.

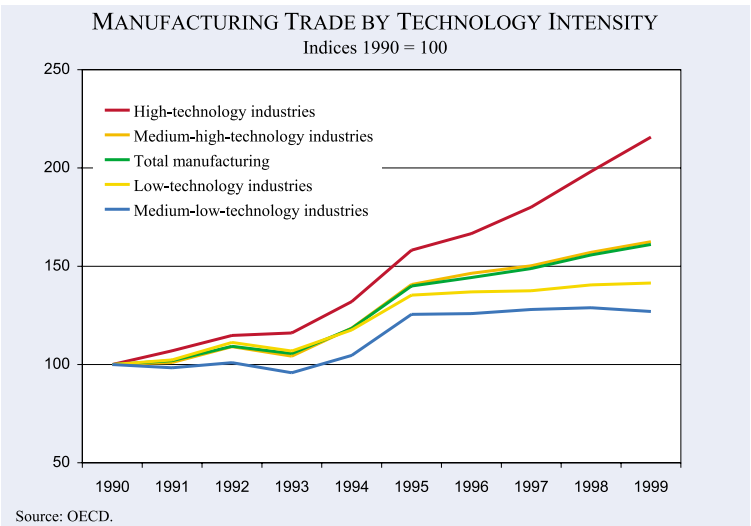
way in the composition and funding of R&D, and in the linkages to innovation (Guellec and van Pottelsberghe, 2000). In the United States, the public research sector, and particularly universities, have played a major role in the overall surge in patenting – one indicator of the output of innovation. On the other hand, with the improved means of communication, the linkages from research through to marketing have evolved in both directions, providing a potential for more market-driven innovation processes, including in services (OECD, 2001d).

Meanwhile, education and skills remain essential. De la Fuente and Dmenech (2000) argue that the impact of human capital on economic growth probably has risen over time, but that understanding its role requires a better handle on the linkages to technical progress. Firm-level studies have found evidence of complementarity between technological change and human capital accumulation (Brynjolfsson et al., 1998). A number of surveys point to far-reaching organisational change within firms and workplaces in the 1990s towards flatter hierarchical structures, greater responsibility for individual workers, multiple tasks and stronger incentives for innovation, flexibility and on-the-job training. Such organisational change can serve as a crucial complement to R&D, ICT or investment in training (Black and Lynch, 2000; Bresnahan et al., 1999). With the key assets increasingly becoming intangible, however, appropriate evaluation and disclosure along with conditions that allow for effective risk-taking become essential. The provision of venture capital, which typically is superior to bank lending in funding new business and new growth areas, increased strongly in almost all OECD countries in the late 1990s, but the US market has the greatest depth and accumulated experience. Also, many countries retain severe barriers to entry and exit of firms, and to entrepreneurship, locking resources into existing operations.

Human capital accumulation, organisational change and venture capital are additional growth factors

While capturing the benefits from the new growth factors thus will depend on a number of areas, a break down of trade, industry, or production statistics underscores that fundamental changes are under way. As seen in Figure 3, there has been a consistent expansion of the share of high-technology products in international manufacturing trade. An examination of industrial trends in the OECD area shows that those industries which are intensive in their use of technology and human skills have consistently increased their share of overall value added and production over the last decades (OECD, 2001c). Meanwhile, services –notably high-value-added services – are rapidly increasing their share of the economy. There seems to be less and less room to make a living out of specialisation based on low cost, and standardised production. While these trends were evident for quite some time before the pick-up of MFP-growth, the latter appears to have resulted where the most effective application of the new growth factors was taking place in the 1990s. The proliferation of knowledge and technology seems certain to remain with us beyond the short-term swings of the cycle, and the ability to respond to the opportunities as well as the challenges that it brings is likely to become increasingly essential.

Figure 3



Source: OECD.

The EU position

Monetary and budgetary policies undoubtedly go some way to explain the performance of the US in the late 1990s, which now might be seen as a classic example of a ”bubble economy” (Cooper et al., 1999). There were substantial macroeconomic imbalances in the form of an expanding current account deficit, negative savings and the build-up of foreign positions in US securities and equities which fuelled ”rocketing asset

prices". However, the wealth creation in equity markets, especially in technology sectors, explains neither the level and exceptional duration of the US productivity record, nor can it help explain the varying performances of other economies such as Australia, the Nordic region, or in continental Europe.

ICT is one area where the United States clearly holds the leading position. The Table shows a compelling US lead over the EU (and Japan) in most respects, although mobile users are an exception. One aspect – which is not easily measured – concerns the extent to which firms adopt ICT in a proactive and strategic way. There are indications that European firms are less aware of the need for a formal e-commerce strategy (PFA Research, 1999), as reflected in the absence of any correlation between use of the Internet and the adoption of a formal e-commerce strategy by European firms. In fact, there appears to be a slightly negative correlation between the rate of Internet adoption and the firm's perception that e-commerce plays a strategic role in their company. With the exception of the Nordic countries, and on the basis of a restricted sample, firms in European countries such as the Netherlands, Spain and the United Kingdom have been found to view electronic commerce as of relatively low strategic importance (OECD, 2001b).

While Europe lags behind the United States, the overall situation masks great variation. Those EU countries that are less advanced in ICT, i.e. Greece, Italy and Spain, have recently undertaken heavy investment in business-to-business electronic commerce, and show signs of catching up. The Nordic countries and the United Kingdom are advanced in regard to PC penetration, number of Internet hosts per inhabitant or use of the Internet for commerce.[6] The penetration of mobile users, which exceeds two-thirds of the population in the Nordic region, is widely viewed as providing the EU with an edge in the start-up of mobile commerce. Related areas in which the EU may also enjoy an advantage *vis-à-vis* the United States include digital TV and methods for more secure communication, e.g. smart cards or the use of mobile telephones for identification. However, the development of the third generation of mobile networks, gradually under way, will exert a major impact on the preconditions for mobile commerce. Technologies, as well as institutions and regulatory conditions, are changing fast, and the scope for genuine competition will be decisive for the ability of producers and service providers to respond. Europe is still plagued by rather severe segmentation in terms of national markets, limiting genuine competition on a wider basis. The reliance on prepaid users in most of the EU raises challenges with respect to applying effective price strategies for 3G mobile services and, unless there is an increase in competition, the required innovation may be slow in coming. The EU has already forfeited the lead in roaming, with costs coming down more quickly in North America than in Europe, and there are signs that US operators have become more active than European ones in developing new solutions for bringing down the price of Internet access via wireless. Further, the wave of auctioning access to third-generation networks on a national basis in the EU amounted to a substantial tax on future investment in this area, which tapped the supply of risky investment by turning it into public rents and raised the already high risks confronted by the industry.

Europe could reap advantages, but genuine competition is limited

These are merely a few illustrations of the prevailing mixture

Indicators of e-commerce readiness: Japan, Europe, United States

	Japan	European Union	United States
Internet hosts per 1 000 inhabitants Oct 2000	32.6	37.4	234.2
Secure servers per million inhabitants July 2001	62.8	65.3	315
Installed PC base per 100 inhabitants 1999	25	23	65
PCs per 100 white collar workers 1999	43	36	98
Employees using e-commerce enabling technologies 1999 (percentage)	60	49[a)]	65
ICT expenditure/GDP (percentage) 1999	8.0	6.4	7.9
ICT in business sector R&D (percentage) 1999	31	19	22
Cellular mobile subscribers (percentage) 1999	45	40	30

[a)] Average of France, Germany, Italy, and the United Kingdom.

Source: (2000i) and OECD Telecommunications database 2000. Host data from the Internet Software Consortium; secure Web servers data from Netcraft.

[6] See European Commission (1999) for detailed cross-country comparisons.

of opportunities and obstacles in the EU. In terms of actual performance, it is particularly the larger continental European countries that now appear stagnant, whereas several of the small relatively advanced EU states have demonstrated new signs of dynamism, indicating that size need not be the issue. But while the EU still belongs to the most advanced and dynamic regions in many respects, a number of barriers continue to hamper restructuring, risk-taking and new products or businesses.[7] With the new growth factors, the potential for global reach is bigger than ever, but so are the costs of rigidities and compartmentalisation. There is no doubt a remaining challenge for the European Commission as well as for the individual European Member states to progress in a more consistent and mutually reinforcing manner. There is a need of a more comprehensive strategy encompassing the key policy areas which together impinge on the incentives for capturing the benefits of the new growth factors, as was envisioned at the *Lisbon Summit*. As part of this, policy makers need to ensure – and publicly demonstrate – that ICT brings with it reduced prices, new services and skills upgrading, and that the benefits are spread broadly throughout society. This has to include addressing the social consequences that arise when some firms, and some jobs, are downgraded or destroyed by rapid technological and organisational change, while others prosper and new ones are born. It will be increasingly important, however, not to address these concerns in a way that compromises the incentives and options to learn, invest and innovate.

The EU must design strategies for capturing the benefits of the new growth factors

References

Andersson, T. (2001), Seizing the Opportunities of a New Economy: Challenges for the European Union, No. 8, OECD Growth Project: Background Papers 1, Paris, 2001.

Barro, R. and Lee, J.W. (1996), "International Measures, of Schooling Years and Schooling Quality", *American Economic Review Papers and Proceedings*, 86, 2, pp. 218–23.

Bassanini, A., Scarpetta, S., and Visco, I. (2000), Knowledge, Technology and Economic Growth: Recent Evidence from OECD Countries, mimeo, OECD, Paris.

http://www.oecd.org/media/release/NBB29May.pdf

Black, S., and Lynch, L.M. (2000), "What's Driving the New Economy: The Benefits of Workplace Innovation", *NBER Working Paper*, No. 7479, January.

Bresnahan T.F., Brynjolfsson E., and Hitt, L.M. (1999), "Information Technology, Workplace Organization and the Demand for Skilled Labor: Firm-Level Evidence", *NBER Working Paper*, No. 7136, May.

Brynjolfsson, E., Hitt, L., and Yang, S. (1998), "Intangible Assets: How the Interaction of Information Systems and Organisational Structure Affects Stock Market Valuations", forthcoming in the Proceedings of the International Conference on Information Systems, Helsinki.

Commission of *European Communities (1999), European Information Technology Observatory 99*, Brussels.

Cooper, J., Dimitrov, O., and Rau, R. (1999), A Rose.com by Any Other Name, mimeo, Purdue University.

Council of Economic Advisors (2000), *Economic Report of the President*, United States Government Printing Office.

David, P.A. (1990), "The Dynamo and the Computer: A Historical Perspective on the Modern Productivity Paradox", *American Economic Review*, 80.

de la Fuente, A., and Dmenech, R. (2000), Human Capital in Growth Regressions: How much Difference Does Data Quality Make? mimeo, Universidad de Valencia.

Fagerberg, J. (1994), »Technology and international differences in growth rates«, *Journal of Economic Literature*, September.

Freeman, C., and Perez, C. (1990), "The Diffusion of Technical Innovations and Changes of Techno-economic Paradigm", in Arcangeli et al. (eds.), *The Diffusion of New Technologies, Vol 3: Technology Diffusion and Economic Growth: International and National Policy Perspectives*, Oxford University Press, New York.

Gordon, R.J. (2000), Does the "New Economy" Measure up to the Great Inventions of the Past", NBER Working Paper No. W7833, August.

Guellec D., and van Pottelsberghe, B. (2000), "Public and Private R&D", *STI Working Paper*, 2000/4, Paris.

OECD (2000a), "Economic Growth in the OECD Area: Recent Trends at the Aggregate and Sectoral Level", *OECD Economics Department Working Papers*, Paris.

OECD (2000b), *OECD Small Medium Enterprise Outlook*, Paris.

OECD (2000c), *OECD Information Technology Outlook 2000*, Paris.

OECD (2001a), *The new Economy: Beyond the hype, OECD*, Paris.

OECD (2001b), *Science, Technology and Industry Outlook, Drivers of Growth: Information Technology, Innovation and Entrepreneurship*, OECD, Paris.

OECD (2001c), *OECD Science, Technology and Industry Scoreboard 2001*, Paris.

OECD (2001d), *Innovation and Productivity in Services*, OECD, Paris.

Oliner, S. D., and Sichel, D.E. (2000), *The Resurgence of Growth in the late 1990s: Is Information Technology the Story*, Federal Reserve Board, Washington.

PFA Research (1999), Bodmin.

Nehru, V., Swanson, E., and Dubey, A. (1995), "A New Database on Human Capital Stocks in Developing and Industrialised Countries: Sources, Methodology and Results", *Journal of Development Economics*, 46, pp. 379–401.

Psacharoulos, G. (1994), "Returns to Investment in Education: A global update", *World Development*, 22, 9, pp. 1325–1343.

Romer, P. M. (1990), "Endogenous Technological Change", *Journal of Political Economy*, 98, Supplement, pp. 71–102.

Solow, R.M. (1957), Technical Change and the Aggregate Production Function, *Review of Economics and Statistics*, vol. 39, pp. 312-320, August.

Schreyer, P. (2000), "The Impact of Information and Communication Technology on Output Growth", *OECD STI Working Paper* 2000/2.

Whelan, K. (2000), Computers, Obsolescence and Productivity, Federal Reserve Board, February, mimeo.

[7] See Andersson (2001) for a discussion of issues and the direction of remedial measures as regards market segmentation, science-industry linkages, ICT infrastructure and services, labour markets and skills, financial markets, venture capital and entrepreneurship.