PRODUCTIVITY, TECHNOLOGY AND GROWTH: A MATTER OF INVESTMENT?

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Introduction

Most honoured *Rector Magnificus*, Ladies and Gentlemen:

"The Renewal of the Old Economy". That was the title of an article that I wrote last year on the economic growth of ten Western countries in the light of the revolution in information and communication technology.[2] The title was a variation on many others dealing with the same topic: "The New Economy: a Familiar Face"; "The New Economy: Old Ideas Parading as New Ones", to mention just a couple that colleagues of mine have written.[3] We economists knew what was going on: the new economy was all hype, and it'd settle after a while. We'd write about it, but not be swept away by it.

It was a wise decision. We had barely had enough time to put down our pens before it became apparent that the "seven fat years" were coming to an end. The growth within the United States has slowed down considerably, and the predictions for Europe and the Netherlands are continually being adjusted downwards. "The New Economy is Dead", the January headlines in the US again screamed, and while the Wall Street rates plummeted, the overenthusiastic investor in technology funds was figuring out how to survive the slump. As economists, we felt a sense of vindication. It was what we'd been saying all along: we're living within the same sort of economy we've always had, and we're going to have to use the old and imperfect policy instruments to keep the train on the rails.

Despite this, we have to make sure that we are not too hasty about throwing away with the bath water of slowing growth, the baby that the new economy has given birth to. The effects of information and communication technologies (ICT, as it is commonly called) on economic

[1] I am very grateful to Inge van Ark, Marcel Timmer and Bart Los for their comments on previous versions of this lecture. Of course I remain solely responsible for its content. The Dutch version of this lecture is available from the following website: http://www.eco.rug.nl/MEDEWERK/Ark/ark.htm
[2] B. van Ark (2000a), De vernieuwing van de oude economie: Nederland in een internationaal vergelijkend perspectief, in L. Soete, red., *ICT en de nieuwe economie*, Preadviezen van de Koninklijke Vereniging voor de Staatshuishoudkunde 2000, pp. 21-59.
[3] E.J. Bartelsman (2000), De nieuwe economie: een oude bekende, oratie uitgesproken aan de Vrije Universiteit te Amsterdam, 21 September; S. Brakman and A. van Witteloostuijn, Jonge wijn in oude zakken; op weg naar een nieuwe economie?, Arbeiderspers, to be published.

growth has been three-fold. In the first place, the ICT revolution has led to greater *investment* in computers. Indeed a slowing down of the rate of growth means that many "new economy" firms that had a place under the sun of a buoyant economy are now loosing out. Other firms are forced to take an investment pause. could have a decided effect on investment in computers. But as I see it, the other two effects of ICT have little to do with short term slowing of growth. The second effect is that computers can lead to a greater productivity within those branches of the industry that *produce* computers. At first sight, this would seem to have little relevance for the European situation, since the computer industry here is much smaller than in the United States. The Intel's, the IBM's and the Microsoft's are primarily American, and their contribution to the accelerated growth in productivity in the United States is enormous. However, as long as ICT products are produced at prices that are increasingly becoming lower, we can, as European net importers of such products continue to benefit. I am, however, more interested in the third effect, and this is also my topic today: whether those areas of business that *make use of* computers are actually providing the growth in productivity that we are all hoping for. With the phrase "those who make use of computers" I am not only referring to electronics or the machine industry, but particularly to those large and growing sectors of industry that fall within the service sectors: financial and business service providers, for example. But this may also include the health sector, education and government services. Taken as a whole, within most of the OECD countries, these sectors account for more than 50% of the Gross Domestic Product. In the United States we see an improvement of labour productivity in these industries as well – even though more moderate than in computer producing industries. But in many European countries – and the Netherlands in particular – the growth of labour productivity in ICT-using industries has been extraordinarily poor.[4]

For the time being the productivity gap between Europe and the United States only increases. In 1995 labour productivity in the European Union was still at more than 87 per cent of the American level. By 2000 this had declined to about 82 per cent. Indeed the growth of labour productivity in the European Union has fallen from 2.4 per cent during the first half of the 1990s to 1.2 per cent during the second half.[5] Europe risks – what I call – a low labour productivity growth path. And that in these times of the new economy!

[4] See B. van Ark (2000a), *op cit.*
[5] The Conference Board (2001), *Performance 2000: Productivity, Employment, and Income in the World's Economies*, New York.

The main question in this lecture therefore is whether Europe – and the Netherlands in particular – fully utilizes the growth potential of new technologies, such as ICT. This question is important as in these days the necessity for investment is a topic much discussed and written about. I shall argue that it is indeed necessary to invest in order to let the old economy fully benefit from the new economy. This requires a broad-based conception of investment; one in which we ought not to look just at *physical investment* in terms of machinery, buildings and infrastructure, but also *intangible investment* in education, in knowledge, in organisations, and perhaps even in social capital. But just more is not necessarily better. New investment, especially in the area of intangible capital, needs to bring more productivity growth as well. Otherwise we run the risk of exhausting the possibilities of promoting economic growth in the long term. That in turn threatens not only the standard of living of the current generation but also that of future generations.

Background to Concepts and Methods

Before I deal further with the opportunities for and threats to economic growth in the Netherlands and elsewhere in Europe, I am going to have to make you listen to brief explanations relating to several important concepts; namely, productivity, investment, and technology. I will also briefly discuss the methodology by which these terms can analysed comprehensively. I shall try to keep it short and to the point, and so I will have to simplify things somewhat.

As a child, I learned more about investment than about consuming – perhaps even more about investment than about productivity. That investment is important is something we learn at an extremely early age. You need to invest in learning how to walk, in learning to talk, and in learning to ride a bike. At a certain stage you have to invest in an education, invest in a house. The one thing that characterises investment is that it requires you to give up some of today's pleasures in order to be better off in the future. In economic terms, the concept of investment comes with the same proviso: you have to save if you want to invest, and if you want to save, you have to forego the pleasure of consumption. Investment now leads to returns in the future.

It is important to realise that the measure of *labour productivity*, just mentioned, can increase merely through an increase in investment. After all, the amount of productivity per hour of work can be increased by simply using more machines. Labour productivity is an important

performance measure because it is closely related to the rise in the income per head of the population. Income may rise either through an increase in labour productivity or through a rise in the number of workers relative to the total population – that is, labour force participation. A significant part of GDP growth during the second half of the 1990s in the European is due to a strong recovery in the growth of employment – not because of a rise in labour productivity.

In the economics literature a somewhat narrower productivity concept is often used. It is only when production increases faster than the increase in the entire input (both labour and capital) that one can speak of a rise in *total factor productivity*. One problem is that total factor productivity cannot be observed in the real world, but has to be measured within a growth accounting framework. First the contributions of investment are deducted from total output growth. The growth that remains is then interpreted as productivity growth. Productivity therefore is a residual. The contributions of investment are computed on the basis of some important assumptions, such as full mobility of labour and capital, no structural shortages of high-skilled labour and internationally free access to technology. Under these assumptions the concept of *productivity* will immediately take on a fairly precise meaning. It is that part of the return on the investment that the private investor *cannot* claim as his or her own.[6] An example is investment in research and development. R&D will lead to new products and processes which – once developed –others can make use of without having to go to a great deal of effort or cost. What we then have is a "spillover" or an "externality".

As the assumptions just mentioned are mostly not fulfilled in practice, the productivity residual has to be interpreted somewhat broader than only spillovers. In 1957, Robert Solow, a Nobel Prize winner and one of the founding fathers of the growth accounting approach, interpreted the residual in terms of "technological change", an approach that much of the standard economics literature still takes for granted.[7] A rather more dramatic description of the residual was provided by Moses Abramovitz in 1956: he named it as being merely a "measure of our ignorance".[8]

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[6] See, for example, D.W.Jorgenson (1995), *Productivity*. Volumes 1 and 2, MIT Press, Cambridge MA.

[7] R.M. Solow (1957), Technical Change and the Aggregate Production Function, *Review of Economics and Statistics*, vol. 39, pp. 312-330

[8] M. Abramovitz (1956), Resource and Output Trends in the United States since 1870, *The American Economic Review*, vol. 46, no. 2, pp. 5-23.

Both descriptions of the productivity residual have, in the meantime, been made obsolete. During the sixties and seventies considerably more substance was given to what the productivity residual actually consists of. It is not only a matter of technological change. Edward Denison, an American economist, has measured factors such as the effect of economies of scale as a consequence of having a larger domestic market or more international trade.[9] He also calculated the effect on productivity of a shift in labour away from less productive agricultural sector towards the more productive industrial sector.[10]

Arnold Harberger speaks in his work of productivity growth as real cost reductions which are realized in 1001 different ways, in different industries and even in different firms.[11] Harberger's approach is a step towards productivity studies of individual companies, and it has practical implications for firm strategies. Moreover when using Harberger's terminology it is easier to understand what it means when total factor productivity growth stagnates: the real cost reductions are then less or even decline.

Angus Maddison, emeritus professor at this university, extended growth accounting studies further into the area of international comparisons.[12] From his work it became apparent that the increased pace of productivity in Europe during the first two decades after the Second World War was partly a consequence of the benefit derived from technologies developed in the United States being relatively easily applied to the European situation. This was thus a genuine spillover effect, as it was previously described.

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[9] E.F. Denison (1962), The Sources of Economic Growth in the United States and the Alternatives Before Us*, CED Supplementary Paper No. 13*, Committee for Economic Development, New York; Denison, E.F. (1967), *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, The Brookings Institutions, Washington; E.F. Denison (1974), *Accounting for United States Economic Growth: 1929-1969*, The Brookings Institutions, Washington; E.F. Denison (1979), *Accounting for Slower Growth: The United States in the 1970s*, The Brookings Institutions, Washington.

[10] During the eighties and nineties attempts have also been undertaken to measure the impact of imperfect competition on the productivity residual by way of price-markup measures. See, R.E. Hall (1986), Market Structure and Macroeconomic Fluctuations. Brookings Papers on Economic Activity, No. 2, pp. 285-322; W. Roeger (1995), Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing, Journal of Political Economy, pp. 316-330.

[11] A.C. Harberger (1998), A Vision of the Growth Process, *American Economic Review*, vol 88, no. 1.

[12] A. Maddison (1972), Explaining Economic Growth, *Banca Nazionale del Lavoro Quarterly Review*, September; A. Maddison (1982), *Phases of Capitalist Development*, Oxford University Press; A. Maddison (1991), *Dynamic Forces in Capitalist Development*, Oxford University Press; A. Maddison (1996), Macroeconomic Accounts for European Countries, in: B. van Ark and N.F.R. Crafts, eds., *Quantitative Aspects of Post-War European Economic Growth*, CEPR/Cambridge University Press, pp. 28-83.

In his work, Maddison paid considerable attention to those sources of growth that are connected to historical occurrences such as wars, major changes in economic policies or the effects of significant technological advances. This approach thus opened the way to a more historical and institutional approach towards accounting for economic growth. For example, it enables the effect on productivity of the present ICT revolution, to be compared with the effects of earlier technological revolutions such as the introduction of the steam engine at the end of the 18th century and electricity at the end of the 19th century. In a recent paper I wrote together with Jan Pieter Smits and Herman de Jong, we showed that as far as effect on productivity is concerned, the first industrial revolution largely bypassed the Dutch economy.[13] The reasons for this were in all probability insufficient economies of scale and a shortage of impulses to develop entrepreneurial activity in the Netherlands during the 19th century. It was only at the end of the century that we witnessed a considerable increase in the effect of the steam engine on investment. The second technological revolution – the introduction of electricity – had a far greater effect on economic developments within the Netherlands. The growth in total factor productivity between 1913 and 1929 was an average of 2.4 percent per annum (compare this with, for example, the growth since 1973, which has not been any greater than 1.5 percent).

Analyses of this type give, on the one hand, rise to the hypothesis that the present ICT revolution will not show its effects on productivity for another couple of decades at the very least.[14] On the other hand, they also show that technological advances do not lead to a rapid acceleration in the growth of productivity as a matter of course. Institutional factors such as the functioning of markets, as well as innovation behaviour and ways in which social and organisational networks function, can also play a role in the success or failure of new technology.

Just as growth in productivity involves more than technological change, technological change has wider implications than productivity. Technological change includes not only

[13] J.P Smits, H.J. de Jong and B. van Ark (1999), Three Phases of Dutch Economic Growth and Technological Change, 1815-1997, *Research Memorandum GD-42*, Groningen Growth and Development Centre.

[14] See also P.A. David (1990), The Dynamo and the Computers: A Historical Perspective on the Modern Productivity Paradox, *American Economic Review, AEA Papers and Proceedings 1990*, pp. 355-361; P.A. David (2001), Understanding Digital Technology's Evolution and the Path of Measured Productivity Growth: Present and Future in the Mirror of the Past, in E. Brynjolfsson and B. Kahin, eds., *Understanding the Digital Economy. Data, Tools, and Research*, MIT Press, Cambridge MA.

improvements in products and the processes, but also the increase in the quality of tangible and intangible capital.[15] Technological change does not only have spillover benefits, therefore. It is not merely the manna that falls from the heaven, as in Moses' desert as well as the desert of growth theories of the fifties and sixties. It requires investment, in a word, and more particularly, that sort of investment that will improve the quality of tangible and intangible capital.

I think it would make sense, before we put ourselves to even greater trouble of working out how to interpret the productivity residual – to given a broader empirical meaning to what investments consist of. In this way the growth accounting approach can be connected again with insights that arose from the new growth theory during the eighties and nineties. After all investments in human capital and knowledge emerged from these approaches as key explanatory factors for differences in economic performance.

Physical Capital and the Role of ICT

Having described what I mean by investment and productivity, now is perhaps a good time to briefly describe some of the components of investment. I shall try to illustrate the importance and the role of investment at the hand of several examples mainly involving the effects of information and communication technology on growth.

Despite the increased importance of intangible capital (I will return to this later), investment in machines, buildings and infrastructure are still *the* basis for economic growth. It is also a great misunderstanding to think that the present physical investments are mainly in computers and ICT. In 1998, ICT could only account for roughly 10% of the total investments in the Netherlands, though it must be said that this percentage represents a doubling of the percentage since the mid eighties.[16] As well as this, ICT's actual share of the investment market – that is, after correction for the rapid drops in price of ICT goods – is increasing rapidly.

[15] P. Stoneman (1995), *Handbook of the Economics of Innovation and Technological Change*, Blackwell, p. 2
[16] CBS (2000), ICT Markt in Nederland 1995-1998, Voorburg.

The old economy therefore still dominates economic activity. I myself am a product of the old economy in many regards. My grandfather was a baker, and my father was the managing director of a biscuit factory. When you visualise the new economy, this line of business is not the first thing that comes to mind. A year ago, I was able to pay the company my first visit in a long time, and during the guided factory tour, I revisited that familiar section where biscuits are still being baked in the same ovens as in my youth. The packaging department had, however, undergone great changes. Where I used to be paid a guilder an hour to pack the biscuits into little plastic trays and put the trays onto a conveyor belt, after which a machine covered the tray with cellophane, there was now a super-modern robot-directed packaging machine doing all that diligent work. My oldest brother, who is still the director of the parent company, will certainly have agreed with those estimations that the robot could generate profits big enough to cover the opportunity costs – that is, the costs involved if he had not made any changes to the old system. After all, I am no longer available for a guilder per hour. But the main point to be made here is that my brother, and so many other biscuit manufacturers, have been investing in ICT for years, though at a macroeconomic level we have not necessarily noticed the growth in productivity. What these entrepreneurs do is take advantage of rapid price drops and the expected large profits made possible by the robot to replace technologically obsolete machines.

In 1987, Bob Solow, who I have already mentioned, formulated the productivity paradox in the following words: "you see computers everywhere except in the statistics".[17] This was not quite right.[18] You could see the computers, and in the statistics too, but only if you looked at them carefully. However, many of the investments have been to replace other capital goods that sometimes – but not by definition – may well have been able to produce growth in productivity.[19]

The euphoria in recent years surrounding the new economy in the United States was, however, understandable, because during the middle of the nineties or thereabouts, there was an *acceleration* in the growth of labour productivity of about 1 percentage point annually. Half of this acceleration was a consequence of increased investment, but the other half could

[17] R. Solow (1987), We'd Better Watch Out, *New York Times*, Book Review Section, July 12, p.36.
[18] J.E. Triplett (1999), The Solow productivity paradox: what do computers do to productivity?, *Canadian Journal of Economics*, 32/2, pp. 309-334.

be ascribed to more rapid growth in the total factor productivity. ICT was of crucial importance there.[20]

Can we expect ICT to have a greater effect on productivity in the coming years in Europe as well? The answer is both yes and no; no, because the edge the United States has over Europe is partly the consequence of the presence of a much larger *ICT producing* industry (relatively less biscuit production; relatively more chips). Europe is not going to be able to catch up, or at least, not in this area of technology.

I do, however, have to give more weight to my "yes" as answer to the question, and for two reasons. In the first place, research that I did last year shows that Europe is not far behind the United States when it comes to the contribution that computer *services* pay to the total production.[21] It is Holland in particular that has been witness to a considerable acceleration in the growth of productivity in computer services and in telecommunication.[22] This strengthens the possibilities to also generate more productivity growth with large ICT-using industries in the services sector. As far as expenditure and investment in ICT is concerned, Holland is in the leading group, immediately behind the United States and the Scandinavian countries. There is a strong ICT infrastructure, and Dutch businesses have good access to venture capital.[23]

There is no doubt that ICT has the potential to be made use of in more productive ways in Europe, though this potential has clearly been realised less here than in the United States. One reason is that ICT investments aside, it is going to be necessary to make also other – intangible – investments in order to renew the old economy.

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[19] D.W. Jorgenson and K.J. Stiroh (1999), Information Technology and Growth, *American Economic Review, AEA Papers and Proceedings 1999*, pp. 109-115.
[20] D.W. Jorgenson and K.J. Stiroh (2000), Raising the Speed Limit: U.S. Economic Growth in the Information Age, *Brookings Papers on Economic Activity*, Vol. 2.
[21] Zie B. van Ark (2000a), *op cit.*
[22] B. van Ark (2000b) De productiviteitsparadox in Nederland in de jaren negentig, *Economische en Statistische Berichten*, 1 December.
[23] OECD (2000a), *A New Economy? The Changing Role of Innovation and Information Technology in Growth*, Paris; UNICE (2001), The reNEWed Economy. Business for a dynamic Europe, Brussels.

Human Capital

As far back as the fifties, a fair amount of effort was being put into extending the concept of investment into the area of intangible capital in particular in the United States. The work of John Kendrick is of specific importance in this respect.[24] In the Netherlands, a fair amount of work in this field has been done by Bert Minne of the Netherlands Bureau for Economic Policy Analysis.[25] By extending his estimates for the start of the nineties, I have been able to calculate that in 1999, about 90 billion Dutch Guilders were spent on education, research and development, software, licences and market research, which is about 11 per cent of the Gross Domestic Product. This equals roughly half of the physical investments, but are not as such identified in the national accounts.[26]

Public expenditure on education and training make up about one third of the intangible investment: about 33 billion guilders in 1999. But how much does this contribute to economic growth, and how do we measure it in a growth accounting framework? The general impression is that the effect of education in growth accounts – but also according to other methods – has been lower than one would have expected *a priori*.

There is no doubt that it is a more complicated matter than evaluating physical investments. In the first place, expenditures on education are something else than investment in human capital. Except for reasons that have to do with economic growth, there are other more consumption-oriented reasons for investing in education. We do, after all, find it important that when our children go to school, they learn at least something about art and culture, they do sport, and so on. We also hope the school contributed to the social infrastructure of our society. If we take a broad wealth concept such expenditure need not immediately be seen as useless, but a positive effect on productivity in the short term should not be anticipated.

[24] J.W. Kendrick (1976), *The Formation and Stocks of Total Capital*, NBER, General Series 100, New York. J.W. Kendrick (1994), Total Capital and Economic Growth, *Atlantic Economic Journal*, Vol. 22
[25] Minne, B. (1995), Onderzoek, ontwikkeling en andere immateriele investeringen in Nederland, *Research Memorandum No. 116*, Centraal Planbureau, Den Haag.
[26] B. van Ark and J. de Haan (2000) Productivity, Income and Technological Change in the Netherlands: Causes and Explanations of Divergent trends, in B. van Ark, S.K. Kuipers and G.H. Kuper, red. *Productivity, Technology and Economic Growth*, Kluwer Academic Press, Boston.

Secondly, there is a data problem. The returns on investments in human capital are determined on the basis of the differences in wages between employees at various educational levels – for example, university, college, etc.. It is of course questionable whether the observed wage differences reflect the differences in quality delivered by workers with different education. Moreover aside from public investments, there is also a considerable amount of private investment in education, particularly by the business sector. Statistics relating to this are not complete, because of the large amount of so-called informal training that takes place at the workplace itself. Studies comparing individual firms can provide important insights. Keeping within my own family tradition, at the end of the eighties, I and researchers at the National Institute in London did some research into comparing (you guessed it) biscuit factories in the Netherlands, England and Germany. In general, the Netherlands shaped up well: the big emphasis on full-time day education made it easier for those who had lower technical levels of education to be placed within various lines of trade and business, and made it easier to facilitate structural changes to the economy.[27] The level of educational training of those working within the service sector in the Netherlands appeared also relatively high.[28]

Refining the growth accounting system with the aid of better data will help to pick up these effects, or at least partially. But this will not help for the third problem associated with the growth contribution of human capital. As well as the direct effect of investment in human capital, there can also be important indirect effects on production growth: after all, better trained employees also make it possible to invest in better machines and greater know-how. These so-called complementaries simply *cannot* be reflected in growth accounts. The importance of human capital for economic growth is therefore probably underestimated.

In recent work that I did with Jakob de Haan, we showed that the average educational level of workers in the Netherlands has risen by about 80% since 1960. In a growth accounting framework this meant about a 20% contribution to the increase in labour productivity.[29] By using techniques that at least partly take account of the indirect effects as well, one finds contributions of education to growth which are up to three times as high. But those

[27] G. Mason, B. van Ark and K. Wagner (1994), Productivity, Product Quality and Workforce Skills: Food Processing in Four European Countries, *National Institute Economic Review*, January, pp. 62-83.
[28] B. van Ark and J. de Haan (2000), *op cit.*
[29] B. van Ark and J. de Haan (2000), *op cit.*

techniques, based on regression analysis, are restricted in their own way, however, and these restrictions are often at least as serious than those of growth accounting itself.[30] As I see it, the most meaningful strategy for getting on top of the complementaries effect would be combining growth accounting with regression analysis. The growth accounting results would then in effect represent a lower level of the effects of human capital on growth.

Before continuing my journey through investment land, I cannot resist the temptation to briefly address the issue of the demand for more financial resources to be put into education in the Netherlands. In spite of the fact that expenditure on education in the past five years has risen by about 5 billion guilders, as a percentage of the national income, that expenditure has dropped from about 6% of the national income to about 4% in 2000 – considerably below the European average of about 5.5%. In particular, capital investment in education, especially in buildings, has dropped in relative terms. Combined with the low provisions for general maintenance, it is highly conceivable that in this regard, the production capacity of education is decreasing in absolute terms.

Nevertheless, in placing more resources at the disposal of education, the productivity of the sector itself has to be taken into account. During the nineties, labour productivity within the Dutch education sector rose by less than 1% per year. This does not take into account that there may have been an improvement in the quality of education. At macro level, such adjustment for quality of education has to be made, by lack of better data, on the basis of testscore results of pupils, such as the qualification tests and exam results.[31] Indeed recent research shows that there is a strong positive relation between economic growth and cognitive abilities, in particular in the areas of math and sciences but –according to other studies – also with literacy skills.[32] Understandably, the educational sector itself is critical of measuring the quality of education on the basis of mere cognitive results. Research should be focussed on finding adjustments for differences between schools in terms of the well-being of pupils and the creation of social capital – a topic I will briefly return to later.

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[30] J. Temple (1999), Growth Effects of Education and Social Capital in the OECD Countries, *Economics Department Working Papers*, No. 263, OECD, Paris.
[31] Eurostat (1998), Final Report of the Task Force "Prices and Volumes for Education", Luxembourg, September.
[32] E.A. Hanushek andD.D. Kimko (2000) Schooling, Labor-Force Quality, and the Growth of Nations, American Economic Review, Vol. 90, No. 5, pp. 1184-1208; OECD (1998), *Human Capital Investment. An International Comparison*, Paris.

Productivity improvements in the educational sector – which does not only take account of quantity but also at quality – has important consequences for the creation of human capital in the long term. Such improvements are realised by investing in better educational material or in ICT as supporting the learning process. But it is also important to allocate the new investments to those areas where these are used most productively. That requires a more flexible funding system in education by which good schools and schools that are not so good can be distinguished. There should also be a bigger role for rewards to teachers on the basis of competencies. Such measures are imminent because the effects of an improvement in educational productivity and quality take a long time to materialise. Moreover the investment path in human capital is more difficult to change than for physical capital. After all, technologically obsolete machines and buildings can be scrapped prematurely, but this is not so easy to do with people that have been given the wrong sort of training. A wrongly trained workforce is as least as bad as an untrained workforce.

Knowledge Capital, Organisational Capital and Social Capital

By definition, human capital is embodied in labour. This is a different thing to knowledge capital. Knowledge capital is usually approximated by the expenditure by business and government on research and development. The problem is that the return on R&D capital cannot be directly measured. Recent research that uses the stock market value of firms to estimate the returns on R&D seems to be one of the most promising approaches to tackle this problem.[33] Moreover it is difficult to estimate how large the spillovers – the "real" productivity effects, so to say – of R&D exactly are.

It is clear however that knowledge capital has also many characteristics of a private good. Following the emergence of a general purpose technology (which information and communication technology is an example of), a stream of both major and minor improvements to products and the processes is prompted. The robot in the biscuit factory is only one example of the range of 1001 cost reduction which Harberger speaks of. The returns on those improvement are a regular part of physical investments in new capital goods.

[33] Z. Griliches (1979), Issues in Assessing the Contribution of Research and Development to Productivity Growth, *Bell Journal of Economics*, Vol. 10, No. 1, pp. 92-166; B.H. Hall (1999), Innovation and Market Value, *Working Paper 6984*, NBER, Cambridge MA..

If we change the emphasis towards the private aspect of knowledge capital, we will see that this has certain similarities with the fourth concept of capital; namely, organisational capital. In practice, organisational changes play an important role in the process of creating knowledge particularly in the service sector. Although the importance of investments in computers and software strongly increased, new products in the service sector are not mainly created through investment in machinery and buildings. It is often due to a new way by which the service is produced or a change in the characteristics of a particular service. Think for example of the introduction of supermarkets at petrol stations; a door-to-door public transport concept; or the endless range of new financial products which we are bothered with every evening around dinner time. To measure these investments, expenditure on research and developments need to be replaced by expenditure on "soft" innovations: for example, expenditure on design or market research.[34]

ICT also has important implications for complementary investment in organisational capital. Danish research done in 1996 showed that the growth in productivity brought about by ICT is four or five times greater if it also involves changes in work-floor methods than if it does not. Norwegian research has shown that the returns on physical capital are 50% higher if the investment in ICT is accompanied by a complete ICT strategy within the particular organisation.[35] A recent American study of 800 businesses stated that the overall expenditure on non-material capital that businesses have to make when ICT is introduced is at least ten times greater than the expenditure on ICT itself.[36] If we were to extrapolate that conclusion to the Dutch situation, it would mean that the establishment of an ICT capital goods stock to the value of 10 to 11 billion guilders would be accompanied by a an additional rise in the intangible capital stock of more than 100 billion; that is, 12% of our national income.

It may be becoming clear that the further we depart from concepts of investment where the costs and returns are difficult to measure, the results look increasingly more spectacular when we attempt to aggregate the findings from firm studies to the macroeconomic level. In relation

[34] B. van Ark, L. Broersma and G. de Jong (1999), Innovation in Services. Overview of Data Sources and Analytical Structures, Research Memorandum GD-44, Groningen Growth and Development Centre, University of Groningen; P. den Hertog and R. Bilderbeek 1999, Conceptualising Service Innovation and Service Innovation Patterns, DIALOGIC, Utrecht.
[35] UNICE (2001), *op cit.*
[36] E. Brynjolfsson and L.M. Hitt (2000), Beyond Computation: Information Technology, Organizational Transformation and Business Performance, *The Journal of Economic Perspectives*, Vol. 14, No. 4, pp. 23-48

to this, Dany Jacobs has talked of added values within the knowledge society that many see as simply being "hot air".[37] But this is precisely where the framework provided by growth accounting comes into its own: if we are able to discipline ourselves to put a value on activities on the basis of costs and future returns we can reduce much of that "hot air" to realistic proportions.

So far I have not yet discussed a form of investment which has only recently found its way into the economic literature. Since ideas about the so-called globalisation of economic relations have led to suggestions of a dominantly American economic model, the interest in the effect of social capital on growth has increased. "It's not what you know but who you know" sums up pretty well what social capital is all about.[38] The empirical work that economists have done to date in the area of social capital is mainly limited to the use of an index for "trust" in regression analyses. The data are based on surveys in which entrepreneurs are asked whether they have much, little or no trust in their business partners. There appears to be no trade off between growth and creation of social capital. On the contrary, there seems to be a clear positive relation between a strong social infrastructure and economic growth.[39] The difference between OECD countries are in fact quite small. But a "trust"-index only tells you indirectly what the returns on investment in social capital are, and nothing about its cost. Social capital clearly requires sacrifices: the time you are going to be putting into the reception that is nearly on us is time that could be put to other productive use. You also have to maintain your social capital: this one reception will not be enough. Moreover social capital has important indirect effects on other investments, such as investments in human capital. Empirically we are still a long way from an operational concept of social capital for which costs and returns can be identified. As a sceptical American colleague once asked me: is gossip also social capital, and if it is, what is it likely to return? But still the concept seems to me be more useful that the way that vague term "social capability" is currently used in economic-historical literature.[40]

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[37] D. Jacobs (1996), *Het Kennisoffensief*, Samson Bedrijfsinformatie bv.
[38] M. Woolcock (1998), Social Capital and Economic Development: toward a theoretical synthesis and policy framework, *Theory and Society*, Vol. 27, pp. 151-208.
[39] A.B.T.M. van Schaik (2000), Amerikaanse toestanden?, *Economische en Statistische Berichten*, 8 december, pp. 992-995; J. Temple (1999), *op cit*.
[40] M. Abramovitz (1996), Catching Up, Forging Ahead and Falling Behind, *Journal of Economic History*, Vol. 46, No. 2, pp. 385-406.

Concluding Remarks

It's now time to strike a balance. Which conclusions can now be drawn concerning the utilisation of the economic growth potential in Europe and the Netherlands in particular? Concerning the increase in physical investment and in particular investment in ICT, Europe is still behind the United States. The slowing growth, which for the time being is more substantial in the US than in Europe, may create a catch-up effect for Europe in terms of physical investment.

But will these investments lead to the same acceleration of productivity growth? The accelerated productivity growth in the United States is not only the result of a good performance of the ICT-producing sector, but also from ICT-using industries, such as trade and financial and business services.[41] The most important test for the American economy now is whether the productivity acceleration can be continued during the times of slowed growth.

In Europe there has been less acceleration of productivity growth among the most intensive ICT-using industries. The acceleration is not self-evident either. An important limitation remains the fragmentation of European labour and product markets and the slow start of structural reforms. In new – as yet unpublished – work with Bob McGuckin of The Conference Board, we show that the productivity effects of the new economy in the United States are also due to reforms and liberalisation of product markets over a period of more than three decades.[42] Such a backlog cannot be recovered in the short term. This can significantly limit the productivity gains from ICT in Europe.

Concerning the increase in intangible investment there is no big difference between the European Union as a whole and the United States. According to figures from the OECD the increase in expenditure on education, R&D and software as percentage of the Gross Domestic Product has increased at 2.9 per cent in the European Union and 3.1 per cent in the United States between 1985 and 1995.[43] There are striking differences in the composition of the

[41] M.N. Baily and R.Z. Lawrence (2001), Do We Have a New Economy?, Council of Economic Advisers, paper presented at AEA meetings, New Orleans.
[42] R.H. McGuckin and B. van Ark (2001), Productivity in the Information Age: Prospects and Problems outside the U.S., Perspectives on a Global Economy, Brussel/New York, te verschijnen.
[43] OECD (2000b), *Science and Technology Outlook 2000*, Paris

intangible investments, with the US having a greater share of software and R&D, and Europe a greater expenditure share on education.

The Netherlands finds itself in a better position concerning its ICT infrastructure than the European Union, and only the Scandinavian countries are doing better in this respect. I have already mentioned that productivity growth in ICT services, such as computer service buries and telecommunication has strongly improved in recent years. In their latest medium term forecasts the mostly cautious Netherlands Bureau for Economic Policy Analysis estimates a sizeable acceleration of productivity for the rest of economy, that is, from 1 per cent per year between 1996 and 2001 to between 1.5 and 2 per cent from 2002 to 2006.[44] A large part of that recovery in *labour productivity* comes from more investment in ICT – not from an acceleration in *total factor productivity* growth.

In the Netherlands the slow growth of intangible investments are a source of concern for the future. As a percentage of the Gross Domestic Product the immaterial investments have increased by no more than 0.9 per cent per year since 1985. Even after correction for its rapid GDP growth, the Netherlands stays behind the rest of Europe in this respect. A backlog in immaterial investment can reduce the potentially positive growth effects from the relatively strong position of the ICT-sector.

In 1994 the American economist Paul Krugman published an article in which he described studies which compared the competitiveness of nations as "a dangerous obsession".[45] Companies can go bust when they lose their competitive position, but that is more difficult to imagine for countries. Is the emphasis on the importance of productivity growth not also a dangerous obsessions? Is growth and improvements in living standards not simply a matter of investment in intangible capital, as the economic growth literature of the eighties and nineties has stressed? Historical studies do not give much reason to think that investment without productivity growth can lead to sustainable improvements in living standards in the long

[44] F.H.J. Don (2001), Het Nederlandse groeipotentieel op middellange termijn, CPB Document 001, Den Haag.
[45] P. Krugman, Competitiveness: A Dangerous Obsession, *Foreign Affairs*, March/April, pp. 28-44.

run.[46] It seems like a risky business to me. The question mark in the title of this lecture will therefore remain for the time being. I will talk to you again during my valedictory lecture.

Words of thanks

Ladies and gentleman, before moving to my words of thanks, it would like to stress that it should be clear that this strongly empirically oriented research programme is very ambitious, and a job that cannot be done alone. For example, the data intensity requires close co-operation with statistical offices and international organizations. Much of the research has been put in motion through joint projects with colleagues from within our Economics Department and outside, both within the Netherlands and abroad. I would keep you another quarter of an hour from the reception if I would mention all institutes and names of colleagues with whom I hope to continue the fruitful co-operation in the future. Still for that reason they are not less important.

It is no more than obvious, however, to stress how fortunate I am to have a liaison for more than four years now with The Conference Board, and especially with the Economics Research team. First of all, I want to extend my thanks to the Executive Board of the Conference Board for the endowing of this chair. I am particularly grateful to the Conference Board's chief economist, Gail Fosler, and its director of economic research, Bob McGuckin, for their continuing interest in my work and for their suggestions and advice. I am honoured to be part of your crowd. My regular visits to New York have made me feel it is almost as nice there as it is in Groningen.

I would also like to address some special words of thanks and appreciation to my former supervisor, intellectual guide and friend, Angus Maddison. Over the past 15 years I have greatly benefited from Angus' guidance and advice. He has taught me to look at details without losing sight of the broad picture. Even this lecture may show that it is a thin line to walk, and I am still learning to find my balance. I admire Angus' work and hope to maintain the spirit of it in future work here in Groningen.

[46] D.S. Landes (1998), *The Wealth and Poverty of Nations*, W.W. Norton and Company, New York. A. Maddison (2001), *The World Economy: A Millennial Perspective*, OECD Development Centre Parijs, forthcoming.

I would like to thank the board of the Faculty of Economics for the trust they have put in me. I hope to be able to contribute to some of the key areas in teaching and research of this department.

Dear colleagues from the departments of General Economics and International Economics and Business: when people ask me what it is like to work in Groningen, I always tell them how much I appreciate the open atmosphere within our department, and the many ways in which those who have their offices on the floor share their working experiences. It is a pleasure to work in a department where the doors are literally and figuratively open. The cigar smoke I take in my stride.

Dear colleagues in the Groningen Growth Development Centre: data, data, data …does our daily work consist of anything else? It is an investment whose returns take a long time to recoup and high costs of maintenance. One measure of the investment's productivity is how it is judged in the research assessment, but also by the international recognition that this group may hopefully continue to enjoy in the future.

Dear father and mother van Ark, and father and mother Thoma: you have been the biggest investors in this hall. When we were young, we did perhaps think that the investments were enforced ones whose returns we could not fathom. You kept on investing in us later too: those notorious "little extras" of yours such as this academic gear, your wise advice and the role you have played for our family at high and low times. Today, some of your investments are bringing in a return: spillovers, therefore! Inge and I are happy and thankful that all four of you are here today.

Brothers and sisters, cousins, friends: in a lot of addresses of this kind, the thanks given to those within the private area usually mentions the loyal support that the speaker has received on the journey to this moment. I am not sure that there has been an enormous amount of that. Your interest in my work has been mainly directed at what it was all good for, and whether it had any practical value (even sometimes its practical value for biscuit making!). As I keep on telling you, science does not *always* have to be about what we do in practice. But you have helped me enormously by making me keep my ideas focussed and my feet on the ground. There is certainly no doubt that I will keep on investing in you!

And if you think I have not had enough obstacles in my path…dear Inge, Tim and Chatree: when we moved to the Savornin Lohmanlaan two years ago, and I was allowed to use one of the nicest rooms in the house as my study and work space, I had the illusion that this was going to be an important moment in my academic career: finally a spot where I could work in peace. Since then, it has been the spot where the most ghastly, romantic, and sentimental films have been looked at in the evening, and during the day, my computer has been loaded up with dangerous viruses, and the train rails have been laid right between the legs of my office chair. Believe me, without you, it would not have been nearly as much fun.

Thank you for your attention.