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Economic Growth in Europe Entering a New Area?
The First Yeat of EMU

6th meeting, Bonn, January 17-18 2000

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SUMMARY OF THE PROCEEDINGS

The sixth French-German Economic Forum was held in Bonn on January 17-18, 2000. The meeting was co-organised by the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and the Zentrum für Europäische Integrationsforschung (ZEI), and hosted by the latter. Two papers were presented. The first one was written by Jürgen von Hagen (ZEI) on "The European Central Bank: 1st Birthday". The second one was written by Dominique Guellec (OECD) on "Economic Growth in Europe: Entering a new Era?".

Morning Session: The first year of EMU

The European Central Bank : 1st Birthday
by Jürgen von Hagen (ZEI)

Three major points were presented: the process of introduction of the Euro, the external performance of the Euro, the integration of money and credit markets in the Euro zone and the monetary policy of the European Central Bank.

First, the smoothness of the transition process confirmed the soundness of the approach that was used: early announcing of the conversion rates combined with large bands. The lesson here was that any would-be member of the EMU should follow the same path, especially the UK which is reluctant to a tight exchange-rate commitment.

On the external front, the Euro weakened considerably during the year, against the Dollar, but also against other currencies, as witnessed by the similar depreciation of the effective exchange rate. Mr von Hagen explained this fact by the growth differential between the world and the Euro zone, and large Euro bond issues. The ECB did not seem worried by this outcome.

The EMU-wide money market was successfully implemented but some problems of liquidity management remained. Thanks to the introduction of the Euro, financial markets witnessed a large increase in bond market activities. However, two major points of worry remained: (i) the bidding procedure of the ECB, based on the use of fixed-rate tenders and a collateral requirement, was deemed inefficient as it encouraged banks to make phoney bids and excluded those short on reserve assets ; (ii) the parallel evolution of marginal borrowing and marginal lending in several instances proved the inefficiency of the inter-bank market ; (iii) the persistence of risk premia (interest rate differentials) between EMU countries showed that the financial markets of the zone are still imperfectly integrated. These spreads could be explained by risk (interest payments as a share of GDP) and size factors.

Finally, the monetary policy strategy of the ECB aiming at medium-run price stability was judged confused by Mr von Hagen. According to him, the two pillars on which this strategy was officially based, M3 targeting and inflation targeting, were both trampled during the first year. Decisions on interest rates largely disregarded the variables that allegedly were the basis for the ECB strategy. Combined with a lack of transparency in the decision making of the ECB and methodological errors in evaluating credit demand, these discrepancies added to the surrounding uncertainties. The persistence of growth differentials added to the risks of a short- term management of the monetary policy.

Discussant: Pierre Jaillet (Banque de France)

Mr Jaillet agreed with the author on the transition strategy. He however stressed that, as shown by the experience of the pound entering the EMS in 1990, the exchange rate level should not be unilaterally fixed. Concerning the exchange rate of the Euro, he reminded that even though it was not the central bank main objective, the ECB officials had still made many declarations on this subject showing they did not neglect this matter. He reminded that some of the liquidity management problems identified by Mr von Hagen (EONIA spikes) were not new and already present for example in Germany during stage II of EMU. He judged Mr von Hagen severe in his assessment of the ECB strategy. First of all, he underlined the difficulties associated with measuring M3: according to him, in 1999, the growth of M3 was closer to five than to six per cent. In addition, a reference value (as opposed to a target) for money growth does not imply automatic adjustment in reaction to discrepancies. With all this in mind, the strategy of the central bank was rather consistent with what was announced. However, the discussant reminded that one year is a very short time to take stock of the ECB's single monetary policy given the remaining uncertainties (e.g. how to deal with possible asymmetric shocks without federal fiscal transfers?).

Discussant: Jens Weidmann (Sachverständigenrat)

Mr Weidmann confirmed that the integration of financial money markets was still far from complete. This was proved by still large differences in risk premia and bid-ask spreads for overnight interbank rates. The solution was to implement structural reforms in clearing and settlements procedures and to curb down the persisting protectionist trends of some countries. He however deemed the size factor to have no impact on the risk premium once a general assessment indicator (SP rating) was included. Concerning the ECB strategy, he underlined the time varying relative importance given to the two pillars. This helped to better understanding of the ECB decisions. Mr Weidmann however blamed the ECB for its lack of transparency which could undermine credibility.

General Discussion

The general discussion began by an evaluation of the remaining disparities in Europe: the imperfect integration of European markets combined with various stages in the business cycle were part of the difficulty of devising the optimal monetary policy for the whole Euro-zone. The discussion centred on the objectives of the ECB, the transparency of its strategy and the decision-making process of the bank.

The neglect of the ECB towards the external value of the Euro was criticised by some participants. It was questioned whether the DM had not entered EMU while being overvalued. However, the negative supply shock suffered by Germany at the end of 1998 led some to think it was not so. The question of whether the low value of the Euro was due to the business cycle, to the lack of perception by the outside of Euro-zone policies, or by structural problems, had to be answered to determine if the ECB was to intervene.

The medium run objective of price stability led to lively discussions about the interpretation of inflation data in the Euro-zone. It was noted that the inflation in asset prices was not taken into account by the ECB, which could prove problematic in the future. The higher than 2%

observed inflation in periphery countries of the zone was said by some to be possibly a one-shot adjustment due to a catching-up process, so the lack of reaction of the ECB was not problematic. However the temporary nature of these figures was questioned, leading to fears of an upswing in inflation.

Many participants criticised the ECB for its lack of transparency in explaining its strategy, which added to the uncertainties of the economic context. The ECB could improve the way it conveyed information to the markets and learn from the Fed. However the expectation-shaping role of a central bank was deemed secondary by some. This commitment problem led to diverging views concerning the strategy to be publicised.

Some participants thought the ECB should clearly indicate the variables influencing its decisions. From this point of view, it was dangerous for the bank to focus one year on output gaps and the following year on wages increases. If the bank acted on monetary targeting as indicated by the first pillar, it should have reacted to the M3 figure, as the delays of reaction could prove costly in terms of inflation. The second pillar strategy (inflation targeting) was preferred by some participants, but judged dangerous by others who pointed out that it requires finding the correct model linking the different macro variables and monetary aggregates. One participants pointed out the lack of transparency of the model used by the ECB for this second pillar.

Others stressed that delivering the goodies were more important than following rules. They reminded that the Bundesbank had not always respected its M3 growth target. Credibility of the ECB would be determined by its capacity to curb down inflation, not by having a M3 growth of 4,5% a year. The uncertainties surrounding the actual M3 growth necessitated taking into account other aggregates to forecast inflation. The ECB decision to base its policy on targeting an observed variable led to fewer interest rates changes. This policy was sound since targeting an expected variable like M3 would have entailed more volatility in the short run. The latter solution would maybe be ok for the UK as many variables were fully indexed on short-term rates, but not for the Euro-zone.

Apart from the general strategy of the ECB, there were some fears about the decision-making process of the bank: some participants thought that the board was not strong enough to stand up against national governors, and that the consensus principle was an error ; others worried about the future of the decision-making process when EMU is enlarged.

Afternoon Session: Prospects for Economic Growth in Europe

Economic Growth in Europe: Entering a New Era?
by Dominique Guellec (OECD)

The second paper tried to answer four questions: (i) how can US growth 1990s be explained? (ii) what was its background? (iii) after a rather dismal decade, what are the prospects for Europe in this light? (iv) what policies are needed to raise growth rates?

The strong performance of the US economy has given birth to various explanations. One is the “new economy” paradigm, also called the technological point of view, according to which a deep structural change driven by regulatory reforms and ICT industries has taken place in

the US, enabling strong sustainable growth without inflation. Another explanation focuses on macroeconomic factors such as sensible monetary policies, short-term factors and the emergence of a possible bubble economy.

Whatever the reasons behind such changes, the macroeconomic consequences are numerous: a rise in inequalities during the first stage, followed by a recent decrease; numerous impacts on the labour markets; surge in investment.

According to Mr Guellec, the two views should not necessarily be opposed: both acknowledge the importance of structural reforms, globalisation and innovation.

In a world of increasing returns, Europe suffers from the still imperfect integration of its markets. Structural reforms such as deregulation and privatisation are needed to speed up the integration process and increase flexibility and competition, leading to the creation of European champions able to compete on the international scene. The same structural reforms are also necessary in the scientific and academic world to help promote innovation in Europe.

Discussant: Anton Brender (CPR)

Mr Brender stressed the very strong macroeconomic implications of the extreme view of the new age economy: end of inflation and of business cycles, increase in growth and in corporate profits, very strong rise in stock prices. The soft version of this new paradigm led "only" to a rise in investment and productivity. So it is necessary to fully take into account the often neglected macro factors. The previous errors in forecasts (for example, how the short-term view of US firms was deemed to be an handicap compared to long-term planning Japanese firms in the 1980's) reminds us of the need to fully understand the broad picture before implementing irreversible reforms. Concerning Europe, the pattern of job creations in the US, which took place at the two ends of the scale of qualification and pay, may not be acceptable.

Discussant : Renate Hornung-Draus (Bundesvereinigung der Deutschen Arbeitgeberverbände)

Mrs Hornung-Draus stressed the importance of having better institutions in the actual economic context. Mentalities also need to evolve. She underlined that, despite the numerous break-up of barriers between European countries, goods and scientific markets were still very fragmented. She noted that there were many pre-requisites for successfully undergoing the change to this new Knowledge-Based Economy (KBE). Because of the present rigidities, she feared Europe did not meet those pre-requisites for the moment. There were still too little contact between industry and research. The education system needed to be improved; in particular, long-life continuous training and formation had to be developed to help an ageing population absorbing the increasingly quick technological change. She wondered whether the author's proposal to develop scientific pools of excellence would not jeopardise general education in Europe. The microeconomic changes induced by the KBE needed to be fully understood so as to help reaching the optimal regulation and social bargaining process.

General Discussion

The discussion focused on the reforms Europe needed to raise growth rates while limiting the rise in inequalities.

The deregulation solution was judged by some not to be a solution *per se*: even though there is a need for greater competition and efficiency gains in the Euro-zone, increasing returns to scale in some of the new high growth sectors could justify governments intervention. The example of a common standard for mobile phones in the EU supported this view.

The early start of the US economy had some wondering whether Europe would catch-up automatically, or if reforms were needed to fill the gap. It was however noted that catching-up was by no means systematic.

The data itself raised several questions: why did the break in the productivity trend in the US happened in 1995? Is this break temporary or permanent? It was noted that every technological revolution took a long time to bring benefits; it required organisational changes and it raised inequalities temporarily.

Two views conflicted on the impact of technical change on the labour markets: both views acknowledged that entering this "New Age economy" raised inequalities in a first stage, but had different medium-run implications. Some participants thought that recent technology changes were biased against low-skilled labour, whereas others wondered whether capital deepening enabled more people to enter the labour market, which would explain the recent decrease of inequalities observed in the US. This brought the question of whether structural reforms were not needed very quickly so as to enable European economies to reach this stage of decreasing inequalities. Whatever the causes, there had been changes in the negotiation process in labour markets.

A very close study of macroeconomic factors was needed to understand the nature and the scope of the recent evolutions: a "New Economy", or just business cycle as usual. Several participants worried about the ability of the ECB to perform as well as the Federal Reserve in monitoring a non-inflationary growth.

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*Economic Growth in Europe: Entering a New Era?**

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1. INTRODUCTION

The economic performance of the US for the past ten years has raised many questions in Europe, which was facing big problems. Growth and innovation on the West side of the Atlantic, stagnation and unemployment on the East side: that is the picture many had in mind not long ago. And there was much truth in it. Things have been changing recently, as European economies were regaining momentum. Much remains to be done however before the performance of European economies can compare with the US. What happened on the two sides of the Ocean? The dominant view of American growth in America (see Alan Greenspan lectures) gives a large role to the ability of US companies to generate and use information and communication technology (ICT) –the extreme version being the "new economy" view (endless growth and price stability thanks to ICT). Conversely, many European economists (e.g. Brender and Pisani, 1999) tend to underline macro-economic factors, notably monetary and budgetary policies –the extreme macro-economic interpretation emphasising the "bubble economy" on which American growth is built. The two views (except for the "bubble" interpretation of macro-economic factors) emphasise that Europe has something to learn from the US, and that a potential for growth does exists that can be captured by Europe.

There is no doubt that monetary policy was helpful in restoring and maintaining the conditions for growth in the US. It is the purpose of this paper however to emphasise more structural aspects, that relate directly to productivity growth and technological change. The way resources are allocated, the intensity of competition, the economic aspects of innovation, the importance of external (foreign) linkages, all these structural features of the economy have experienced tremendous change in the past years, especially in the US. No need to support the "new economy" view to reckon these evolutions and their positive effects on potential growth. It is the purpose of this paper to explore these features and examine their impact on economic growth.

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1 This study is based on work for a project of the OECD on the sources of cross country differentials in economic growth. All opinions expressed herein are those of the author, and do not reflct necessarily the views of the OECD or its Member countries.

More precisely, this paper will address the following questions:

- Is there currently a surge in structural growth going on, notably in the US?
- If yes, what is its background?
- What are the conditions for Europe to catch the train?
- Which policy implications?

2. GROWTH AND PRODUCTIVITY IN THE 1990S

The 1990s have been a dismal decade for the economy in Europe, especially when compared with the US success. This is partly the picture that emerges when looking at GDP growth over the decade (Table 1). Over the whole decade (1990-98), the European Union has grown by 2% a year, which is substantially less than the US (2.6%). Over the more recent period (since 1995), the US economy has accelerated (3.7% a year in 1995-98), as did Europe but to a much lesser extent (2.3%). The performance of Japan was even worse (1.2% a year over the decade). The very end of the decade has seen more optimistic prospects emerging for Europe: The recovery seems now to be spreading all over Europe, although it still lacks momentum in a few big countries. In the meantime there are no signs of a coming slowdown in the US economy.

The picture within Europe is quite contrasted however (a detailed examination is made in OECD 1999). Over most of the decade, a few smaller countries such as Ireland, Denmark, the Netherlands or Finland experienced higher growth than others, especially the big continental countries (France, Germany, Italy). The UK is in a medium position. Then, although there are Europe-wide factors for the slow growth, a few countries managed to thwart these factors.

The image of a fast growing and job creating US economy, opposed to sluggish Europe. Economic growth in the US has been impressive not only by its rhythm: it has also displayed features that make it difficult to understand with the standard macro-economic analysis that applied to the 1970s and 1980s. It is to become the longest growth cycle ever (reaching a ten years length soon); it has accelerated sharply late in the cycle (since 1995) and gives currently no sign of running out of steam; this performance has not triggered inflation pressure (even booming oil prices in the past year have not had important effects on consumer prices); and GDP growth is now pulled by accelerating productivity growth.

We will focus now on productivity. The US records in productivity had not been high over the past decades, including the last one, as compared with other developed countries. As the most advanced country, the US did not benefit much from other countries' technology, whereas these countries were catching up to the US productivity level, hence experiencing high gains. However, things have changed since 1995-1996, with a sharp acceleration in some indicators of productivity in the US. Figure 1 shows the output per hour worked, in the US business non financial sector. For the past 3 years, the US have experienced productivity gains that had not been seen since the 1960s. Hence the claim of an acceleration in technical change, which is the major driving force of productivity. Measuring productivity is not so simple, and various existing measures give somewhat different pictures (see box 1). When looking at total factor productivity (TFP) for instance, the most recent data available (up to 1997) show only that the US is now experiencing gains of the order of 1% a year, which is less

than in the 1960s and similar to European countries. However, at this stage of the cycle (where capacity utilisation must be high and non increasing) this is significantly better than it has been since the early 1970s. Hence, although the figures may differ, all indicators tend to show a recent acceleration of productivity in the US.

Does this acceleration in productivity signals an acceleration in technical change? As technical change is not measurable, we are left as usual at examining alternative explanations (technology is the residual explanation, that may be considered only if others don't hold), and at looking at anecdotal evidence regarding technology. There are two alternative explanations in this case: physical investment and regulatory reform. These two explanations are very consistent with the technological vision. Investment is driven notably by technological opportunities, and as it embodies new technology it is a source of productivity growth (even of TFP, as the price of equipment may not capture all of the quality improvement they embody). A recent study of the factors of labour productivity growth in the U.S. (Macroeconomic Advisers 1999) shows that more than half of the contribution of capital deepening to productivity growth in 1998-1999 is due to ICT equipment (0.65% for ICT, 1.19 for total capital deepening). The steady growth of the contribution of ICT through this channel since 1994 is due to the price drop it experienced, which created incentives both to substitution to other equipment and to an increase in total investment. The role of regulatory reform will be examined later; suffice it to say at this stage that its effects are not static only, but also dynamic: resources are better allocated to productive, but also innovative activities, hence generating more technological change for the economy. Then, far from excluding technology, both investment and regulatory reform give rationales for the observed surge in technical change.

Anecdotal evidence and partial statistics show booming investment in ICT equipment and large productivity gains experienced by companies. Technical change in the ICT producing industries is well known (the "Moore's law" recognises a doubling of the power of computers every 18 months), and it is confirmed by available statistics (e.g. hedonic price indices for computers). As a result of this technological progress, ICT equipment is rapidly substituting to older, non computerised generations of equipment.

The share of ICT equipment in non-residential investment has been increasing consistently in all OECD countries, and it is higher in the US than in most other countries (table 2): it was 20% in 1996. This figure does not take into account investment in software, which is estimated at around 10% of non residential investment in the US (6% on average in OECD countries), and would boost the share of ICT in total investment to about 30% in the US. There is plenty of anecdotal evidence of the productivity gains and new services allowed by new technology. Examples include: a reduction in the cost of share trading thanks to online trading (Charles Schwab&Co); Internet platform for moving procurement online (Ford, GM, Boeing with Oracle – replacing EDI based systems), allows a more efficient management of the supply chain, which translates in reductions in procurement, inventory, sales execution and distribution cost; direct management of the consumers base allows companies to better identify and forecast demand at the very micro level; in the transportation industry, new technological systems (integrating GPS, portable phones, computers) allows to manage more efficiently flows of freight. In most industries and especially in the services, ICT is changing the way business is done.

Little doubt that rapid technical change has been at work in the US in recent years, and that it is part of the growth record achieved by this economy. The growth rates of the 1950s and 1960s, in the order of 4-5% a year, are probably not achievable in the foreseeable future in a sustainable way. The reason is that in these decades the US was catching up its potential GDP after the losses due to the 1930s crisis and the Second world war (i.e. implementing and realising the full potential of technologies initiated in these troubled times). Growth in the after war period was even higher in European countries and especially in Japan, which were catching up the US itself, implementing US technology. By definition catching up cannot last: when economies have reached the "technological frontier", meaning that they are using the full potential of existing technological knowledge, the only way of continuing growth is to push forward the frontier. The waning of the catch up forces triggered a period of crisis, starting in the late 1960s in the US, the mid 1970s in Europe, the late 1980s in Japan: actually, developed economies had to adapt to the new conditions. They should now generate more technical change, which involves different economic mechanisms than just accumulating physical capital for catching up a known technological frontier. It takes time to change economic and institutional structures, hence the poor growth records of the past decades. The current technological revival reflects the fact that economies are getting back to steady state regime of growth -but some have been quicker than others to do so. Hence, future growth will not benefit from a premium due to inherited output gap, and will be at a more moderate pace than the "golden 60s", although it will be higher than in the 1980s for the US, the 1990s for Europe and Japan.

Why did this technological wave start in the US? and to which extent is Europe able to surf it? Answering these questions requires the perspective to be broadened –which is attempted in the next paragraphs.

In the 1990s Europe performed better than the US in terms of productivity. As mentioned before, thanks to catching up since World war 2, this is not new and does not go against the above arguments. In addition, two new elements are to be noticed. First, productivity growth in most European countries was enhanced by rising unemployment (lower productivity jobs are suppressed first, resulting in a higher average productivity level for the remaining ones). Second, the US has outperformed Europe since 1995, for the first time since 1945. The good news for Europe is that, in some countries (e.g. Netherlands, recently France), this is due partly to a more "job intensive" growth process (the reverse mechanism as the one which worked in the first half of the decade). The bad news is that the technological wave has been late in reaching Europe.

3. THE NEW ECONOMIC REGIME: INNOVATION AND COMPETITION

3.1. Trends that underlie the new economic landscape

Three broad, basic trends (interrelated and partly endogenous, but still basic), which emergence has contributed to shape economic patterns in the 1990s and will be still more important in the future:

Emergence of the knowledge-based economy (KBE): It comes from the size of the stock of knowledge (accumulated in the past) and the progress of ICT, which together entailed a surge

in the return to investment in knowledge, triggering in turn a virtuous, endogenous growth type, circle of economic expansion. In this context all knowledge related activities are expanding rapidly: research and development, technological innovation, higher education, supply and demand for ICT, software. Total investment in knowledge now overtakes investment in equipment in most OECD countries (see figure 2).

Globalisation: It is also a long term trend, which has reached now such a level that it changes in many respects the way economies work. It boosts competition (lowering of national boundaries, end of protected markets), it increases the scale of activities (world-wide markets), and the circulation of knowledge (technology crosses borders). Along with the development of formerly poor countries, globalisation impacts particularly on knowledge intensive activities: with emerging economies overtaking markets in low tech goods, resources are freed in developed economies for the production of high tech goods (similarly: the increase in the world-wide supply of low skill labour triggers higher demand for high skilled labour). Moreover economic development enlarges the world market for high technology goods produced by developed economies, then stimulating supply. Hence globalisation reinforces the KBE in developed economies.

- *Deregulation, privatisation*: During the after-war period, an administered, regulated institutional framework dominated, which was consistent with the then economic, social and political conditions (catching-up, cold war). Since the late 1970s, the market mechanism (competition, co-ordination through prices) has been extending its area of dominance (at the expense of the government, and to some extent of non-monetary motivated activity), and on existing markets competition is getting fiercer than it used to be (markets are more contestable, as regulatory barriers are removed, customers are better informed etc.). This still ongoing process concerns markets for goods and services as well as for capital and labour.

These broad trends underlie an in-depth change in the micro-economic conditions and the institutional conditions that underpin economic growth.

3.2. A new micro-economy

Innovation and competition are the master words for firms, reshaping the business environment and strategy :

Innovation has become the highest priority for many businesses. In industries such as ICT or pharmaceuticals, the strategy of firms is entirely determined by their innovation goals and achievements. Industries that used not to innovate much, especially in the services, have experienced a surge in innovation, often related to the processing of information (e.g. the transportation industry, that increasingly uses integrated systems with GPS, mobile phones and the internet for monitoring flows of freight). The basic rationale is that innovation provides high returns, whereas non innovating leads to losses as competitors are innovating. The profits and market share of firms is increasingly dependant on their availability to launch new products and services and to improve their production processes: and in this process, technology plays a key role.

The surge in innovation is illustrated by the surge in patenting (see figure 3). Since the mid-1980s, the number of patents granted by the USPTO has experienced steady growth that is higher to the one of the 1950s and 1960s. Moreover in these decades GDP growth was higher, indicating that other sources of growth (e.g. catching up) were stronger than they are now, which emphasises the current role of technical change. This growth in patenting is partly explained by changes in the law (e.g. software became patentable), but patent offices in other countries and regions (e.g. the EPO in Europe) have also been faced, later than the USPTO, with a similar surge. Moreover, although a major contribution was made by ICT and biotech, most technology fields also grew rapidly (Kortum and Lerner, 1998). There is a strong presumption then that technological innovation has experienced an acceleration since the mid 1980s after a through since the early 1970s.

Technological innovation in many fields makes more intensive use of scientific knowledge than before. Actually, in ICT or biotech, the frontier between science and technology is blurring, as fundamental discoveries can lead both to scientific publication and commercial success. A series of studies on the biotech industry (Darby et al. 1999) showed that the commercial success of companies in this industry is closely linked to their connections with the scientific community (e.g. participation of renown scientists in the board). A study of scientific publications in the UK (Hicks and Katz 1997) shows that the proportion of articles authored by industry scientists with co-author from university rose from 20% in 1981 to 40% in 1991. Similar trends are occurring in the US (NSF 1998, p. 5-38). A recent study (Narin, Hamilton and Olivastro 1997) shows that 73% of references made in patents to published articles were to "public" science - academic, governmental and other public institutions. The number of references to public science had nearly tripled during the six year period studies.

Most OECD countries, with the exception or large European ones and Japan, have experienced high growth of their business funded R&D expenditure in the 1990s (see figure 4). This is the case especially of Australia, Ireland, Nordic countries and the US. Stagnation in a few countries was caused mainly by economic slowdown and a reduction in government spending (OECD 1998): business funded R&D has started recently to pick up in most of those countries.

At the same time, the organisation of R&D has changed markedly. Firms are doing less basic research in-house, contracting it out, instead, to universities (OECD 1998). Increasingly in large firms, central laboratories have less resources, which are allocated instead to departments and affiliates laboratories which perform more applied research. The point is that universities have a comparative advantage in basic research: the circulation of knowledge (through publications, conferences) that is key to the advancement of basic knowledge is better organised, peer review allows quality check and the incentive system is more adapted (Dasgupta and David, 1994). Hence the development of links between universities and business, which take various forms: research contract, research co-operation, patent deals (sales or licences), mobility of researchers, consulting. the increasing share of university research which is funded by business (see table 3) in most countries, including the largest spenders (US, Japan, Germany). Largest increases are met in Finland, the Netherlands and the US. Largest countries were business funding of higher education R&D dropped are the UK (where it is relatively high) and France.

The new economic environment, shaped by innovation and competition, is triggering large changes in the organisation of industry.

- As markets become world-wide and the cost of innovation increases in many industries (pharmaceuticals, chemicals, automobile), the minimal size for firms to be competitive has increased in these industries, leading to a wave of mergers and acquisitions (M&A) which reached US$ 3,430bn in 1999, against US$2,520 bn in 1998 which was already a record year (Source: TFSD) -1999 is actually the 7th consecutive record year. Most of these M&A aim at reinforcing the core business of firms -they are mergers of firms in the same business (all the 10 biggest M&A in 1999 were between firms in the same industry). This is to be contracted with the 1980s, when M&A between different fields of business were more common (UNCTAD 1998). The global basis for business restructuring is demonstrated by the increasing share of cross-border deals, which reached 28% in 1999 against 22% in 1998. Actually, the amount of cross border M&A has grown more than tenfold between 1991 and 1999 (sources: KPMG and TFSD).

At the same time, many firms have been contracting out activities that they used to do themselves, or have split up into new entities that are more specialised in one business (e.g. AT&T in 1994, that gave birth to AT&T, Lucent and a company in the software services). In the automobile industry, a growing role is left to suppliers, that design and produce now entire parts of the cars instead of providing small pieces later assembled by the motorcar firm. Such specialised suppliers are getting bigger and their number is decreasing. This allows to limit the size of firms in a context of large M&A, hence preserving their reactivity and limiting the costs of bureaucracy generated by size. Both moves, M&A and split up/contracting out, aim at creating large, focused firms and reactive firms.

The pressure of financial markets in these moves is overwhelming, as more profits are expected from the new corporate entities. This is at odds with the hitherto prevailing tendency of firms to diversify, that was supported by management and banks (in search of insuring themselves against industry specific shocks: now diversification is made by investors, not by companies). In a context of deregulation of financial markets since the 1980s, firms have increasingly access to direct finance through emission of shares and bonds, shortcutting banks, which have weakened the position of banks and strengthened the position of shareholders.

An alternative way to M&A for capturing economies of scale due to knowledge is networking. Moreover, it gives to the firm access to complementary knowledge, that is outside its own business but may help it. There is abundant evidence of increasing networking by firms, with universities and other public bodies, but also with other firms, be they in the same line of business or in other ones. It is also shown that firms with more connections are also more successful in innovating. Networking can take many forms: research joint ventures, research contracts, cross-licensing agreements. The number of technological alliances between firms was 136 in 1980, 287 in 1990, 483 in 1996 (source: CATI, MERIT). Networking develops at an international scale, since firms have to find the best partners wherever they stand. This is reflected in the increasing share of patents with co-inventors from different countries, which has doubled between the mid-1980s and the mid-1990s (from 2.5% to almost 5%).

At the same time, a wave of new, small, innovative firms has risen. Creation of new business is very active, especially in new technology industries. Does it contradict the trend towards world-wide concentration? No. First, many new firms do not stay small for long. Either they get big (Microsoft), or they are purchased by bigger firms, or they fail. Second, many are highly specialised, e.g. in a special type of software or genetic experiment, so that they are big on their own market (which is small). Third, these start-ups fulfil a special role that is less accessible to large firms: they are at the forefront of building entirely new industries (e-commerce, genetic engineering), which is a very risky endeavour, that requires both flexibility and strong incentives that are more easily achieved in small businesses than large ones, and also a business approach that is somewhat different from established industries where big firms come from. There is a strong complementarity between small and large firms, as the latter purchase the successful ones among the former (e.g. Alcatel and Cisco go shopping to Silicon valley; in 1999 Microsoft acquired shares in 44 firms for US$ 13bn, Intel 35 firms for US$ 5bn), leaving in a way to the market the role of selecting successful innovations before integrating them in their own portfolio.

3.3. Economy-wide aspects

An efficient functioning of this innovative/competitive system requires some conditions to be met in the environment, especially at the country level:

- Countries must have *a strong knowledge base*, where firms can tap in. Government and university research must be strong and opened to industry. Knowledge has a public good component that makes public funding necessary to its progress. At the same time, knowledge does not flow automatically from the university lab to the firm: certain conditions must be fulfilled for knowledge to circulate, such as the mobility of researchers themselves, or an involvement of the user at the research stage (that allows early learning). The institutional and incentives structures must be adapted accordingly. Countries benefit from a large endowment in *human capital* (coming from education or immigration), that provides the labour force needed by business and enhances the demand for knowledge intensive goods (that require skills from the consumer). The public schooling system and universities have a key role there, provided that they take into account the evolutions of demand.

- *Market forces should work efficiently*, generating a strong competitive pressure on firms (markets for goods) and the permanent reallocation of resources (capital, labour) required by the innovative economy. Creative destruction is the result of competition and innovation, and competition is a major factor of innovation. Trying to thwart competition or its consequences (creative destruction) is detrimental to innovation. At the same time, co-operation between businesses, and between businesses and public institutions should be encouraged, provided that competition is not distorted. The institutional framework, especially financial institutions, should allow the allocation of resources to risky activities conducted mainly in start-ups (venture capital, stock options).

- *Size matters*: either a country must be large or it must be opened (or both), so that firms have access to a large pool of customers, to a large pool of capital and to the specialised labour force they need. In the case of small countries openess and specialisation were necessary for long as globalisation is nothing new: it is becoming the case increasingly

for medium sized countries (especially the large European countries) as the critical mass in many industries is growing.

- *Distribution of income*: there is a need for strong (mainly financial) incentives for innovators, entrepreneurs, etc. that favour initiative and risk taking; this conveys the danger of increased income inequality, resulting both from the working of market forces (that favour the skilled and powerful more than do an administered, regulated, redistributive economy), and from the KBE (increased demand for skills). Increased risk and creative destruction imply that market forces will leave losers as well as winners: those who fail in there entrepreneurial activity, those who work in firms or industries that are destroyed by competition need some support, otherwise they will resist change -to the detriment of economic growth.

3.4. The diverse fates of countries

These new conditions for economic growth are fulfilled to a differing degree by countries. This diversity in turn explains most the growth differentials in the 1990s. Economies which have been in a favourable initial position (by their factors endowment), or have implemented the relevant institutional changes to live in this new model have experienced higher growth than others. Overall, more favourable conditions were met or built in the US and in some small countries (e.g. Australia, Ireland, Denmark, Finland), rather adverse conditions in large European countries (but things are changing rapidly there) and, even more, in Japan.

UNITED STATES

- Large endowment in science and technology: The US is the largest spender in R&D, funded by business or by government; it has the best universities in the world, as illustrated by the number of Nobel laureates (many of them foreign born). Government R&D policy (with defence or civilian purpose) anticipated the ICT revolution. The regulatory framework encourages technology transfers from universities to business (Bayh-Dole act for patents). There is plenty of human capital available, at least in the upper tail, either produced by the world best universities or attracted from abroad (thanks to universities, income inequalities and business friendly environment).

- A deeper rooted tradition of competition made it easier than in other countries to adapt the institutional framework from the late 1970s on (deregulation of the labour market, break down of ATT, deregulation of air, road and rail transportation). A legal framework that favours risk taking: Pension funds have been allowed to finance venture capital since 1979; well functioning financial markets allow to channel funds to projects with rewards only far in the future (internet stocks). The patent system gives a strong protection to innovators.

Size of the economy: The US is the largest economy in the world. Market size is key in industries such as software, e-commerce (a large base of known and relatively homogenous customers). Raising capital in the largest financial market in the world is easier than in smaller ones.

***Conclusion*:** the US was in the best position to lead and get the rewards (growth, productivity) coming from the KBE, as it is shown by the 1990s. Problems may be coming in the future from the weak educational system (except the upper tail) that could generate a shortage of intermediate level skills (technicians). When other developed countries recover, a possible reversal of migration streams may hit innovation and entrepreneurial capacities, and a similar reversal of financial capital streams may reduce investment. When macro-economic conditions deteriorate, with an increase in unemployment, income inequality may become a bigger social and economic problem as the social net has been substantially lightened in the 1990s.

JAPAN

Weak science base, due to a weak public research sector; good endowment in human capital, especially at the intermediate level (blue collar high skilled, technicians). The 1996 plan by the government to double public expenditure in basic research was good news.

Highly rigid labour market, for the skilled at least (life long employment); highly regulated markets for goods and capital, resulting in weak entrepreneurial activity. *Keiretsu* linkages reduce the ability of firms to focus on core activities, and hamper competition. Except for a few, selected industries(automobile, consumer electronics), the country is quite insulated from the outside world.

***Conclusion*:** Recently, there have been signs of reform of the institutional framework and of openness (Nissan). Change is going on in Japan, but at a slow pace and it is just starting.

4. EUROPE IN THE NEW ECONOMIC CONDITIONS

It is common to dismiss Europe as a laggard on the technological scene, pointing out its weaknesses in ICT and biotech. Some go to say that this would be largely irreversible, as the the new industries are characterised by economies of scale that give a permanent advantage to the first mover (i.e. the United States). Although European weaknesses are real and big, they should not be overestimated, and there is no evidence of irreversibility in these industries that are still in their infancy and will change totally (in unknown directions) in the future.

First, there is huge diversity within Europe: Nordic countries are more advanced than the US in many respects (PC penetration in households, and even for the number of internet hosts per inhabitant - figure 5). A ranking of the best banks web sites in 1999 (with criteria such as: accessibility, navigability, customer service, content, technical performance and visual expression), Interbrand found that the first was a US bank, followed by three Nordic banks. Actually, seven out of the first ten were European.

Second, things have been changing rapidly in Europe in the very recent past: investment in venture capital has trebled between 1995 and 1998 (as in the US); the penetration of equipment and the use of ICT are increasing more rapidly than in the US (starting from a much lower level).

Third in some high tech industries (not many) Europe is a frontrunner, not a laggard: this is the case in mobile phones, aircraft; Linux is a European invention, and European research contributed to the Internet (Mosaic, the first internet protocole was designed at the CERN in the early 1990s).

The bottom line is that Europe is actually weak in ICT and innovation, but its situation is far from desperate and it is improving rapidly. What are the factors underlying this position?

4.1. The science base

- Most countries have a quite strong science base and a good educational system (although not as good, for the top end, as in the US). There are however a few problems:

- In most European countries, public research seems to be little reactive to changes in the distribution of scientific opportunities, with excessive rigidity in the allocation of resources by scientific fields. Entrenched in established fields with established research teams, public research was unable to catch the ICT revolution.

In a way, the overall quality of European science is probably lower than the sum of its national components: still relatively weak cross border links between national research systems entail duplication, weak competition and weak networking. EC programs and country initiatives (such as the synchrotron "Projet Soleil" that the French Ministry of research wants to share with the British government and the Wellcome Trust) go in the right direction, which is more integration. Research by the OECD (1999c) shows that being a member of the EU does not increase the probability to co-invent with another member as compared with a non-member (when other aspects, such as technological similarity, a common language or geographical proximity are controlled for). Also the EU taken as a whole is not as open to foreign (non EU) S&T co-operation as the US is. In an era of globalising science and technology, this is probably a handicap.

4.2. Institutions for technological change

Until recently, European economies were highly regulated, with a large government owned sector and very protected labour market. In the UK, as in the US, deregulation started earlier and was conducted bluntly, something more difficult to do in continental Europe where consensus has to be reached for broad reforms to be feasible. In smaller countries (Finland, Netherlands, Denmark) a strong social/political consensus (in the European tradition) was achieved in order to reshuffle the system, especially to make the labour market more flexible (higher incentives to work, lower costs of hiring and firing). In larger continental countries, reaching a consensus is obviously more complex and difficult, and it took some time to go ahead. Structural change is now under way, and well advanced in some countries.

- European integration also has put pressure on national governments for liberalising markets, pressure which is conveyed by the European Commission. Markets that used to be legal monopolies (telecoms, energy) have been progressively opened to competition. Government owned companies (e.g. banks, telecoms) are privatised, especially in Italy and France. Liberalising the economy results in dropping these firms and industries that

are not competitive and allocating more resources to efficient activities, hence in higher specialisation (economies of scale) which is visible in Finland.

- Industrial restructuring: European M&A reached US$ 1200bn in 1999, more than double their 1998 amount (US: US$ 1750bn) (source: TFSD). In the first three quarters of 1999, EU companies made cross border M&A totalling US$ 430bn (world: US$ 608bn), compared with US$ 203 in the same period of 1998. The EU accounts for 70% of the total value of cross border deals completed, with the UK for 33%. Excluding the UK, EU made US$ 228bn, a 45% increase over the same period in 1998 (US: US$ 113bn, a 7% increase over 1998) (source: KPMG).

- Venture capital (see box 2) is weak yet, but it has been booming in recent years, thanks to new awareness of financial institutions of its potential return, thanks to government policies (creation of public VC funds, tax breaks), and to the establishment of secondary financial markets (Neuer Markt, Nouveau Marché, EASDAQ). The absence of pension funds, the major provider of capital to VC in the US, remains an obstacle in some countries.

4.3. Size of the market

No doubt that Europe is far from being a single, integrated economy as the US is. There are still national champions, language barriers, differences in regulation, in financial channels etc. This has hampered innovation in larger countries, which were reluctant to let non competitive industries decline and specialise according to their comparative advantages. Small countries have been traditionally more opened, they used to specialise before and did not feel the pressure to specialise as anything new. Hence the success for instance of Nokia (more than half of the Helsinki Stock exchange capitalisation). The potential of innovation in Europe when internal barriers are removed or overcome is exemplified by the mobile phone (a common standard unified the demand side) and Airbus (pooling of resources boosted the supply side). For the mobile phone, four different standards have been competing in the US, resulting in weak demand that limited supply. Conversely, thanks to its single standard, Europe has the highest diffusion rate in the world and three of the four leading companies (Nokia, Ericsson and Alcatel). Airbus shows the ability of European technology to compete with the US when enough resources are pooled for a critical mass to be reached.

The launch of the Euro has contributed to mitigate this internal split, as it is shown by the wave of large national and cross-border M&A and industrial restructuring since early 1999 (see above). Whereas the UK's acquisitions have been focused on the US market, other European firms have been setting their sights on other European countries. Among the ten largest M&A involving French firms in 1999, 5 involved a foreign partner, including 4 from other European countries. (Source: TFSD). Some big and really European companies, beyond national frontiers, are now emerging: EADS from Matra-Aérospatiale and DASA, Aventis from Rhône-Poulenc and Hoechst, Framatome/Siemens. Vodaphone bid on Mannesmann exemplifies this new situation. Only a deep financial market can provide capital for large operations (often funded by corporate bonds) that give birth to European industry giants.

***Conclusion*:** Europe has paid in the 1990s the price for the adaptation of its institutional framework to new growth conditions and for its integration. As both are under way, the current signs of a revival in growth reflect a structural shift in the right direction.

5. POLICY IMPLICATIONS

What can governments do for fostering growth in Europe, while not losing valuable aspects of the "European model" (especially its emphasis on social cohesion)? Following the above analysis, government should strengthen the knowledge base of European economies, foster competition on all markets, encourage innovation and push forward the integration of European economies. At the same time, governments should limit social disparities – an objective that may be difficult to make consistent with the preceding ones. While not setting up a catalogue of possible measures to take, a few examples may give substance to this policy agenda. One will see then that European governments and the European Commission have started, sometimes long ago, in most cases more recently, to work in this direction, although following often a piecemeal approach. It is now at the top of the agenda of European policy makers to help promoting an innovative, high growth economy.

- Research policies must have a built-in European dimension (which does not exclude international co-operation beyond Europe). The goal is to create a really European field for science, as there is one in the US, generating both complementarity, competition and circulation of knowledge between now rather separate research communities. Examples of measures that go in this direction are: i) strengthening a few high level universities, world class research centres, by concentrating resources on a few selected "centers of excellence" (instead of trying to promote research in all regions, whatever their ability to do so, as do some EC programs); ii) encouraging the circulation of graduate students and researchers across the EU ("Erasmus program"). iii) Increasingly, large research equipment must be part of international programs (recent case of the British-French synchrotron), in order both to reduce cost and enhance quality of research. The CERN is of course the leading example.

- Innovation policies: contrary to tradition in some countries, innovation policies must be market friendly –help the market to work instead of substituting for it. Innovation policies should favour new and small firms, as they are faced with larger barriers than big firms (access to capital, to markets, to skills); university/industry relationships should be strengthened (commercialisation of results from public research, creation of networks involving public and business research); the diffusion of ICT should be encouraged among SMEs. There are a few examples in the past of such innovation policy programs, ANVAR in France, or Fraunhoffer Institutes in Germany. But there are not many such examples, and in both countries, as in other European countries, an in-depth reshuffling of innovation policies is under way along the above lines. It is also important to encourage co-operation between firms from different countries (the EC framework programs already try to do that). Finally, creating a EU patent is necessary for simplifying intellectual property issues in Europe and reducing the cost of protection.

- Structural policies, for more unified and more flexible markets: privatisation of the remaining government owned industrial companies (e.g. power industry in France);

promote competition (deregulation and anti-trust); encourage risk taking (bankruptcy law must be more friendly to the entrepreneur according to a recent EC report; taxes on stock options are very high in some countries). Capital should circulate more easily across borders within Europe: the Euro was a great achievement in this respect; further advances would include a more homogeneous tax system, more integrated financial markets (Neuer markt, Nouveau Marché, Easdaq) that could raise funds at a European scale for innovation, and a European corporation status (in discussion for more than 20 years now) that would simplify the conditions for setting up large European firms.

- Education and training: one strength of most European countries (Vs the US) is a high quality of their primary and secondary schooling system, which provides relatively qualified workers for intermediate skills levels. While this must be kept, Europe must strengthen the high end of its university (tertiary) level, that is currently relatively weak. This should be done in co-ordination with research policy (see above).

- Most of these recommendations, if successfully implemented, lead directly or indirectly to higher income inequalities. The trend towards a more equal income distribution, started in the first half of this century, reversed in the US in the late 1970s and stopped in Europe in the early 1980s (it reversed in the UK at least). But increased unemployment in Europe has hidden potential wage inequalities, that will turn out as many low skilled are coming back to work. Why this reversal? Basically, growth based on competition and innovation goes hand in hand with inequalities, for many reasons (information rents for the decision makers, reward to risk taking); the knowledge based economy increases the demand for high skilled workers, reducing the price of low skilled labour. Inequalities as they have developed in the US are unacceptable in most European countries. They would lead to social disruption and would have counter-productive effects. It is necessary to ensure security and some income equality among citizens, through redistributive policies that: i) do not give incentives to keep out of work, and ii) do not penalise failure for citizens who take risk.

6 CONCLUSION

Due to technical change, globalisation and more competitive markets, economic growth is gaining momentum again in Europe, in the steps of the US. There are macro-economic imbalances in the US, especially the low (actually negative) households saving rate and the related balance of payments deficit: part of investment is financed by foreign capital, as well as immigration of scientists allows partly free (but not sustainable) imports of human capital. The business cycle is not dead, and growth will slow down at some point in the future, even a recession may occur. This will not change however the fact that a more innovative and more competitive economic structure has been built in the US and some other countries, that is a basis for long term growth. Europe is now on the way to achieve a similar situation, with competition and innovation gaining momentum here too. In order to realise all the potential gains that the new economic context conveys, European countries must keep embracing a policy aimed at accelerating European integration, strengthening their science base and allowing greater flexibility of markets while preserving social cohesion.

Table 1: GDP Growth (average annual growth)

	1995-98	1990-95	1990-98
Australia	4.0	2.7	3.3
Austria	2.6	1.7	2.1
Belgium	2.3	1.4	1.8
Canada	2.9	1.6	2.2
Denmark	3.1	2.4	2.7
Finland	4.6	-1.1	1.4
France	2.1	0.8	1.4
Germany	1.6	1.1	1.3
Greece	2.6	1.0	1.7
Ireland	8.7	4.1	6.1
Italy	1.2	1.2	1.2
Japan	1.2	1.4	1.3
Netherlands	3.1	2.0	2.5
N. Zealand	1.5	2.6	2.1
Norway	3.7	3.5	3.6
Portugal	3.2	1.6	2.3
Spain	3.3	1.2	2.1
Sweden	1.9	0.3	1.0
United King.	2.7	1.4	2.0
United Stat.	3.7	1.7	2.6

Source: OECD, Economic Outlook.

Table 2: ICT investment, as a share of non residential investment (%)

	Canada	France	Germany	Italy	Japan	UK	US
IT							
1985	6.9	6.1	3.4	3.4	3.4	5.2	6.3
1990	7.3	5.0	3.5	4.1	3.8	7.5	8.7
1996	10.1	6.0	6.1	4.2	4.6	11.7	13.4
Communication							
1985	4.2	4.0	3.7	2.4	0.8	5.2	5.8
1990	5.3	3.8	3.7	3.6	1.5	5.8	7.0
1996	6.1	4.9	4.8	5.4	3.5	6.6	6.5

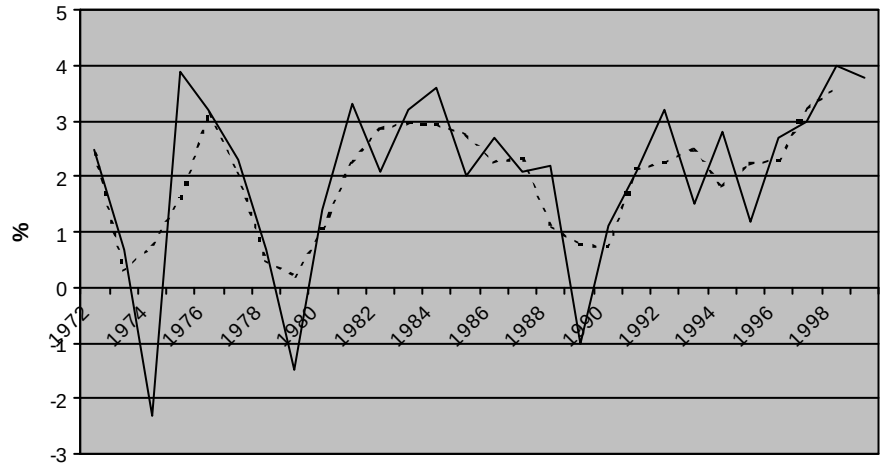
Source: OECD estimates.

Table 3: Share of business in Higher Education R&D funding

	1989	1999
Australia	2.3	5.2
Belgium	12.6	10.6
Canada	6.3	10.8
Denmark	1.5	1.8
Finland	4.8	14.1
France	4.6	3.1
Germany	7.0	9.7
Italy	2.6	4.8
Japan	2.2	2.4
Netherlands	1.1	4.3
Norway	3.9	5.2
Spain	9.2	6.5
Sweden	7.9	4.5
UK	7.7	7.1
US	4.5	6.0

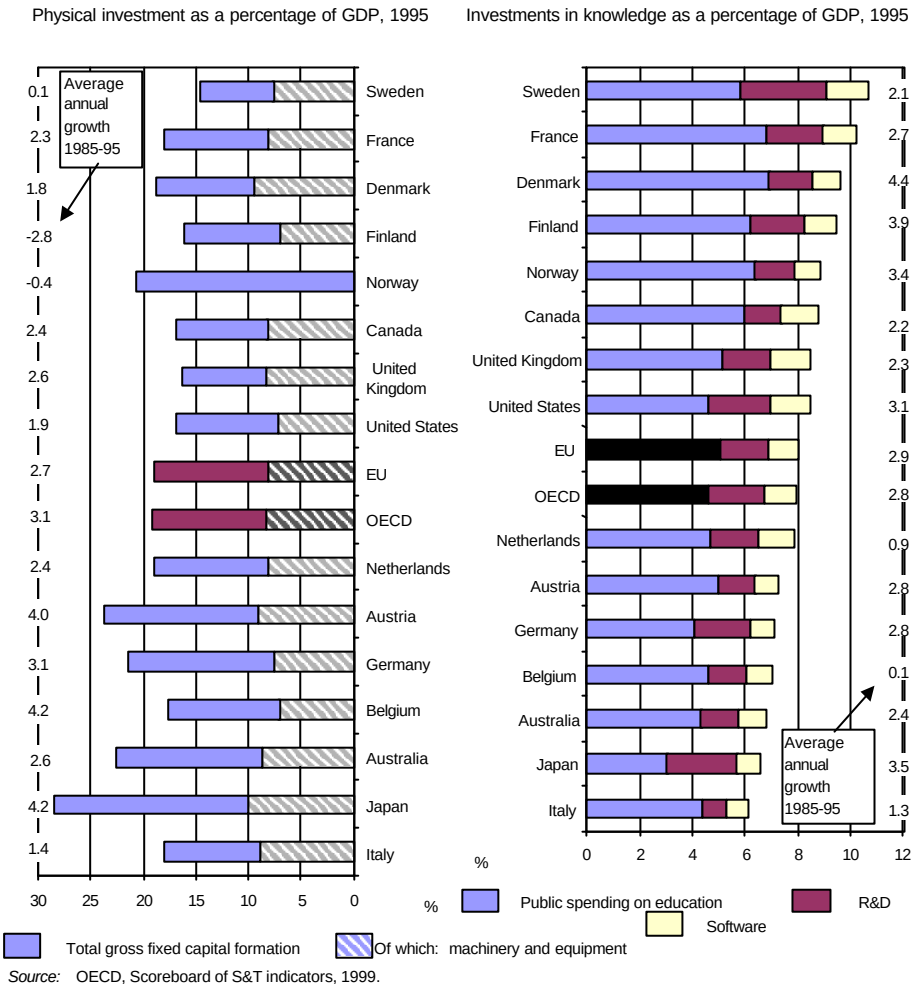
* Or latest year available

Figure 1: Output per hour, US business non financial sector



Source: BLS.

Figure 2: Investment in tangibles and in knowledge



Source: OECD, Scoreboard of S&T indicators, 1999.

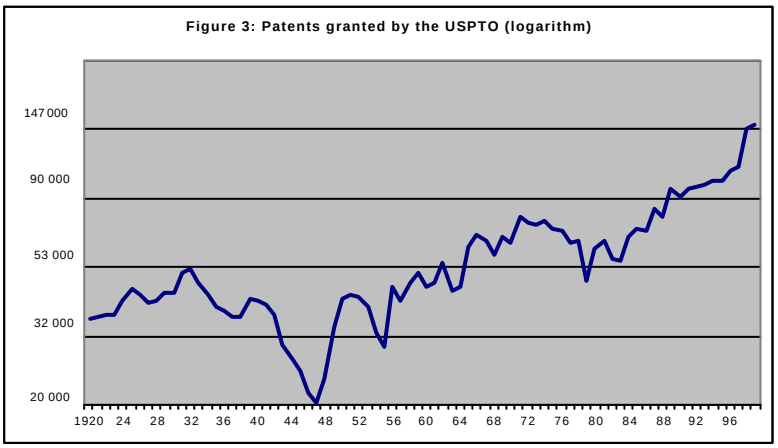
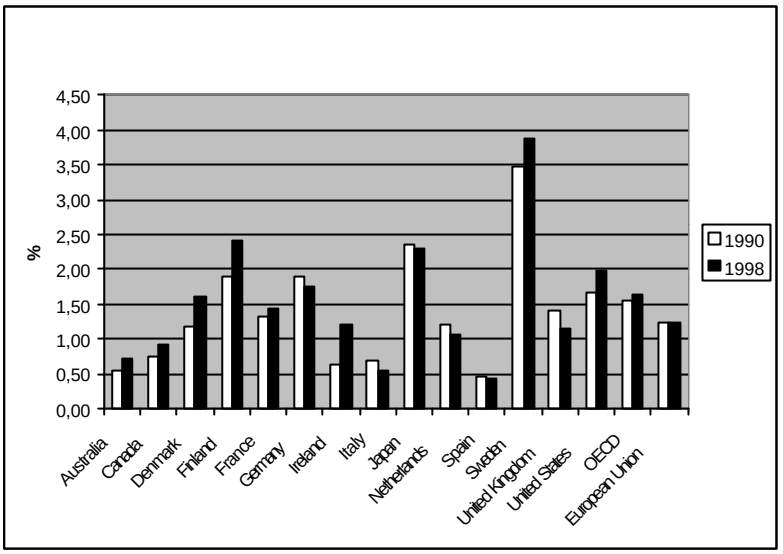


Figure 4: R&D financed by business as percentage of business sector GDP



Box 1: Measurement of output and productivity

Several measurement issues arise when time series of inputs, outputs and productivity are compared at the international level. Currently, the three most pertinent issues in output measurement are (i) the independence of output from input measures, (ii) the use of chained and fixed-weighted indices and (iii) the treatment of price indices of information technology products, in particular computers. Although it is not possible to draw overall conclusions about the extent of a bias in international comparison of growth rates of output, the following observations can be made: (i) *Independence of output from input measures*. A vital point for the validity of productivity measures is that price and volume indices of inputs and outputs are constructed independently of each other. Dependence occurs, in particular, when output volume series are based on the extrapolation of input measures, for example when employment series are used to carry real output series backwards and forwards. The use of extrapolation methods, which occurs most frequently in industries that mainly comprise non-market producers (such as health or education), generates, in all probability, a downward bias within each country. It is difficult to make statements how extrapolation bears on cross-country comparisons of growth rates of output.

(ii) *Chained and fixed-weighted indices*. Economic theory and the 1993 System of National Accounts recommend the use of chain-weighted indices over the use of fixed base years for the analysis of time series of outputs, inputs and productivity. The main reason is that chain-weighted indices minimise the substitution bias implicit in fixed-weight price and volume indices that occurs in periods of rapid change of relative prices and quantities. To date, only a small number of OECD countries have introduced chain-weighted indices. Whether this reduces or increases comparability is difficult to assess. Comparability is reduced with respect to a (hypothetical) situation where every country employs fixed weight indices with the same base year. However, in practice, there have always been significant differences in the periodicity at which countries re-based fixed-weight index numbers and in the degree to which the new base was carried backwards. It is certain that international comparability is being improved between those countries that employ chain-weighted indices.

(iii) *Computer deflators*. Methods to construct price indices of computers and peripheral equipment varies between OECD countries. The use of hedonic methods in the deflation of computers tends to produce much more rapid price declines than other methods. Hence, the growth rate of volume output of those countries that do not use hedonic methods is likely to exhibit a downward bias. This is almost certainly true for volume output measures of the computer industry. Whether or not an industry-level bias carries over to aggregate measures of GDP depends on the size and delivery structure of the computer and ICT industry

(*Source: OECD 1999*).

Box 2: Venture capital

1. Venture capital

Venture capital (VC) can be defined as equity or equity-linked investments in young, privately held companies, where the investor is a financial intermediary, who is typically actively as a director, an advisor, or even a manager of the firm. Using a variety of mechanisms, VC are able to finance many risky early-stage projects with no tangible assets. First, business plans are intensively scrutinised: historically, only 1% of those firms that submit business plans to VC have been funded. The VC's decision to invest in a project is frequently made conditional on the identification of a syndication partner who agrees that the invest. Is attractive. Once the decision is taken, VC disburse funds by stages. To ensure that the money is not squandered, managers of VC backed firms are forced to return repeatedly to their financiers for additional capital. In addition, VC intensively monitor managers. These investors demand representation at the board of directors and preferred stocks with numerous restrictive covenants.

2. Recent developments in OECD countries

The VC was traditionally a US industry, with some diffusion in Canada and to a lesser extent the UK. Since 1995 VC has been booming in all European countries, and the share of technology in VC has increased sharply. This is not the case yet in Japan.

Table 2: Amount invested by VC funds, US$PPP billion

	1995	1997	1998
Europe: total VC	2.6	4.1	6.0
Of which: technology	1.3	2.3	4.0
US: total VC	6.2	11.5	14.3
Of which: technology	3.6	7.8	10.5
Japan: total VC			0.4
Of which: high technology			0.1

Source: PriceWaterhouse, EVCA, MITI.

US: First created in 1945, VC experienced a big push in the early 1980s, after pension were allowed to invest part of their assets in risky ventures. There have been a strong acceleration in the second half of the 1990s, which is going on in 1999 (more than 100% growth for the first three quarters over 1998). Most high tech firms created since the late 1970s in the US have been backed by VC. The recent surge of VC investment is fuelled mainly by internet related investment, that jumped from one quarter of VC in 1998 to one half in 1999 (amount multiplied by five). VC is very concentrated in a few areas (37% in Silicon Valley, 10% in New England/Massachusetts, 8% in New-York Metro, in Q3-1999).

Europe: The VC industry was traditionally small, except in the UK, and not focused on high tech segments and early stage funding. It has surged in all countries since 1995 (similar growth as in the US), especially in technology related fields. Why this surge?

- The US has shown the way to investors and government (the example was made visible by the press, its viability demonstrated by US economic growth, its recipes learned through European entrepreneurs established in the US and US VC funds crossing the Atlantic);
- Secondary financial markets were set up;
- Macro-economic conditions improved (in 1997), increasing the availability of funds;
- Deregulation in some industries opened new opportunities: telecoms;

New policy in some countries: creation of government funds, fiscal measures etc. Creation of a more business friendly environment.

Japan: VC is very low as compared to other countries. This is related to the weak openness of some markets (telecoms), to the industry organisation (keiretsu, cross-shareholding limit the scope of entrepreneurial activity), to the job market (life long employment for the skilled reduces mobility and increases the risk of going to a small start-up firm), and to the absence of a secondary market where investors can exit. Japanese VC tend to invest small stakes in many firms (in 1998, the average size of a deal was US$ 0.5 million in Japan, as compared to 4.7 in the US and to 1.1 in Europe), in order to diversify their risk. In FY1998, less than 2% of investment went to the creation of new firms, whereas more than 35% went to firms aged 20 years or more. VC funds do not get involved in the management of firms therefore not bringing expertise to the backed firms. Most funds ("VC associations") are affiliates of stock brokers, that make money by underwriting the floatation more than from their investment. The MITI is currently working on a new policy package aimed at fostering VC (that includes a government VC fund).

3. The contribution of VC to innovation and growth

There is apparently only one quantitative study of the relationship between innovation and VC. Kortum and Lerner (1998) explore the experience of 20 US industries over a 30 years period. They find that, controlling for the amount of R&D, VC investment has a significant positive impact on patenting. VC, even though it is less than 3% of R&D, may be responsible for 15% of patenting in the 1990s. On a separate sample of firms, they show that not only VC backed firms patent more than similar, non VC backed firms, but also their patents are more cited and more aggressively litigated, which indicate a higher technological and economic value. Also, VC backed firms are more frequent litigators of trade secrets, which suggests that they are not simply patenting more in lieu of relying on trade secret protection.

Anecdotal evidence: Silicon valley has been boosted by VC. Most large high tech firms in recent decades have been the offspring of VC (Microsoft, Netscape, Compaq, Sun Microsystems, Intel, Apple, Digital Equipment Corp., Genentech, etc.). Over the last twenty-five years in the US, almost 3000 companies financed by venture funds have gone public.

4. Policy aspectsVC is only one component of a broader system aimed at financing innovation in start-up firms. Its is one stage in the innovation chain that goes from investors (institutional, individuals) to entrepreneurs, and one stage in the financing process (from initial investors to IPO or acquisition). Therefore, a well functioning VC is important for the whole system, but it is not sufficient for giving momentum to innovation economy-wide. The experience of OECD countries suggest certain conditions that allow VC to play an active role in the broader innovation dynamics:

- Government VC funds may be useful in countries where VC is not yet developed, or for providing seed capital. Otherwise, government funds may crowd out private funds.
- Investment in VC funds by institutional investors (pension funds, life insurance funds, banks) should be allowed to the extent that it is compatible with prudential rules.
- Fiscal treatment of capital gains and revenues coming from investment in VC should be friendly, as the risk incurred by investors is higher than in other types of endeavours.
- Stock options should be allowed and taxed not too heavily: they are the only way for cash less firms to attract the human capital (technology and management skills) that must complement their financial capital.
- Secondary markets (NASDAQ type) should be created where they do not exist, so that investors can recoup liquidity securely.
- An entrepreneur friendly environment: simple conditions for the creation of firms, bankruptcy laws that protect to some extent the entrepreneur, encouragement for public and university research to be transferred to the business sector (incubators around universities).
- A general environment that support the openness of markets (e.g. telecoms, energy) and mobility of the labour force (especially for skilled workers).

BIBLIOGRAPHY

BRENDER, A. and PISANI F. (1999), "Le nouvel âge de l'économie américaine". Economica. Paris.

DARBY, MICHAEL R., QIAO LIU, LYNNE G. ZUCKER (1999), "Stakes and Stars: TheEffect of Intellectual Human Capital on the Level and Variability of High-Tech Firms Market Values". NBER Working Paper No. 7201

DASGUPTA, P. and P. DAVID (1994), "Towards a New Economics of Science", Research Policy 23 (4): 487-521

KORTUM, J. and J. LERNER (1998), "Stronger Protection or technological Revolution: What is behind the Recent Surge in Patenting?", Carnegie-Rochester Conference Series on Public Policy.

HICKS, D. and S. KATZ (1997), "The Changing Shape of British Industrial Research", STEP Special Report No. 6.

MACROECONOMIC ADVISERS, LLC (1999), "Productivity and Potential GDP in the New" US Economy. Mimeo.

NARIN, F., K. HAMILTON AND D. OLIVASTRO (1997), "The Increasing Linkage between U.S. Technology and Public Science", Research Policy 26(3): 317-330.

NSF (1998), Science and Engineering Indicators. Washington D.C.

OECD (1998), Technology, Productivity and Job Creation. Paris.

OECD (1999), Economic growth in the OECD area: Are the disparities growing?

OECD (1999b), Implementing the OECD Jobs Strategy. Assessing Performance and Policy.

OECD (1999c), Patents as indicators of internationalisation.

UNCTAD (1998), World Investment Report: Trends and Determinants.