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May 28, 1998

MEMORANDUM FOR JON ORSZAG

FROM: David Lane
Eric Biel

SUBJECT: Ideas for President's June 5 Commencement Address at MIT

This memorandum suggests themes for the President's June 5 remarks and provides background information on MIT that might be of interest. We have also attached copies of the Department's recently released report, *The Emerging Digital Economy*, and remarks delivered by Secretary Daley at a May 11 "town forum" on "*Developing a Competitive Information Technology Work Force*."

Suggested Themes

Technology's Contribution to the Strong U.S. Economy. Our sustained U.S. economic expansion is the product of *deliberate decisions by this Administration* to invest in the engines of economic growth -- in research and technology -- and to make the United States an attractive place for business, investment, and entrepreneurship.



Over the past 5 1/2 years, government and the private sector have focused on investing in the infrastructure needed for the new "knowledge-based" economy. Today, investments in information technology represent nearly half of all business equipment investment. What once seemed to be a distant vision of an "Information Superhighway" is today taking shape. In 1994, three million people used the Internet; by 1997, that had grown to over 100 million -- with Internet traffic doubling every one hundred days. When the President took office, only 50 websites existed. Now 65,000 pages are added every hour. Business transactions on the Internet are expected to reach \$300 billion by 2002 -- and that electronic commerce is still in its infancy. The MIT venue provides the President with an ideal opportunity to emphasize to the young engineering students the amazing array of opportunities ahead of them in this relatively young, path-breaking industry. (Indeed, many MIT students probably view the Internet not as a new innovation, but rather as we view a telephone -- an integral, well-established part of their everyday lives. You can remind them of how far we have come and how far we have yet to go in preparing for the digital age of the 21st Century.)

Commerce's recently-released report, *The Emerging Digital Economy*, provides some perspective on just how quickly and significantly things have changed. Today, the information technology industries constitute over eight percent of total U.S. GDP; they are responsible for fully one-quarter of economic growth during this Administration. Information technology workers earn over 60 percent more than the average private sector wage. Finally, a less obvious effect of the

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information technology revolution is the impact on inflation. Our report reveals that information technology was responsible for a one percent drop in the inflation rate last year.

Innovation and Economic Growth. Economic analysis reveals that whereas, over the course of the 20th century, increases in physical capital (i.e., new plant and equipment) have accounted for roughly 12 percent of U.S. economic growth, increases in human capital (i.e., gains in the education, skills, and ability of our workforce) have accounted for double that -- about 25 percent of overall growth. And innovation broadly defined -- encompassing not only new technologies and processes but also new ways of marketing, financing, and distributing goods and services, of organizing the workplace and running businesses -- accounts for as much as 45 percent of growth. Moreover, technological innovations help drive the other facets of growth by requiring new physical capital, new skills, and so on.



Technology and the Spreading of Economic Benefits. This speech provides an opportunity to help refute the argument that technological advancements are creating a "two-tier" American economy -- in which high-tech industries are advancing and "traditional" manufacturing industries are losing ground. In fact, new information technologies, and electronic commerce in particular, are "generic" technologies in the sense that they benefit a broad cross-section of Americans, including traditional firms that need to become more productive and innovative.

More generally, as the *Emerging Digital Economy* report details, these information technologies can be a democratizing force, in that the productivity and income gains are available to any firm or individual who acquires the skills to take advantage of them. While it is also true that those who do not gain the necessary skills are likely to lose ground economically, the opportunities to obtain such skills are much more broadly available than in the past.

Technology and Education. While a great deal remains to be accomplished, this Administration's coupling of increased investment in research and development with increased investment in education is bearing fruit, and more students and workers are on the path to a "lifetime of learning."

As noted above, the economic rewards of an advanced education are more critical than ever -- both in terms of wage levels and employment stability. Demand for high-skilled jobs in certain sectors exceeds supply and, as the Commerce Department has reported, over the next decade we will need an additional 1.3 million workers to fill newly-created "high-end" information technology positions. Never before have the highly-educated graduates of MIT been as well-positioned to contribute to U.S. economic growth as today -- whether those contributions are in academic research, as high-tech entrepreneurs, or in another field that benefits from MIT graduates' mix of a broad-based educational background with expertise in science and technology. And the President can remind them that they have an obligation to share their knowledge and skills with a society becoming ever more dependent on the technology that they have spent the past four years learning about.

Technology and Today's Critical Challenges. The President may wish to mention examples of the challenges that the graduating MIT students are poised to address in the years ahead -- from helping find a cure for cancer and AIDS to assisting tobacco growers find new uses for their crops to designing cars that get 100 miles per gallon of gas. The central point here could be that the most important technologies may well be those that we use -- and take for granted -- every day. With the leadership of today's MIT students, perhaps 10-20 years from now an AIDS vaccine will be seen not as some revolutionary discovery but as nothing more unusual than a measles or polio shot.

Highlighting MIT Accomplishments

Innovations developed at MIT. Perhaps one way to provide some historical context for these remarks would be to focus on the remarkable role that MIT and its faculty have played in the development of leading-edge technologies throughout this century. Worth highlighting in this regard is the development of radar by MIT's Radiation Laboratory during World War Two -- an accomplishment described in Robert Buder's 1996 book, *The Invention that Changed the World*. As Buder writes in his Preface, the Radiation Laboratory at MIT was "the cradle of much World War II radar development and the technological revolution that roared in war's wake . . ." The book details the implications the development of radar has had for some of the most important advances in both engineering and the physical sciences during the past half century, and for what Buder terms the "endless intertwinement of science and technology" in areas ranging from air traffic control to weather monitoring to key military applications. As importantly, it provides a great illustration of the benefits derived from the fact that the Radiation Laboratory was a civilian-led enterprise. This both broadened the ability to recruit the leading academic minds for the project and minimized the bureaucratic constraints on the project.

This speech also could highlight the fact that the first Presidential Science Advisor, James R. Killian, Jr. (appointed by President Eisenhower), as well as several of his successors such as Frank Press (President Carter) were recruited from leadership positions at MIT.

Intellectual Property and MIT. According to our Patent and Trademark Office, MIT received more utility patents (generally, those that are not for plants or designs) than any other U.S. university or college between 1969-96. During that period, MIT was awarded 1769 such patents; only the University of California system was even close to that number.

'Use technology to create jobs'

By Robert Chote,
Economics Editor

Industrial countries devote too much effort to promoting new technology in the small "high-tech" sector, rather than fostering innovation and technology diffusion more broadly through the economy, ministers heard yesterday.

The Organisation for Economic Co-operation and Development, the Paris-based think-tank for industrial country governments, insisted in a report to its ministerial meeting that new technology should promote jobs rather than destroying them. "Its economy-wide employment impact is likely to be positive provided that the mechanisms for translating technology into jobs are not impaired by deficiencies in training and innovation systems and rigidities in



product, labour and financial markets," the report said.

The OECD argued that governments should make innovation and technology diffusion policies an integral part of their overall economic strategy.

"Technology policies continue to be piecemeal, with insufficient consideration given to linkages within national innovation systems and to the broader structural reform agenda," it admonished. "To be effective, they need to operate in a stable macroeconomic environment and complement broader reforms."

The OECD noted that government funding for

research was falling and that the private sector was concentrating on short-term innovation rather than basic research. It argued that public research institutions had to be funded adequately, although there was scope to make them more flexible by channelling resources through contracts.

"At the same time, governments should remove impediments to the development of market mechanisms for financing innovation, such as private venture capital," the report argued. This chimes with recent comments by Gordon Brown, UK chancellor. Partnerships between the private and public sectors should be encouraged, but while minimising the risk that this would channel money to private sector companies that should or would have financed the research themselves.

In another report prepared as part of the OECD's "jobs strategy", the think-tank argued that governments should also do more to foster entrepreneurship. Again the promotion of venture capital markets is important, as is reducing the cost and paperwork associated with starting a business. Tax compliance also needs to be simplified.

The report also emphasises the need to use local authorities to promote entrepreneurship, on the grounds that they understand the needs and potential of their own areas. Governments should also do what they can to create a culture conducive to entrepreneurship, one in which business failure does not carry an unduly negative stigma.

The final report discussed under the heading of the jobs strategy looked as

investment in human capital - skills and education. It noted that there was agreement that investment in human capital should be encouraged, but great difficulty quantifying it and therefore assessing policy effectiveness.

The report noted that between a third and a half of adults in industrial countries lacked the kinds of literacy skills needed to function well in modern society. The distribution of human capital and earning power is worryingly skewed.

The OECD argued that policies should focus more on the costs and benefits of particular policies. It noted that some money spent on college and university education might yield more benefit for society as a whole if it was spent on ensuring that more people completed upper secondary education.

settlement

By George Graham, Banking
Editor, in London

IBM is to build and operate the new settlement bank which is being set up to handle the \$3,500bn of foreign exchange trades settled each day.

CLS Services, the consortium set up by a group of leading international banks to handle the foreign exchange settlement problem, said it had chosen IBM to design and build the new settlement system and to operate it for at least five years after it starts up in mid-2000. The communications will be supplied by Swift, which operates the main interbank network.

Yesterday's announcement coincides with the deadline set two years ago by central bankers for the private sector to come up with a solution to the problem of settlement risk in foreign exchange trading. The deadline inspired creation of the settlement bank. It also spurred banks to tighten their internal procedures, and triggered the development of netting services.

Foreign exchange trades today are mostly settled by paying the two different cur-

rencies banks settle in known as the clearing - that a receiving foreign exchange before payment. When it comes to the trade, that one midstream manager, Morgan CLS Services, a consortium, significant the stratification of clearing. Members of 20 banks project shareholding in given the CLS financial settlement. The bank to set

OECD SPENDING ON LONG-TERM CARE FOR ELDERLY NEEDS TO BE MORE COST-EFFECTIVE, SAYS REPORT

Research 'should focus on the aged'

By Robert Chote

Medical research and technology should be focused on areas such as senile dementia and arthritis, which rob older people of their independence, according to a report discussed by ministers from leading industrial countries yesterday.

Spending on health and long-term care for the elderly needs to become more cost-effective, the report on ageing by the Organisation for Economic

Co-operation and Development, said.

The report was discussed at the OECD's ministerial meeting in Paris.

"People are leading longer and healthier lives", the report noted.

"Nevertheless, population ageing means that health and long-term care costs are likely to rise, although perhaps by less than was once feared".

The report noted that care-giving for frail old people was often fragmented and unnecessarily expensive.

The industrial country think-tank is only the latest of several international forums to offer its thoughts on the implications of an ageing population.

It noted that over the next 25 years the number of people aged 65 and over would rise by 70m, while the number of those of working age would rise by 5m.

Many of the report's conclusions were familiar. Countries were urged to cut government borrowing and move to a mix of public and private pension provision.

The report also noted that the development of funded pension systems should go hand-in-hand with reform of financial market infrastructure.

"Middle and higher-income earners will want to supplement their public pensions," the report said.

"Therefore, it will be important to establish a sound regulatory framework for private pension funds, including, occupational pension schemes".

The OECD said that pension and tax systems and

social programmes provided a strong disincentive for the elderly to keep working.

"Removing these disincentives, perhaps even providing positive incentives to work longer, and coupling them with effective steps to enhance the employability of older workers, could make an important contribution to sustaining the growth of living standards," the report added.

Also, it said that employers would have to change their attitude to employing older workers.



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Technology, Productivity and Job Creation

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Council at Ministerial Level, 27-28 April 1998**TECHNOLOGY, PRODUCTIVITY AND JOB CREATION -
BEST POLICY PRACTICES****HIGHLIGHTS****Note by the Secretary-General**

This document presents the "highlights" of the study on Technology, Productivity and Job Creation - Best Policy Practices.

The final version of the analytical report can be found in two parts: Chapters 1-5 are in C/MIN(98)7/ANN1; Chapters 6-12 are in C/MIN(98)7/ANN2.

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Or. Eng.

KEY POLICY MESSAGES

1. Technological change drives long-term economic growth, productivity and improvement in living standards. At the same time, the emergence and diffusion of new ideas, products and production techniques throughout the economy entails a process of "creative destruction". New technologies destroy jobs in some industries, especially among the low-skilled, while creating jobs which are often in different industries and require different skills. Historically, this process has led to net job creation, as new industries replace old ones and workers adapt their skills to changing and expanding demand. Today's rapid technological change coupled with the extensive restructuring underway in OECD economies leads some to associate technology with unemployment and social distress. However, technology *per se* is not the culprit. Its economy-wide employment impact is likely to be positive provided that the mechanisms for translating technology into jobs are not impaired by deficiencies in training and innovation systems and rigidities in product, labour and financial markets. To realise the full potential of technological change in improving economy-wide productivity, growth and job creation, governments need to make innovation and technology diffusion policies an integral part of overall economic policy.

Knowledge-based economies raise new policy challenges

2. The report *Technology, Productivity and Job Creation – Best Policy Practices* assesses innovation and technology diffusion policies, identifies "best policy practices" and makes country-specific recommendations. It presents evidence on the extent to which new technologies are transforming the structure of OECD economies and enhancing their ability to grow and create wealth and jobs. Economic activity is becoming increasingly knowledge-based: jobs are shifting from low- to high-skilled workers; productivity and employment growth depend on the conditions for economy-wide diffusion of new products and processes. While aggregate productivity and employment growth remain modest in most countries, those firms that combine technological change, organisational change and upskilling display strong economic performance. With globalisation, the innovation and production systems of different countries are becoming increasingly interdependent; opening up new opportunities while at the same time accentuating the need for restructuring and adaptation. Countries differ with respect to where they stand in this process of structural adjustment, because of different starting points, technological and industrial specialisations, institutions, policies and attitudes to change.

Technology policy: an integral part of the broader structural policy agenda

3. While a number of countries have undertaken impressive reforms in innovation and technology diffusion policies, current approaches are insufficiently adapted to the characteristics and problems of knowledge-based economies, and the potential contribution of technology to growth and employment remains largely untapped. Technology policies continue to be piecemeal, with insufficient consideration given to linkages within national innovation systems and to the broader structural reform agenda. To be effective, they need to operate in a stable macroeconomic environment and complement broader reforms. In an increasingly integrated world economy, product market reforms enable more rapid diffusion of technology and information, and strengthen incentives for firms to innovate and adapt goods and services to changing consumer needs. Reforms to financial markets facilitate the allocation of capital to new technology-based entrepreneurial initiatives. Labour-market reforms, combined with measures favouring upskilling and lifelong learning, contribute to further innovation, facilitate the use of advanced technologies, and allow technical change to translate into more jobs.

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Wide-ranging policy reforms are required

4. Enhancing the contribution of technology to growth and productivity, while putting in place the conditions to translate its potential into higher incomes and employment, requires the implementation of wide-ranging and coherent policy reforms. In most OECD countries, current policies in this area focus too much on developing new technologies in the small "high-tech" part of the manufacturing sector and too little on fostering innovation and technology diffusion throughout the economy. There is scope for increasing policy effectiveness, through better use of market-based instruments and improved evaluation efforts. While substantial progress has been made in these areas, much remains to be done. There is a large potential for mutual learning among Member countries from existing "best practices" and the experience of past and current reform efforts.

- The underlying long-term growth rates in OECD economies depend on maintaining and expanding the knowledge base, while making it more responsive to economic and social needs. This is particularly important given the recent decline in government funding for research, and the shift of private sector efforts away from basic research and towards more short-term innovative efforts. The reforms required to safeguard long-term technological opportunities include: adequately financing public research institutions within increasingly tight government budgets, while raising their flexibility (by, for example, increasing the share of contract-based resources); and strengthening incentives for university-industry or inter-firm collaboration in pre-competitive research. ★
- Productivity growth depends on firms' innovative efforts, and all OECD governments have policies in place for the support of industrial R&D. There is significant scope for *improving the efficiency and increasing the leverage of industrial R&D support measures.* Efficiency gains could be obtained by reducing the generosity of R&D tax incentives in some countries, and by reforming support schemes in many others. At the same time, governments should remove impediments to the development of market mechanisms for financing innovation, such as private venture capital, as an alternative or complement to traditional financial R&D support. The leverage of policies can also be increased through greater use of public/private partnerships, provided that their design minimises the potential risks of capture by private sector participants, as well as dead-weight losses. Compared with traditional R&D support, public/private partnerships entail more competitive selection of participants, increased private sector participation in project selection and management, and greater leverage of public funding on private resources. R&D
- Economy-wide productivity and employment gains are generated when new technologies are diffused and widely adopted, making *strengthening technology diffusion mechanisms a key policy priority.* Open trade, regulatory reform and enhanced competition spur diffusion and innovation in areas such as telecommunications, but also in mature sectors. At the same time, better designed and integrated public initiatives can help this process by increasing the ability of firms to access and exploit new technologies. This involves enhancing the effectiveness of technology extension services and information provision through greater industry participation and cost-sharing.
- Complementarity between technology and education and training policies is important for *reducing mismatches between demand and supply for skills* and improving employment performance. This involves measures to reinforce, expand and broaden the content of vocational and technical training in a number of countries, and increased mobility between vocational/technical and academic studies. It also requires involving business more closely in government initiatives to support adoption of new work practices and work organisation

as well improving their articulation with education and training programmes. Enhancing mobility of highly skilled and technically trained workers is an important complement to the emphasis on strengthening technology diffusion mechanisms.

- *Improving conditions for the creation and growth of new technology-based firms* increases their direct job-creating potential, while indirectly contributing to economy-wide growth and job creation through higher productivity, lower prices and greater product variety. There is further scope for reducing regulatory barriers to entry and promoting private venture capital industry, including through programmes to leverage private investment. Disincentives to "technological entrepreneurship" (e.g. regulations discouraging spin-offs from universities and large firms) and obstacles to risk taking (e.g. bankruptcy law which excessively penalises failure) should be removed or modified.
- New industries such as Internet-based services and environmental goods and services play an important role for translating technical change into productivity and employment. Governments should *create an environment conducive to the emergence of demand and jobs in new growth areas* through regulatory reform encouraging flexible technological responses and entry. The combination of infrastructure liberalisation, technological innovation and flexible service conditions has led to job creation in network-based services in a number of countries. In the environmental area, combining a flexible regulatory framework with incentives encouraging innovation has led to the creation of high- and low-skill jobs to supply environmental goods and new services such as eco-auditing.
- *Improving techniques and institutional mechanisms for the evaluation of policies* will increase their efficiency. Few OECD countries systematically evaluate innovation and technology diffusion programmes based on socio-economic criteria and with resource allocation and priority-setting as goals. Others have put in place a number of evaluation initiatives, usually aimed at improving decision-making and programme management. In most countries, however, evaluation remains an ad hoc practice; there is a recognised need for the development of better methodological tools as well as improved institutional mechanisms to embed evaluations in policy making.

Reforms need to be made politically feasible

5. Achieving consistency and credibility in implementing reforms is key to best policy practice, and requires overcoming institutional inertia as well as addressing transition costs and the redistribution of incomes and jobs associated with technological change. Factors for success include the extent to which co-ordination can be achieved between different ministries and the involvement of various stakeholders. Checks must be put in place against government failure, such as institutions furthering their own special interests, or adopting a partial rather than an economy-wide perspective. Measures to promote upskilling and lifelong learning can raise the mobility and employability of workers, mitigate the costs of job displacement resulting from rapid technological change and reduce resistance to reform. At the same time, policies must be designed so as to avoid undermining incentives for work, upskilling, organisational change and restructuring.

EXECUTIVE SUMMARY

Introduction

6. Technological change drives long-term economic growth, productivity and improved standards of living. It is however a process of "creative destruction". New technologies destroy jobs in some industries, especially among the low-skilled, while creating jobs which are often in different industries and require different skills. Historically, this process has led to net job creation, as new industries replace old ones and the skills of workers adapt to changing and expanding demand. Today's rapid technological change coupled with the restructuring underway in OECD economies leads some to associate technology with unemployment and social distress. However, technology *per se* is not the culprit. Its economy-wide employment impact is likely to be positive provided that the mechanisms for translating technology into jobs are not impaired by deficiencies in training and innovation systems and rigidities in product, labour and financial markets.

7. OECD countries increasingly seek wide-ranging and coherent policy reforms to enhance the contribution of technology to growth, productivity and jobs. As of today, this potential contribution remains largely untapped, with policies not yet fully adapted to the characteristics and problems of knowledge-based economies. While weaknesses remain in the framework conditions for technological change, innovation and technology diffusion policies themselves continue to be too piecemeal, with insufficient consideration of the linkages within national innovation systems and to the broader structural reform agenda. There is too much focus on measures assisting the development of new technologies in the small high-tech segment of the economy and too little on fostering economy-wide innovation and technology diffusion. There is also scope for improving policy effectiveness, notably through more use of market-based instruments and hard evaluation of the impact of policy initiatives.

8. The report assesses the policy reform efforts of OECD countries, identifies "best policy practices" in different technology policy areas and presents recommendations (summarised in Box 1). It is part of the follow-up process to the 1994 *Jobs Study*, which included a number of wide-ranging policy recommendations aimed at reducing unemployment and raising living standards, and formed the basis for in-depth examinations of individual countries. The 1997 report, *Implementing the OECD Jobs Strategy*, examined progress made, and provided suggestions on how to make different policies mutually strengthening and reform more politically feasible, e.g. through co-ordination of different policies. In the area of innovation and technology diffusion policies, which formed part of the original *OECD Jobs Study* recommendations, the 1996 *Technology, Productivity and Job Creation* report provided new evidence on the role of technology in economic performance, and recommended further policy action. Building on those findings, this report contributes to the ongoing reform process in OECD countries in two ways:

- by identifying the appropriate roles of government in regard to the linkages among technology, productivity and job creation in a policy environment characterised by increased globalisation, the move to the knowledge-based economy, the systemic nature of technical advance, and changing patterns of government funding and firms' innovative strategies;
- by assessing innovation and technology diffusion policies in OECD countries and providing country-specific recommendations as to how technology policies should be improved, as well as how they could be better implemented and integrated with other reforms (summarised in Table 1).

Box 1. Summary of main policy recommendations

1. Innovation and technology diffusion policies need to become an integral part of the broader policy agenda through:

- better co-ordination with structural reform in product, labour and financial markets and in education and training systems as well as with macroeconomic policy;
- openness to international flows of goods, people and ideas coupled with policies increasing the absorptive capacity of domestic economies.

2. Policy should help realise the productivity benefits of technical change by:

- improving the management of the science base via increased flexibility in research structures, and strengthening university-industry collaboration;
- ensuring that long-term technological opportunities are safeguarded through adequate financing of public research and incentives for inter-firm collaboration in pre-competitive research;
- raising the efficiency of financial support for industrial R&D while removing impediments to the development of market mechanisms for financing innovation, e.g. private venture capital, as an alternative or complement to traditional financial R&D support;
- strengthening technology diffusion mechanisms by encouraging more competition in product markets and through better design and delivery of programmes ;
- strengthening incentives for comparable measurement and reporting by firms of intangible investment to improve the management and composition of investment.

3. Policy should ensure favourable conditions in which technical progress can contribute to job creation by:

- helping to reduce mismatches between demand and supply for skills and improving the framework for firms to adopt new organisational practices;
- facilitating the creation and growth of new technology-based firms by fostering greater managerial and innovation capabilities, reducing regulatory, information and financing barriers and promoting technological entrepreneurship;
- promoting new growth areas such as Internet-based services and environmental goods and services through regulatory reform which encourages flexible technological responses and new entry.

4. The efficiency and leverage effects of innovation and technology diffusion policy initiatives need to be strengthened via:

- improving techniques and institutional mechanisms for evaluation;
- adopting new mechanisms for supporting innovation and technology diffusion through greater use of public/private partnerships;
- removing obstacles to international technology co-operation by improving transparency in foreign access to national programmes and securing a reliable framework for intellectual property rights.

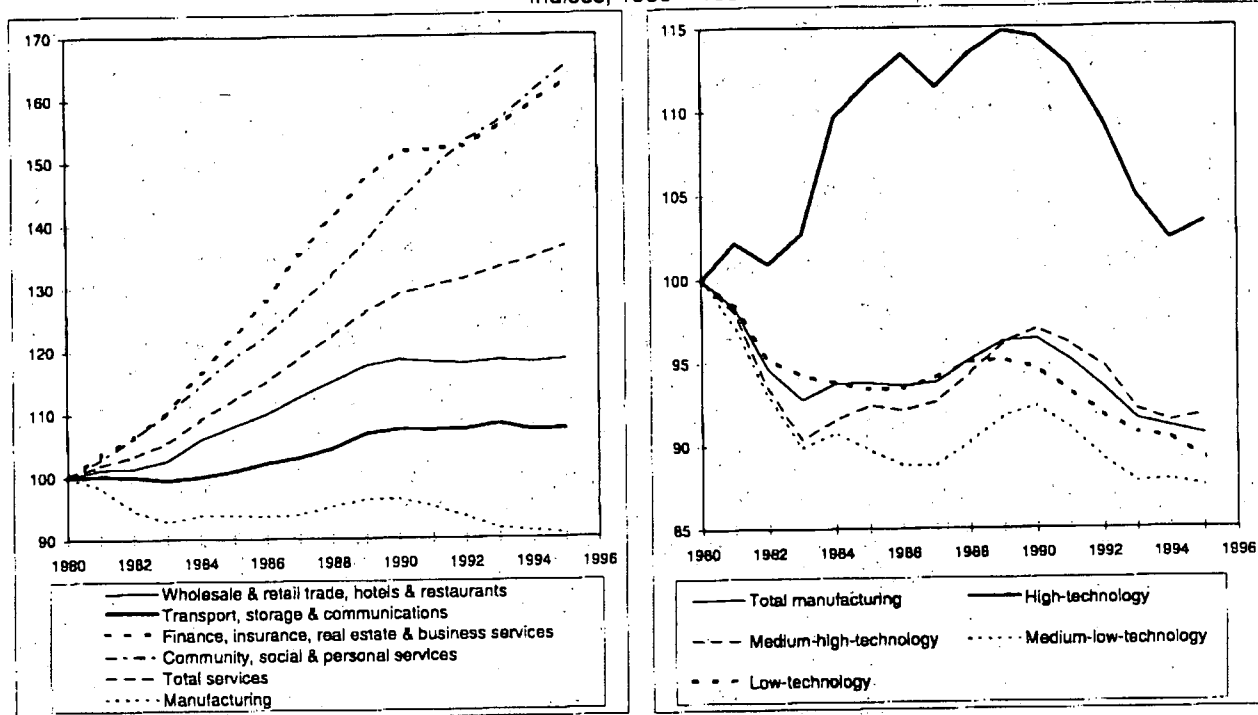
5. Reforms need to be made politically feasible through:

- improved inter-ministerial co-ordination, involving major stakeholders and monitoring of implementation, to ensure consistency and credibility in policy formulation.

Box 2. The changing policy environment in knowledge-based economies: key findings

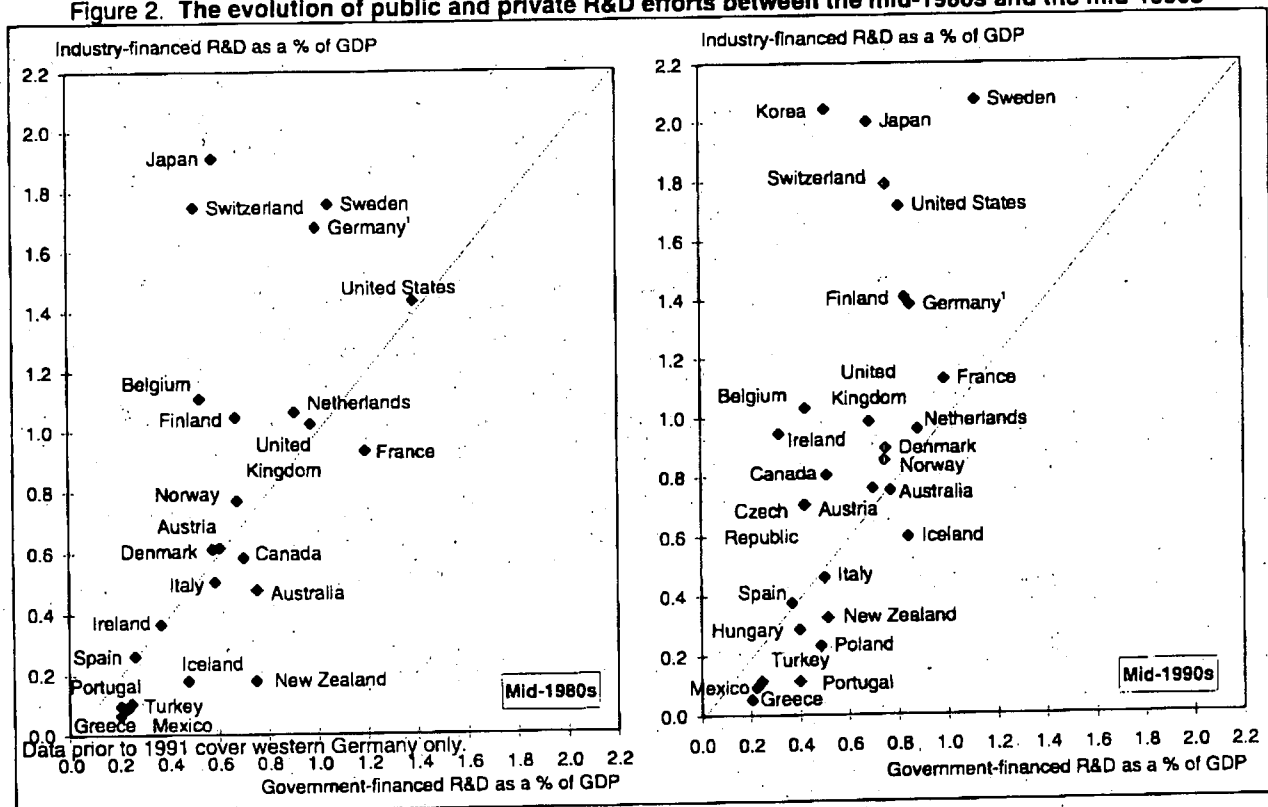
- *Many OECD countries show weak employment growth and/or increasing income inequality, with an employment structure shifting towards high-skilled workers.* Growth in white-collar, high-skill jobs (e.g. professionals) has been very dynamic in most countries, although in some low-skill employment has also increased, and in others employment in some high-skilled occupations has declined. More generally, the content of skills in both high- and low-skilled occupations is changing rapidly.
- *OECD economies are increasingly knowledge-based, with a shift of economic activity to services, and to high-tech and innovative activities.* Two-thirds of OECD production and 70 per cent of jobs are in services, whose nature is being transformed by information technologies, innovative efforts and upskilling. Most of employment growth is also in services (Figure 1). While manufacturing has declined in importance, its high-tech segment is very dynamic in terms of output and productivity, although less so in terms of jobs. Technology-based industries in manufacturing and services accounted directly for between one-quarter and one-third of G7 output growth between 1980 and 1995. But their economy-wide impact is most notably felt through the diffusion of new products and processes, generating productivity and employment gains throughout the economy.
- *Aggregate productivity growth remains modest, but the combination of technological change, organisational change and upskilling helps many firms achieve strong productivity growth and job gains.* Evidence from firm-level studies suggests that R&D-performing and/or technology-using firms have higher than average productivity and employment growth, but that other factors, such as worker training, organisational structures and managerial ability, are critical. There is a tendency for a smaller average size of firm, and small and medium-sized enterprises (SMEs) are of increasing importance for net job creation, although their average productivity remains lower than that of larger firms.
- *Globalisation is knitting dense and diversified linkages among national innovation systems.* The technology content of international trade is rapidly increasing, with the share of high-tech products growing faster than any other commodities, and technology embodied in imported capital and intermediary goods contributing significantly to productivity growth. International technological alliances and purchases of foreign patents and licences have grown. Corporate innovation activity remains predominantly located close to firms' headquarters; nevertheless, there is a marked tendency towards internationalisation of R&D, mostly by firms based in smaller home countries.
- *Government financing for R&D declined in many countries.* The share of R&D financed by government stagnated since the early 1980s (Figure 2), with its level declining in real terms in many countries (including all G7 countries except Japan). This affected support for technology more than for science as funding for defence and economic objectives fell while that for health, environment and the advancement of knowledge rose. As government-financed R&D in industry declined, closer links have developed between business and scientists, and scientific research has become the leading source of innovations in fields such as biotechnology, blurring the distinction between science and technology.
- *Private-sector R&D has generally levelled off, and there are signs of an orientation away from basic exploratory research towards more market-driven and short-term innovative efforts.* Slower economic growth, declining government support for industrial R&D and high interest rates caused a stagnation of private R&D expenditures in the mid-1980s/early 1990s. The recent recovery has not led back to previous R&D intensities. There are also indications of a re-orientation away from basic exploratory research towards more market-driven, short-term efforts. Market pressures, on the other hand, have in many cases raised the efficiency of R&D. While no serious adverse consequences have been felt to date (since it is mainly long-term research which has suffered), such effects may show up in the future.

Figure 1. Employment trends by industry, total OECD
Indices, 1980 = 100



Source: OECD, STAN, ISDB databases and Labour Force Statistics database, 1997.

Figure 2. The evolution of public and private R&D efforts between the mid-1980s and the mid-1990s



1. Data prior to 1991 cover western Germany only.

Source: OECD, MSTI database, 1997.

Best policy practice and main policy recommendations

9. The purpose of innovation and technology diffusion policy is to create the conditions in which new ideas, products and processes can translate into maximum economic and social benefits. This requires fostering a strong knowledge base, innovative capacity and behaviour on the part of firms, and conditions for diffusion and adoption of technology throughout the economy. Traditionally, governments have intervened in this area so as to provide for public goods as well as to address externalities, inefficient market structures, barriers to entry, imperfect markets for information, etc. However, there are limits to effective government action and the existence of market failures does not necessarily mean that action is justified. The nature of the factors shaping technical progress increasingly calls for policy measures to address "systemic failure", which occurs when there are mismatches between the different components of innovation systems, such as conflicting incentives of markets and non-market institutions.

10. The main features of the changing environment for innovation and technology diffusion policies are laid out in Box 2. OECD economies are experiencing a wave of technological change as indicated by the swift pace of scientific discovery, high patenting activity by the private sector, the rapid diffusion of new technologies, notably information and communication technologies, and a growing share of knowledge-based industries. However, this report shows that the economic outcome of technical change crucially depends on how technology is diffused, absorbed and used throughout the economy, as well as by structural impediments to job creation. There are marked differences between countries in how these processes take place, partly reflecting differences in the specialisation and structure of innovation systems.

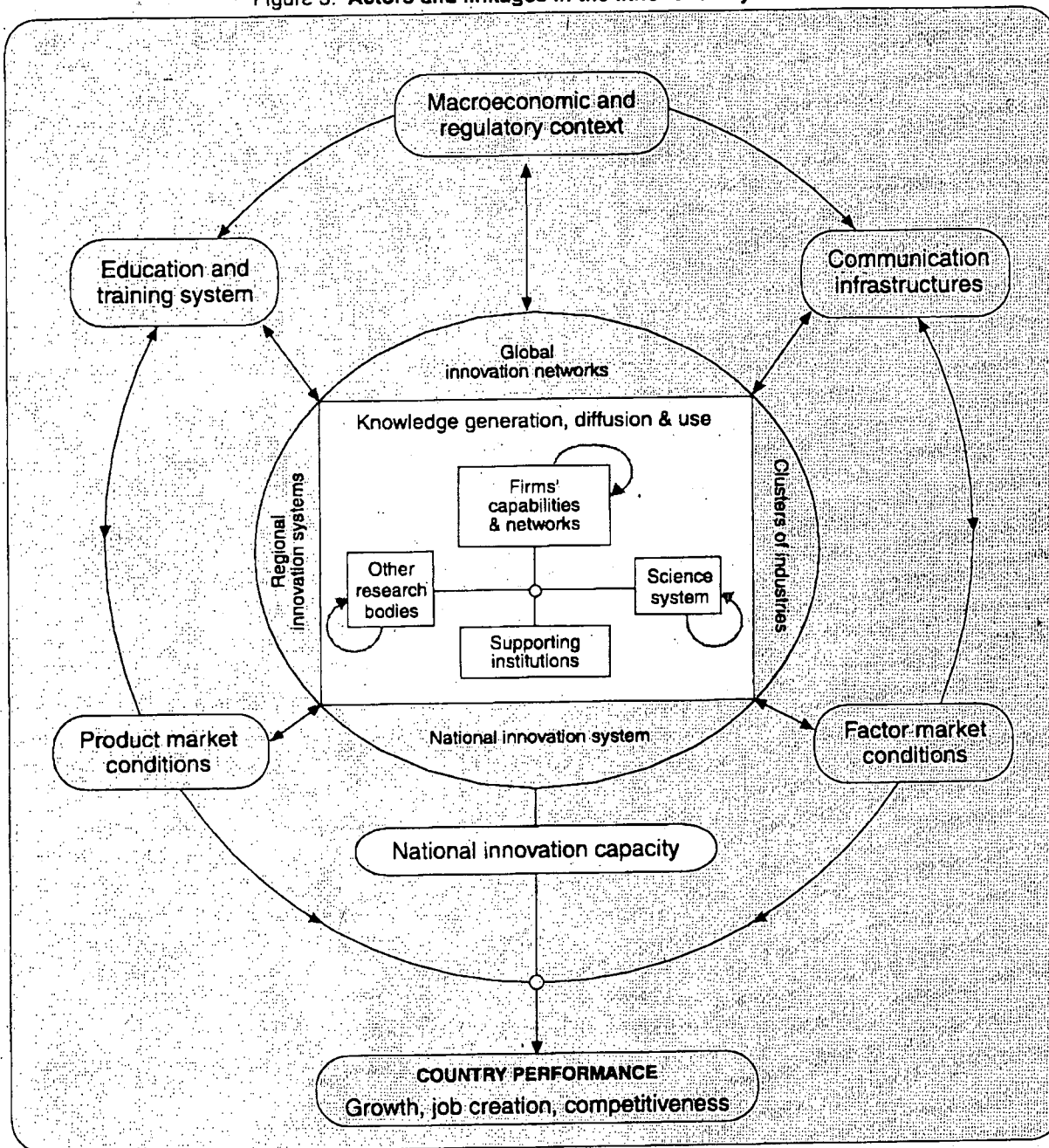
11. This changing environment calls for the actions which go beyond innovation and technology diffusion policy defined in a narrow sense, encompassing only those government actions and regulations that are directly technology-related, and whose main instruments are managed by ministries and public agencies with technological development or diffusion as their main mission. The present report extends the boundaries of technology policy to include all measures targeting innovation and technology diffusion, irrespective of institutional arrangements and division of labour within government (for example, an R&D tax incentive is included even when managed by the Ministry of Finance), as well as related policies with a different primary goal (e.g. education or training). Figure 3 illustrates actors and linkages in countries' innovation systems.

Technology policies need to become an integral part of the broader policy agenda

12. The impacts of innovation and technology diffusion policies will be modest unless they are consistent with, or complemented by, broader reforms. In this respect policy-makers should:

- *Ensure complementarity between technology policy and reforms in product, financial and labour markets, as well as in education and training.* In an increasingly integrated world economy, product market reforms enable more rapid diffusion of technology and information, and strengthen incentives for firms to innovate and adapt goods and services to changing consumer needs. Financial market reforms facilitate new technology-based entrepreneurial initiatives. Labour market reforms, combined with measures favouring upskilling and lifelong learning, contribute to further innovation, facilitate the use of new technologies, and allow technical change to translate into more jobs. There is a need for technology policy to act in concert with further structural reform, such as product and labour market reform in many European countries, broad-based upskilling in a number of countries including the United Kingdom and the United States, regulatory reform of product and financial markets in Japan and Korea as well as in Europe, and comprehensive strengthening of framework conditions in transition economies.

Figure 3. Actors and linkages in the innovation system



Source: OECD Secretariat.

- *Co-ordinate technology policy and macroeconomic policy.* A sound macroeconomic environment is a necessary precondition to innovative behaviour and investment in technology. Technological progress, on the other hand, affects macroeconomic performance and policy in a number of ways, including via its impacts on growth, prices, measurement of output and inflation, and the stability of tax bases. International technology co-operation (for example in the context of the European integration process) can spur technology diffusion, industrial restructuring and long-term economic performance, helping to make structural reform feasible and strengthening the credibility of

macroeconomic policy. Policy-makers should look for positive synergies between technology policy and macroeconomic policy, for instance, in fostering more reliable conditions for long-term investment and innovation. In some cases, severe economic shocks have helped to muster support for improved policy co-ordination as a means to break out of vicious circles (Finland, Japan).

- *Build on the globalisation process through openness to international flows of goods, people and ideas and policies increasing the absorptive capacity of domestic economies.* To fully benefit from the internationalisation of trade, investment and knowledge, policy-makers, especially in small countries, need to foster a strengthened interplay between absorptive and innovative capacity. Virtuous circles in technology, growth and employment can be set off by openness to foreign direct investment, as in Ireland. Japan and Korea have benefited from technology imports and incremental innovations, but now need to upgrade their innovative capacity. This requires comprehensive reforms in several areas, including competition policy, frameworks governing universities and industry relations and their approach to sourcing of foreign technology. In Germany, public investment in the R&D infrastructure must be complemented by broader structural reforms so as to effectively raise inward flows of R&D and know-how.

Realising the productivity benefits of technical change

13. Technology directly increases the productivity of innovating firms, and indirectly raises economy-wide productivity through its diffusion and adoption. As information and communication technologies become pervasive, the potential for economy-wide productivity gains shifts from high-tech manufacturing to the overall economy, and notably to the expanding service sector. The realisation of these potential productivity gains can be helped by policies which either directly encourage technology development and diffusion or seek to remove obstacles to such activities arising from market, policy and systemic failure. They involve regulatory reforms in product and factor markets, policies that allow domestic firms to take advantage of international sources of technology, and also encompass direct policy initiatives providing services to firms aimed at increasing their capacity to absorb new technologies, as well as to engage in collaborative research with other firms.

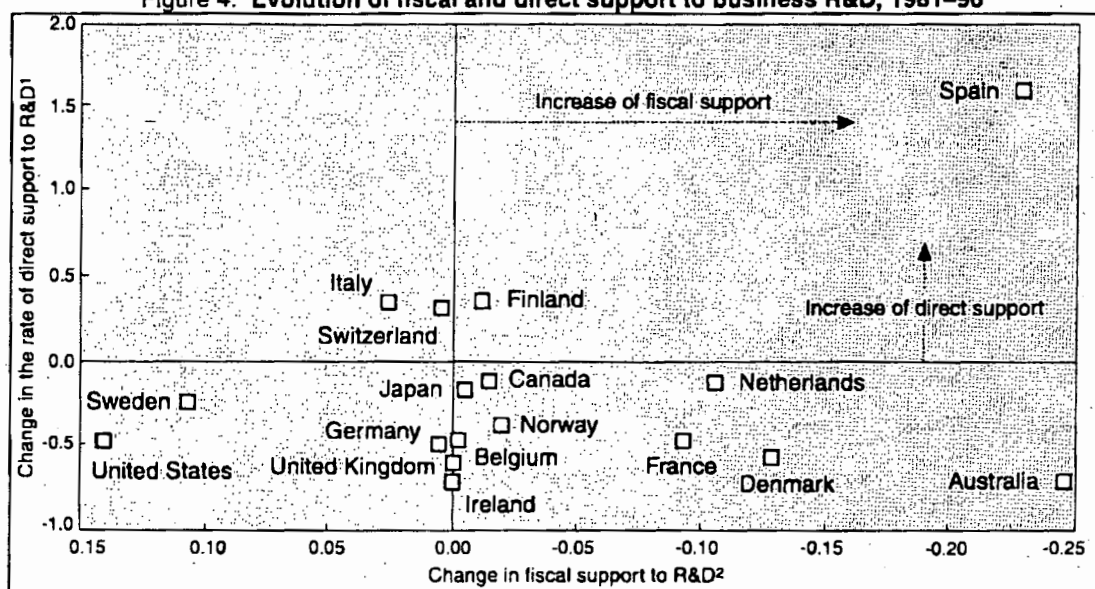
14. Policies are needed not simply to encourage the efficient diffusion of and exploitation of technology, but also to encourage innovation and growth in the knowledge base of an economy. This involves initiatives aimed at improving the management of the science base, as well as reforming support schemes of industrial R&D so as to increase their leverage effect on firms' R&D efforts and consequently improve productivity. However such policies will only be fully effective if complemented by measures which help firms improve their performance in terms of non-technological aspects of innovation, e.g. adoption of new organisational structures and upgrading workforce skills. Policy-makers need to:

- *Improve the management of the science base* via increased flexibility in research structures and incentives for university-industry collaboration. An important current issue is the appropriate balance between core and contract-based resources in financing research institutions. While in some countries there is a risk that the share of contract-based resources becomes excessive, in many others (notably in Continental Europe) increasing that share will stimulate flexibility and the responsiveness of research structures to economic and social needs. There are benefits from greater involvement by industry and other stakeholders in setting research priorities (including cross-disciplinary research). The experiences of Australia, Canada, Sweden, the United Kingdom

and the United States are instructive in this respect. The research Framework Programmes of the European Union have for the last 15 years focused on supporting co-operation between universities, research centres and firms as well as the international mobility of scientists. The organisation of research in universities and government laboratories should both stimulate scientific excellence and facilitate mobility of ideas and people. A number of countries need to take measures concerning the status and training of university researchers, their conditions of employment, and other factors influencing mobility, including possibilities for creating their own firms.

- *Ensure that basic, exploratory research is kept at a level which allows technological opportunities to be maintained in the long run.* Increasing market pressure on firms has led many to improve the efficiency of their research activities in terms of economic outcomes. However, it has also reduced the funding of basic, exploratory research, whose outcomes are uncertain or difficult to appropriate. In addition to the appropriate funding of public research within increasingly tight government budgets, it is important that policy induce research by firms, or at least does not deter them from undertaking it. Many public programmes (the Advanced Technology Programme in the United States, the Framework Programme and Eureka in Europe) aim at encouraging co-operation between firms, and sometimes universities, on such "generic technologies". The regulation of concentration (mergers and acquisitions) and R&D co-operation increasingly takes this aspect into account. Antitrust policies in Europe, Japan and the United States have adapted to such concerns since the early 1980s. Still, governments generally need to improve the balance between allowing co-operation upstream, where it helps to keep research costs down and allows partners to benefit from each other's competencies, and enforcing competition downstream, when it comes to production and marketing, where it allows consumers to benefit from lower prices.
- *Raise the efficiency of financial support for industrial R&D while better weighing its merits relative to other instruments for financing innovation.* While there is a sound economic rationale for some public support to industrial R&D, in the form of either tax incentives or targeted R&D subsidies, in most countries there is room for improving such schemes. (Figure 4 shows the evolution of the two types of support over the last 15 years in a number of countries.) Efficiency gains could be obtained by reducing the generosity of R&D tax incentives in some countries (Canada, Spain), or by fine-tuning their inducement mechanism (Australia, France, Japan). A common weakness in measures to support pre-competitive R&D is that funding mechanisms remain relatively crude, in contrast with the increasing sophistication of market financing tools (e.g. venture capital). Many programmes to promote near-market R&D on a project basis have had mixed results; this explains recent efforts to streamline or reform them (e.g. Austria). As removing the impediments to the development of market mechanisms for innovation financing becomes increasingly attractive, countries should assess the appropriateness of the current scope and design of their financial support for industrial R&D.

Figure 4. Evolution of fiscal and direct support to business R&D, 1981-96



1. Percentage change in the rate of direct support to R&D, measured as the percentage of business R&D financed by government.
2. Change in the value of the B-index. The B-index is an indicator of the generosity of R&D tax treatment. The lower its value, the more generous the R&D tax treatment.

Source: OECD Secretariat.

- *Strengthen technology diffusion mechanisms by fostering competition in product markets and through better design and delivery of programmes.* Technology diffusion can be strengthened through open trade, competition and regulatory reform. Better designed and integrated public initiatives can help this process by increasing the ability of firms to access and exploit technologies. Enhancing competition and liberalisation of infrastructure has a strong potential for spurring innovation and diffusion in growing sectors such as telecommunications as well as in mature sectors, particularly in Austria, France, Germany and Spain. Australia, Finland, the Netherlands and the United Kingdom have consolidated the institutional infrastructure for diffusion policies so as to reduce overlap, while in France there exists a potential for overlap between national and regional initiatives. Denmark, the Netherlands and Spain have taken measures to improve the functioning of technology transfer centres. Technology extension services and information provision have been made more effective through greater industry participation and cost-sharing in Canada, Germany, Switzerland and the United States, although in Germany many technical centres remain heavily dependent on public support. Australia, Canada and the United States have integrated diffusion issues more explicitly in technology development projects; similar action is warranted in Korea, Mexico and Spain. Schemes to promote greater technology uptake have been made more effective in Austria, the Netherlands, Norway and the United Kingdom through evaluation and a better targeting of firms.
- *Strengthen incentives for comparable measurement and reporting by firms of intangible investment to improve the management and composition of investment.* While investment in intangible assets underpins productivity growth, there may be a tendency for firms to underinvest because of the lack of visibility of such assets in reporting practices. Strengthened incentives for their disclosure can improve resource allocation through better internal management and improved external capital market assessment. There are scattered examples of good practice at the firm level, for example in Swedish firms, and experimentation in US firms. However, there are also disincentives to reporting, such as not wanting to reveal strategic information, concerns about taxation treatment

and about becoming locked into static reporting practices. Denmark is pioneering initiatives to encourage firms to disclose more systematic comparable information, based on current best practice. Similar initiatives in other countries will be important for further progress, and to enable a better understanding of the benefits of improved reporting, as well as a more favourable balance between its costs and benefits. However, in the absence of government initiatives, it is unlikely that individual efforts by firms will lead to internationally comparable reporting practices.

Ensure the conditions for technical progress to contribute to job creation

15. Technology policies must not aim at direct employment goals at the expense of productivity and competitiveness; nevertheless, a number of OECD countries are in need of policy adjustment in order to strengthen job outcomes. Reducing the potential mismatch between the skills in supply and those in demand, while ensuring complementarity between technology and human capital policies is one area for reform. Technology policy can also help improve the conditions for the creation and growth of new technology-based firms (NTBFs), which contribute directly to job creation, but even more importantly, create and diffuse new goods and services, thereby instilling a culture of innovation, encouraging investments in skills and improving economy-wide dynamic allocative efficiency. Policy measures in this respect involve fostering greater managerial and innovation capabilities, removing regulatory, information and financing obstacles and promoting technological entrepreneurship. More broadly, an important role for policy is to help create an environment conducive to the articulation of demand and jobs, including in new growth sectors such as Internet-based services or environmental goods and services. Policy should:

- *Help overcome mismatches between demand and supply for skills and improve the framework for adoption of new organisational practices.* The productivity and job gains associated with new technologies are best realised when firms make complementary investments in organisational change and upskilling. Canada, New Zealand, the United Kingdom and the United States have improved previously uneven performance in this respect; nevertheless, to varying extents they still need to expand and improve vocational and technical education and training. Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) and many continental European countries as well as Japan have traditionally done well in these respects but a number of them must combine greater firm-level flexibility with improvements in vocational education and strengthen its links with business. Expanding or improving the content of vocational and technical education is an issue for Austria, Belgium, Germany, Iceland, the Netherlands, Norway and Switzerland, improving links with business an important issue for Finland and France, while Austria, Germany, Japan and the Netherlands should facilitate mobility between vocational/technical and academic studies. Expansion and improvement of vocational education is of prime importance for the group of "catch-up" countries, including Italy, Greece, Portugal and Spain. Nordic and continental European countries and Japan have a strong infrastructure and traditions supporting diffusion of information on new work organisation and work practices, but this institutional infrastructure needs to reinforce its links with business and become more demand-driven as well as more closely co-ordinated with education and training programmes.
- *Facilitate the creation and growth of new technology-based firms by fostering greater managerial and innovation capabilities, reducing regulatory, information and financing barriers and promoting technological entrepreneurship.* Governments must address the specific factors which restrain the number of valuable entrepreneurial technology-based projects, raise obstacles to their transformation into business start-ups, and weaken subsequent market selection processes to the detriment of firms with growth potential. Increasingly this must include measures which spur greater management and innovation capabilities within firms, raising their potential for growth and investment in technology and skills. Regulatory barriers to entry should be reduced, and private

venture capital industry promoted (including specialised financial market segments and "business angel" networks). This may be achieved through programmes to leverage private investment (e.g. in Australia, Germany and the Netherlands), or relaxing investment rules for pension funds, banks and insurance companies (e.g. in Australia, Finland and Italy). Direct financial support should be concentrated on early stages of innovative ventures (seed capital or pre-investment appraisal). Disincentives to "technological entrepreneurship" (regulations discouraging spin-offs from large firms and universities) and obstacles to risk-taking (e.g. bankruptcy law which excessively penalises failure, lack of stock options which improve the risk/reward ratio for highly-qualified staff) should be removed.

- *Promote new growth areas such as Internet-based services and environmental goods and services through regulatory reform which encourages flexible technological responses and new entry.* The emergence of new industries to replace declining ones is important for growth and job creation. In new areas such as network-based services and environmental goods and services, government measures have helped to foster market-driven innovation, technology diffusion and economic expansion. Policies to facilitate growth need to integrate and co-ordinate different policy targets (encouraging positive social impacts of Internet-based services, the goals of environmental and technology policy), combine consistent regulation and economic incentives covering supply- and demand-side market behaviour of individuals and firms, and avoid lock-in to particular technologies. Jobs in network-based services have been created in access providers and new media due to infrastructure liberalisation, technological innovation and flexible service conditions. Best practices are found in Canada, Finland, the United Kingdom, the United States and the European Commission. High- and low-skill jobs are similarly being created to supply environmental goods and in new services such as eco-auditing; the distribution of jobs is shaped by combining flexible application of regulations with economic incentives encouraging innovation. Best-practice policies are found in Canada, Germany, Japan, the Netherlands, New Zealand, Nordic countries and the United States.

Improve the efficiency and leverage effects of innovation and technology policy initiatives

16. There is a need for improvement in the efficiency and leverage effects of innovation and technology diffusion policies via:

- *Improved techniques and institutional mechanisms for evaluation.* The increasing emphasis on evaluation partly reflects tight government budgets, but is also emblematic of a trend towards more accountability, transparency and the desire to minimise distortions from government policies while maximising their leverage effect. Only a few countries (Australia, Canada, the United Kingdom and the United States) systematically evaluate the whole range of technology programmes based on socio-economic criteria and with resource allocation and priority-setting as goals. While evaluation in these countries is mature and institutionalised, further efforts are needed to allow better comparison of the relative efficiency and effectiveness of different policy tools. In Europe, the European Commission has helped to put evaluation on the policy agenda in certain countries, by developing methodologies and supporting networks of evaluators. Among European countries, Denmark, Finland, France, Germany, the Netherlands, Norway, Sweden and Switzerland have well-developed evaluation practices, but tend to use evaluation mainly for improving programme management. Their approach provides part of the information necessary for managing the systemic nature of modern innovation systems, but fails to provide a sufficient basis for allocating public funds between competing uses. The approach taken to evaluation in New Zealand is similar, while in Japan a number of recent initiatives take a more rigorous methodological approach to evaluating socio-economic impacts of programmes. In Greece, Ireland, Italy, Portugal and Spain, as well as in

the Czech Republic, Hungary, Mexico, Poland and Turkey, evaluation remains ad hoc, and there is a need to institutionalise the process by developing the methodological tools and mechanisms that will help embed evaluations in policy making.

- *Adoption of new mechanisms for supporting innovation and technology diffusion through greater use of public/private partnerships.* Public/private partnerships seem particularly well suited for correcting market failures in certain areas (e.g. development of generic industrial technologies) while minimising some systemic failures, by fostering co-operation between different actors (examples of such programmes exist in Australia, Austria, Japan, the United States and the European Commission). In comparison with traditional R&D subsidies, they entail a more competitive selection of private participants, an increased influence from the private sector on project selection and management, as well as greater leverage of public funding on private resources. Public/private partnership schemes have the potential to enhance synergies between market-driven R&D and R&D responding to governments' needs in accomplishing their direct missions (e.g. defence, public health, environment, etc.), provided that they can be designed so as to minimise the potential risks of capture by private sector participants, as well as dead-weight losses. Realising this potential is of particular importance for countries with a large public research sector (e.g. France, the United States). It involves different types of adjustment to policy practices, for example: the need to improve synergies between mission-oriented national programmes and diffusion-oriented regional initiatives (e.g. in Austria, Germany and the Netherlands), or to make the technology diffusion infrastructure more flexible in supporting diffusion, adoption and innovation in a broad range of firms and activities (e.g. in Nordic countries).
- *Removal of obstacles to international technology co-operation by improving transparency in foreign access to national programmes and securing a reliable framework for intellectual property rights.* International discrepancies in the access of foreign firms to government-funded research programmes have been reduced, especially following positive initiatives in Japan. Rules (e.g. reciprocity requirements or conditions regarding exploitation of research results) and practice now differ as much from programme to programme as from country to country. They should be made more transparent, especially in the United States where each of the many agencies involved in technology policy applies its own eligibility criteria. There is scope for improving other aspects of the regulatory framework for trans-border co-operation among private enterprises, especially in the area of intellectual property rights. Despite progress in harmonization under the aegis of the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO), the lack of predictability in intellectual property rights and standards, enforcement and litigation still hampers firms' global operations, particularly in new technology fields.

Making reforms politically feasible

17. Achieving consistency and credibility in implementing reforms is key to best policy practice, and requires overcoming institutional inertia as well as addressing transition costs and redistribution of incomes and jobs resulting from technical change. A fundamental question is whether the signals sent by policy to individuals and firms are consistent and credible. Factors for success include the extent to which co-ordination can be achieved between ministries and also involve various stakeholders. New forms of interaction with the private sector have helped dynamise research policies and innovation systems and better link them to economic and societal goals in Denmark, Finland, Germany, the Netherlands, the United Kingdom, the United States, as well as within the framework of the new Innovation Action Plan of the European Union. Many countries could further implement checks against government failure, use

financial pressures to spur change in governance as well as "audits" and international benchmarking to induce critical self-examination.

18. Policy-makers should pursue international policy co-ordination, which may help achieve consistency in national reforms and secure broad public acceptance. Governments also have an important role to play in ensuring that mobilisation of efforts takes place at the regional and local levels, *e.g.* through the design of administrative and fiscal frameworks. Along with the goal of transparency of policies and resulting impacts, governments should put in place incentives which spur competition among local authorities in initiatives for improved framework conditions rather than in mere attraction of financial support.

19. Technology policies need to be part of a broader package, developed in consultation with the social partners to ease transition problems. One strategy is to begin with those measures which appear to be the most feasible, universally supported and whose effects are likely to be the most evident. Once these measures have been in existence for some time and their effects have been evaluated, necessary corrections can be implemented and more difficult decisions can be pushed through. Science and technology policies in Finland, Iceland, Japan and the Netherlands have been able to evolve along these lines. Even when "big bang" policies have been introduced, technology policy has generally evolved gradually over a period of decades (*e.g.* New Zealand). On the other hand, the ability to advance may hinge on the political will to push through difficult decisions, handle the associated transition costs and demonstrate positive outcomes. In some countries, a crisis situation has helped muster support for reform (*e.g.* Finland, Japan). It is important that policy makers exploit such opportunities as they arise, thereby preventing conditions from deteriorating to a degree which makes it extremely difficult to repair the damage.

20. Measures that promote broad-based upskilling and lifelong learning can help to raise the mobility and employability of workers and mitigate the costs of job displacement resulting from rapid technological change. To the extent that innovation and technology diffusion contribute to economic performance and increased job creation overall, they should help improve social cohesion. Social security programmes and transfers protecting social cohesion will nevertheless continue to play an important role in preserving a social fabric conducive to trust; itself a major building block for risk-taking, innovation and creativity in a broader sense. At the same time, such policies must not undermine incentives for work, upskilling, organisational change or restructuring. OECD countries face a major challenge in putting into place, and successfully communicating to the public, a comprehensive policy framework which allows for a mutual strengthening of social cohesion, on the one hand, and technological progress and change on the other.

Overview of the main country-specific findings

21. Table 1 presents an overview of the main country-specific findings of the report. It shows national strengths and weaknesses and serves as a guide to the best practices and policy recommendations in the background report. In summarising the evaluation of national challenges and policies in different innovation and technology diffusion policy areas, it distinguishes between five situations: (i) case of best policy practice; (ii) partial best practice policy, with minor policy recommendation; (iii) minor policy recommendation; (iv) partial best practice policy, with remaining major weakness; (v) major weakness.

22. This report defines best policy practice as a learning tool rather than a normative concept; the table should not be interpreted as a ranking of countries. Neither can it be used to prioritise policy reforms within individual countries since it is not based on a series of country reviews and does not cover

all areas of innovation and technology diffusion policy. Identified best practices are examples of successful national responses to generic problems that comprise elements (*e.g.* the general approach or a specific instrument) which could be emulated, with appropriate adaptation, in other countries. The report provides numerous examples of such best practices, although there are fewer in some areas than in others.

23. Areas where best practices are few and far between are precisely those where a systemic policy approach is inherent to success, namely: the institutional settings for policy formulation, implementation and evaluation, as well as the promotion of NTBFs and new demand. In other areas, such as technology diffusion or the management of the science base, where examples of best practices abound, they do not everywhere translate into satisfactory performance because their impact depends in part on conditions created by other policies. For example, efforts to make the science base contribute more to economic growth must be echoed by an increasing uptake of scientific inputs by the business sector – especially by NTBFs and in new growth areas. Industrial renewal brought about by firm creation and expansion of new markets will in turn enhance the effects of schemes for promoting technology diffusion.

24. For each country, the table gives indications on where policy adjustment and learning from best practices of other countries is required. Broadly speaking, three groups of countries can be distinguished. Some countries (*e.g.* Australia, Canada, Finland, the United Kingdom and the United States) exhibit few pronounced weaknesses and generally require only incremental improvements. However, except in the case of Finland, vocational and technical education and training constitute a weak point of the innovation systems of these countries and threaten long-term performance, requiring further expansion and improvement or reductions in drop-out rates. In Finland, as in Sweden, an important challenge is to make the infrastructure for diffusion better serve interactions between small and large firms. In Canada, financial support to industrial R&D should be rationalised. There is also room for improvement of the overall co-ordination in innovation and technology diffusion policies in most of these countries, including the United States.

25. By contrast, a number of OECD countries face a comprehensive agenda of far-reaching policy reforms. They include all new Member countries (the Czech Republic, Hungary, Korea, Mexico, Poland), where the institutional set-up for innovation and technology diffusion policies is still incomplete; European countries with less policy experience in this area (Greece, Ireland, Portugal, Spain, Turkey); but also more advanced countries such as Austria and Italy which face lasting problems of policy co-ordination that weaken efficiency in every technology policy area. The remaining Member countries, including Japan and other European OECD countries, fall somewhere in the middle and show more contrasted profiles of strengths and weaknesses. The weaknesses, *e.g.* in France, Germany and Sweden, partly reflect rigidities in the public research sector and related difficulties in adjusting financing and regulatory policies to the requirements of the emerging entrepreneurial model of knowledge generation and use.

Table 1. Overview of best policy practice and policy recommendations in individual areas of innovation and technology diffusion policy¹

	Chapter 5 ²	Chapter 6	Chapter 7	Chapter 8	Chapter 9	Chapter 10	Chapter 11		Chapter 12
	Institutional framework for policy formulation and implementation	Evaluation	Managing the science base	Financial incentives to industrial R&D efforts	Technology diffusion policies and initiatives	Promoting new technology-based firms	Facilitating growth in new demand	Internet-based Environment	High-performance workplaces and intangible assets
Australia	●/□	●	●/□	●	●/□	□	●/□	□	○
Austria	○	○	□	□	●/□	○	□	□	□
Belgium	○	□	□	○		○	□	○	□
Canada	●/□	●	●/□	●/○	●/□	●/□	●	●	●/○
Czech Republic		○	○		○	○		○	
Denmark	□	□	●	□	●/□	□	□	□	●
Finland	●	□	●	●/□	□	●	●	●	●/□
France	□	□	○	●/○	●/□	●/○	□	□	□
Germany	□	□	□	□	●/□	●/□	□	□	●/○
Greece	○	○	○		●/○	○	○	○	○
Hungary		○	○		○	○		○	
Iceland			●				□	□	□
Ireland	□	○	●	□	□	□	○	○	●/□
Italy	○	○	○	○		□	○	○	○
Japan	○	□	●/○	○	●/□	○	●/□	●	●/○
Korea	□	○	○	□	●/○	○	□	○	□
Luxembourg							□	□	
Mexico	○	○	○	●/○	○	○	□	○	○
Netherlands	●/□	□	●	□	●/□	□	●	●	●
New Zealand		□	□				●/□	●/□	□
Norway	□	□	□	□	●	□	□	●	●
Poland	○	○	○	○	□	○	□	□	○
Portugal	○	○	□				○	○	○
Spain	○	○	●/○	○	●/○	○	○	○	○
Sweden	□	□	●/□	□	□	○	●/□	●	□
Switzerland	□	□	□	●/□	●/○	○	□	□	□
Turkey	○	○	○	□	□		○	○	○
United Kingdom	□	●	●/□	●/□	●	□	●	□	●/○
United States	○	●/□	●/□	●/□	●/□	●	●	●/○	●/○
EC	●/○	●/□		●/□	●/○	□	●	●	●

Key: ● represents case of best policy practice; □ represents minor policy recommendation; ○ represents major weakness calling for policy adjustment.

1. The table should be interpreted with caution and not be read as a ranking of countries. Five situations are distinguished: (i) case of best policy practice; (ii) partial best practice policy, with minor policy recommendation; (iii) minor policy recommendation; (iv) partial best practice policy, with remaining major weakness; (v) major weakness. A blank means that available information was insufficient to draw conclusions.
2. This column is also based on judgement derived from other chapters.

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re:

Technology, Productivity and Job Creation

pages:

20, including cover sheet.

NOTES:



THE WHITE HOUSE /

WASHINGTON

April 24, 1998

MEMORANDUM FOR THE PRESIDENT

FROM: GENE SPERLING
SYLVIA MATHEWS

SUBJECT: *Prosperity*

As you know, two of the top reporters for the Wall Street Journal, David Wessel and Bob Davis, asked both of us to give you a copy of their recently published book *Prosperity*. They are both highly intelligent reporters who cover your policy agenda and so we wanted you to not only have their book, but also be familiar with it. Indeed, some of the themes could be relevant to your MIT Commencement Speech. We asked Peter Orszag to read the book and provide you with a summary which is attached.

cc: Michael Waldman

THE WHITE HOUSE

WASHINGTON

April 24, 1998

MEMORANDUM FOR THE PRESIDENT

THROUGH: GENE SPERLING
SYLVIA MATHEWS

FROM: PETER ORSZAG

SUBJECT: Bob Davis and David Wessell's *Prosperity: The Coming 20-Year Boom and What It Means to You*

Prosperity: The Coming 20-Year Boom and What It Means to You, a new book by Bob Davis and David Wessell of the *Wall Street Journal*, offers a decidedly upbeat prognosis for the U.S. economy. The book has two principal themes:

- Workers and firms are finally figuring out how to use computers effectively, and therefore the computer revolution will unleash a significant improvement in productivity growth over the next 20 years.
- As more people respond to the education wage premium by attending college -- especially community colleges -- and as technology makes some tasks *easier* rather than more complicated, inequality will narrow.

As discussed in the conclusion of this memorandum, some cautious optimism may be warranted on both these fronts. But two caveats are crucial. First, while Davis and Wessell put forward a very optimistic view of the world, their view is less extreme than that of some other (perhaps less responsible) prognosticators. Second, history has shown how easy it is to make forecasting mistakes, and a variety of countervailing forces could well turn out to dominate the ones identified by Davis and Wessell.

Davis and Wessell highlight their two main themes with two pedagogical devices. The first is a plethora of specific examples -- from the role of computers and enlightened management in improving productivity at the Allen-Bradley Company in Milwaukee, to the impact of Cuyahoga Community College in Cleveland in training workers for better jobs, and the experiences of the Kerley and Blentlinger families in Chattanooga through the "golden age" of 1950-1973 and the "age of anxiety" of 1973-1996. The second is broad comparisons between the beginning and end of the 20th century -- between the spread of computers now and the spread of electricity then, and between increased enrollment at community colleges now and increased enrollment at high schools then.

The computer revolution now and the spread of electricity then

Alan Greenspan has grown fond of citing research by Paul David of Stanford and others, comparing the computer revolution that we are experiencing now to the spread of electricity in the early 20th century. Davis and Wessell pick up on this theme, devoting several chapters to explaining the similarities in detail:

- In 1884, Frank Sprague exhibited his first electric motor. Nonetheless, it took four decades before the majority of America's factories moved away from the old system of shafts and belts -- which required the *entire* factory to operate or shut down simultaneously, even if only one part of the factory needed to run or be repaired -- to the new system of decentralized motors. Davis and Wessell offer several explanations for the delay, including the reluctance of managers to adopt a new and potentially risky technology given the millions of dollars they had sunk into the old belt and shaft machinery; the refinements that were necessary in the technology of electric motors, which took time to develop; and perhaps most importantly, the inherent inertia in human responses to new technology.¹
- In 1899, only 3 percent of factories used motor-driven machinery. By 1919, the share had risen only to a third. During the 1920's, however, the technology took off. By 1929, 56 percent of factories used motor-driven machinery. As Davis and Wessell write, "At that point, a majority of the nation's factories were committed to using electric technology and replacing shaft-and-belt systems with electric motors. The trend began to feed on itself. As factory after factory installed individually powered machines in the 1920s, word spread through a web of industry contacts..."
- Davis and Wessell believe that the "United States is now at a similar take-off point -- this time, powered by microcomputers. Census Bureau surveys show that about half of American workers today use computers on the job -- a fair analogy to the percentage of factories using electricity in 1920. And as with electricity, productivity will start to increase dramatically." The authors cite academic studies suggesting that computers could boost productivity growth by 0.3 to 0.5 percentage point per year (which would amount to an increase of roughly 30 to 50 percent, relative to the current long-term trend of about 1.1 percentage point per year).
- The authors note that many of the most important advances in computer and

¹ As in the computer age, the beginning of the electric age witnessed several battles among competing standards -- which slowed the dissemination of the technology. The most prominent battle in electricity standards was between alternating current (which was backed by George Westinghouse, and had an advantage in transmissions over long distances) and direct current (which was backed by Thomas Edison, and had an advantage over short distances).

communications technology resulted from government investment. The Internet is perhaps the most prominent example, but many crucial research projects were sponsored by DARPA and other government agencies. Today, the Federal government is investing roughly \$1 billion per year in computing and communications research -- relative to \$14 billion invested in the National Institute of Health.

Community colleges now and high schools then

Davis and Wessell document the role of high schools in promoting greater income inequality in the early 20th century. They argue that community colleges are likely to play a similar role in the early 21st century.

- In 1910, only about 10 percent of 17-year-olds in the Midwest were high school graduates. Controversy swirled over whether the high schools should continue focusing on traditional academic subjects (Latin and the classics) or emphasize vocational training (typing, shop, etc.). President Teddy Roosevelt complained in 1907 that "our school system is gravely defective in so far as it puts a premium upon mere literacy training and tends therefore to train the boy away from the farm and the workshop."
- In the two decades or so that followed, both enrollment and the curriculum at high schools expanded substantially. By the early 1930s, the typical Midwestern 17-year-old had a high school diploma and by 1934, as many U.S. high school students were taking typing as were taking Latin or algebra.
- Despite the increased demand for educated workers during the 1920s, the large influx of workers with high school degrees narrowed wage differentials. As Davis and Wessell argue, "in labor markets that determined whether the vast majority of Americans did well or not, there was more equality, and the expansion and evolution of the high school deserves much of the credit for that."
- Davis and Wessell believe that the nation's 1,100 community colleges will play a similar role in the 21st century. The mechanism is the same as the one operating through high school education earlier in the century: as the wage premium for better educated workers induces more people to attend school, the increased supply of educated workers drives down the wage premium and reduces wage differentials.
- Davis and Wessell cite a paper co-authored by Cecilia Rouse, a Princeton professor currently on the NEC staff, showing that each year of college course work (whether at a four-year college or a community college) raises subsequent earnings by up to 6 percent.²

² Other studies show somewhat higher returns to college education. The CEA has summarized the relevant literature as indicating a return between 5 and 15 percent per year.

Davis and Wessell note that at least partly in response to this wage premium, enrollment at community colleges has grown by 24 percent over the past decade, roughly twice the rate of growth at four-year colleges. Today, about 40 percent of today's college students are attending a community college.

- The authors emphasize that community colleges are particularly effective because they are closely integrated with -- and responsive to the needs of -- local employers, just as high schools were in the early 20th century. As they write, "What business wants, community colleges teach."³

Conclusion

What then should we take from the book? Unlike many, Davis and Wessell should be commended for being willing to make specific long-term predictions about fundamental issues affecting the economy (Paul Volcker once remarked that a forecaster could pick a number or a date, but never both!).⁴ And unlike others who are willing to make bold predictions, Davis and Wessell insist on backing up their thinking with empirical evidence and logic. The book makes a reasoned case for optimism -- provided in language that could be broadly understood.

The most recent productivity numbers seem to underscore the first theme of the book. Productivity growth over the past 25 years has averaged 1.1 percentage point per year, but increased to 1.7 percent in 1996 and 2.1 percent in 1997. While it is much too soon to declare a new "trend" in productivity growth, many observers believe that we could be seeing the first glimpses of a computer-driven uptick. As Alan Greenspan recently testified, "More recent evidence remains consistent with the view that this capital spending has contributed to a noticeable pickup in productivity..." If the recent increases in aggregate productivity growth are indeed maintained, they could help answer the puzzle of why, as Nobel prize-winning economist Robert Solow put it, "You can see the computer age everywhere but in the productivity statistics."

³ Davis and Wessell compliment you for your emphasis on community colleges, but unfairly criticize the Hope Scholarship as "lousy policy" which subsidizes "college tuition bills for upper middle-class and affluent families" instead of "concentrating on the families where it would make the most difference -- those with incomes below \$40,000."

⁴ In addition to their two principal themes, the authors argue that increased trade offers benefits for the middle class through both exports and imports. They note that exports boost incomes through improved (not necessarily more) jobs. They also emphasize the benefits of imports, which expose domestic firms to new technology and management techniques, provide consumers with more variety, and restrain inflation. As they write, "It's hard for Americans to appreciate the benefits of imports because it's impossible to imagine life without them."

Yet despite the most recent productivity figures and the evidence marshaled by Davis and Wessell on the side of optimism, at least two crucial caveats must be emphasized. First, a 0.5 percentage point increase in annual productivity growth from computers would make a significant difference in economic performance over time.⁵ But it is not nearly as dramatic as the increases that others have suggested are possible. Jack Kemp, for example, has suggested we could double the economy's growth rate, which would imply an increase of 1.1 percentage point or more. Even a 0.5 percentage point per year increase, furthermore, would imply that trend productivity growth would remain only about half of what it was before 1973 (about 1.6 percentage point per year, relative to 2.9 percentage point per year between 1950 and 1973). Thus, even if the optimism of Davis and Wessell ultimately proves correct, the potential gains are much more moderate than sometimes claimed in popular discussions.

Second, while some cautious optimism may be warranted, we should be chastened by the many historical examples in which a favorable long-term economic shift was more apparent than real. Davis and Wessell themselves cite a *Time* magazine article from 1969, before the stagflation of the 1970s, concluding that "The amazing U.S. economy may defy even the laws of physics: what goes up need not necessarily come down." Given the large uncertainties involved in forecasting the future behavior of technology and workers, such mistakes are more than possible again. For example, economists still do not understand what caused the slowdown in productivity growth around 1973. Nor do they fully understand the complex relationships involved in research and development, technological dissemination, and economic growth. While mini-computers may well be nearing their "take off" point, they may have a much longer runway than anyone has previously thought. And while inequality may indeed narrow as more people attend community colleges, it could rise if low-skilled immigration swells, trade expands dramatically, or new technology lifts the skill premium even faster than increased education reduces it. After all, the authors themselves note that community college enrollment has risen rapidly over the past decade. Yet over that period, income inequality *expanded* -- because the positive impact from increased community college enrollment was dominated by other adverse trends.

In the end, then, achieving higher growth and lower inequality in the future remains an alluring but somewhat uncertain possibility. Perhaps the best way forward is therefore to continue pursuing policies that promote growth and/or reduce inequality even if we do not, and can not, know their precise long-run economic impact. (As just one example of this effort, your advisers are currently working on policy initiatives that could be announced as part of your MIT commencement address to keep the United States at the forefront of the information revolution.) It is also worth emphasizing that unlike previous Administrations, this Administration has

⁵ Over 30 years, a 0.5 percentage point increase in productivity growth would ultimately raise GDP per capita by over 15 percent -- or over \$5,000 per person in today's dollars -- relative to the baseline. It would also reduce the 75-year actuarial deficit in Social Security by about 0.5 percent of payroll -- from 2.23 percent to roughly 1.7 percent.

always used conservative economic assumptions. We have underestimated growth and overestimated the deficit for five years in a row, and our credibility has benefitted substantially as a result.

Gov't Reports on 'Digital Economy'

ASSOCIATED PRESS

WASHINGTON (AP) -- Information technology, including business on the Internet, is growing twice as fast as the overall economy, the Commerce Department said today.

In the latest look at the impact of advances in telecommunications and computing, the Commerce report, "The Emerging Digital Economy," also found that the industry employs 7.4 million workers, some of whom earn among the nation's highest average salaries.

Traffic on the Internet has doubled every 100 days and Internet commerce among business will likely surpass \$300 billion by 2002, the report concluded.

Other findings:

The Internet is growing faster than all other technologies that have preceded it. Radio existed for 38 years before it had 50 million listeners, and television took 13 years to reach that mark. The Internet crossed the line in just four years.

In 1994, a mere 3 million people were connected to the Internet. By the end of last year, more than 100 million were using it.

Without information technology, inflation in 1997 would have been 3.1 percent, more than a full percentage point higher than the 2 percent it was.

Workers in the information technology industry earn an average of almost \$46,000 annually, compared to an average of \$28,000 for the private sector overall. Workers in the software and service industries are the highest wage earners, at almost \$56,000 annually.

"Information technology is truly driving the U.S. economy - more than previous estimates had revealed," said Rhett Dawson, president of the Information Technology Industry Council, a Washington-based trade group of U.S. information technology companies.

The report recommends that governments stay out of the growing industry, saying electronic commerce shouldn't be "burdened with extensive regulation, taxation or censorship."

Government instead should help provide legal frameworks for business on the Internet, and rules should result from "private collective action, not government regulation" whenever possible, the report said.

The Commerce Department said consumers must be getting more comfortable making online credit-card purchases: 10 million people in the United States and Canada had purchased something on the World Wide Web by the end of 1997, an increase from 4.7 million people six months earlier.

The Commerce report also notes a shortage of highly skilled workers and recommends that students be better prepared.

Countries that have an insufficient supply of skilled workers will see high-skilled, high-paying jobs migrate to countries that can supply the needed talent, the report said.

Earlier this month, a Senate committee approved a bill to raise the number of "H-1B" visas, which allow high-skilled workers to remain in the United States for up to six years -- from the current 65,000 annual limit to a maximum 115,000 for each of the next five years.

The legislation came after computer companies argued that the shortage of available talent would dampen the industry's explosive growth. Organized labor has complained that high-tech companies are trying to guarantee themselves a constant supply of foreign recruits to hold down salaries.

U.S. Department of Commerce
Wednesday, April 15, 1998
Contact: Mary F. Hanley
202-482-4883

Remarks by U.S. Secretary of Commerce William M. Daley--"The Emerging Digital Economy"

Good morning. And welcome. I am delighted all of you could be here. And I especially want to thank the Information Technology Policy Council for helping to organize this.

For several months, we have looked at the economic impact of information technologies. And I told my staff on this day, April 15th -- of all days -- I want to release the study.

As you know, this year when American taxpayers pay up, we will spend less than they send in. The last time that happened, IBM was not yet a member of the Dow; and there were no Microsofts, or Worldcoms, or Yahoos. In fact, as I look around, I think half of your companies weren't around 30 years ago.

Obviously, we arrived at this day because President Clinton and Congress took the hard medicine of downsizing and cutting programs. But the President would be the first to say that the natural strength of America -- our entrepreneurs, all of you -- also brought us here.

So, the symbolism is clear: American technologies have strengthened our economy to the point that this tax day, we are in the black.

Let me say one more thing, before I go through the numbers. This is about more than e-commerce, or e-mail, or e-trades, or e-files. It is about the "e" in economic opportunity. It is about the "e" in empowering businesses, workers, and consumers in ways that have never been done. It is about making sure this works to the benefit of all our businesses -- large and small, old and new, service or manufacturing.

~~This is about~~ whether we can give workers the skills to be a part of this. And whether this is what American consumers want, because in the end, they have all the votes. You can hook them up, but consumers have to like it, or the technology loses this election!

When I read papers, I see articles about the Internet focused on negative issues. Things like pornography, identity theft, or electronic pirating. You and I know these are only by-products of something much larger, and with a much more positive impact on people's lives.

The report I am releasing today, called the Emerging Digital Economy, documents the importance of information technologies to our economy, to our businesses, and to our consumers. This is a work in progress. It will help us make better policy decisions; and you in business make better business decisions. And, the American people need to hear this side of the Internet, too.

So, with this in mind, look at some charts.

I am pleased to announce that in the last five years, information technologies have been responsible for more than one-quarter of real economic growth.

During a time when 15 million new jobs have been created, unemployment is the lowest in 24 years, inflation is the lowest in 30 years -- let me say this again: more than one-quarter of the growth comes from information technologies.

You have demonstrated this is the best time in America to be in business, and I, personally, thank you for that.

Next, as you can see, this industry now makes up more than 8 percent of our economy. And in our review, we found computer and communications industries growing at more than double the rate of the economy.

Next, these investments in information technologies account for over 45 percent of all business equipment investment -- up from 3 percent in the 1960s.

Our report shows companies are investing in these technologies to boost productivity and efficiency. Already, in industries like communications, insurance, and brokerage houses, they constitute over three-quarters of all equipment investments.

Next, you can see that declining prices of information technology products have lowered overall inflation by one full percentage point.

Finally, and this is important, these jobs pay well -- very well. There are 7.4 million people working in this field. They earn close to \$46,000 annually -- 64 percent more than the private sector average.

And even with the big paychecks, there are more jobs than people with the skills to fill them. We will require 1.3 million new information technology workers over 10 years. That is more people than build cars and trucks at the Big Three.

The President asked me to see what we can do to expand the pool. But, to be honest, in this economy, where new industries emerge overnight, and new talents are needed, I feel businesses have to take on new responsibilities.

We want you to work with us to help people make the shift into changing jobs. We need you to retrain workers whose skills may be obsolete. And we need you to work more closely with schools.

I see it happening. When CEOs are faced with turning away business because they cannot find the right people, they are serious about changing.

Let me give you a few more numbers. Last year, 100 million people logged onto the Internet, up from 40 million the year before. That is faster than the phone, TV, and radio were adopted.

When President Clinton took office there were only 50 -- 50 -- web sites. Now, 65,000 are being added -- every hour.

Those are impressive numbers, no doubt. But the question we have to ask is: are businesses truly reshaping themselves? Or are they just dancing around here?

The answer is a big yes to true re-invention.

General Electric went on line to find suppliers -- and cut costs tremendously. In two years, GE plans to buy \$5 billion of goods over the Internet, and expects to save \$500 million.

Dell Computers saw 1997 Internet sales increase from less than \$1 million per day in January -- to daily sales of \$6 million several times in December.

Cisco Systems closed 1996 with \$100 million in sales on the Internet. By the end of 1997, sales topped \$1 billion.

It is small businesses, too. When I was in Michigan last week, I heard an amazing number: 750 computer-related firms in the state export. This is Michigan, smokestack America -- not Silicon Valley.

E-commerce gives small and medium-sized firms immediate access to worldwide markets without the need for overseas trips or overseas reps.

On the retail front, we see two types of distinct activity. First, direct access -- as when music is downloaded directly from a company to a customer's computer.

And second, orders for goods to be delivered physically. For example, Auto-by-Tel is a web-based automotive marketplace. Last year, it generated \$500 million in sales and processed 100,000 purchase requests -- each month.

So, what is the report telling us?

That the digital economy is alive and well and growing; that some businesses and workers are reaping the benefits; that businesses of all sizes should prepare for the digital economy; and that, given the new role of electronic commerce, government should re-think the way it looks at the economy.

To that end, at Commerce, I want to improve our surveys that measure GDP, in order to better capture the value of these technologies. I have asked Congress for the funds to do so.

As you know, our approach to e-commerce is that the private sector should lead. Government's role is to establish a climate where electronic commerce can flourish. We prefer private contracts over government regulation. And, where we need to act, the private sector should be part of the dialogue.

I am obviously focusing on adequate protection of intellectual property on-line. It is staggering to think that one day people with a computer may get every song ever sung, every movie ever made, every creative work ever created.

My children would tell me: this is big. It is also big for the entertainment industry, and clearly you can see their concerns.

The Administration negotiated two treaties in 1996: the World Intellectual Property Organization Copyright Treaty, and the Performances and Phonogram Treat. These set international standards for protecting copyrighted works, musical performances, and sound recording.

I am pleased to say that Rep. Hyde recently moved the implementing legislation through his Committee. Senator Hatch is also working to move it through his Committee, soon after Congress returns. I am also pleased to say that industry has reached an agreement in principle on how to address the potential copyright liability of on-line service providers.

I call on Congress to move quickly to finish the work, so we can give a gift to consumers, while protecting the artists. It is important that industry support these measures. We lead the world in creating copyrightable works. We need to lead the world in protecting those works.

Another key issue is privacy. To me, this is the make or break issue. Look -- you can offer the best products, the best selection, the best distribution. But consumers need to feel a certain level of privacy.

They know companies can collect vast amounts of information and instantly analyze it. And if they feel when they order a plane ticket or buy a stock, that their personal transactions are being shared with others, then I say it will be the last time they do business on the Internet.

Last month, in an editorial, Business Week told businesses and I quote: "Time is running out. The public does not trust its promises for self-regulation to ensure privacy. The polls show that people don't believe that these voluntary standards are working. It's no wonder that the public wants the government to step in immediately."

Now is the time for industry to act. President Clinton has called for a self-regulatory approach to privacy. This would stand on four pillars:

- One, awareness. Consumers need to know who is collecting personal information, how it will be used, and how they may limit disclosure.

- Two, choice. Consumers should have an option as to if and how their personal information is used.
- Three, data security. Companies with personal information must take reasonable measures to assure reliability and protection from loss, misuse, alteration, or destruction.
- And, four, access. Consumers should have reasonable access to personal records held by companies and be able to correct or amend them.

The truth is, industry has been slow to put these protections in place. While the pace has picked up recently, the July 1st deadline when I report the progress to the President is looming. I very much want this to be a positive report. And I would like to use this opportunity to encourage industry to meet this challenge.

I hope you move quickly to establish an overarching, self-regulatory effort that includes consumer representation.

Let me say, I am also working quickly to end federal involvement in Internet addressing. We have put forward a plan. We are reviewing the comments. And we will move ahead to put this into private hands.

We are also working to develop a uniform commercial legal framework for electronic transactions worldwide. A key element of this is recognition and enforcement of electronic signatures.

We have recently proposed an international convention that supports two goals: recognition of signatures for legal and commercial purposes; and expressly allowing a full range of authentication technologies and business applications.

And one last issue I want to address is security, in particular, encryption. Good security is essential. If you don't have confidence your message or transaction will go only to its intended destination and will not be intercepted, and read, or changed by someone else e-commerce will never fulfill its potential.

The President is trying to pursue a policy that balances law enforcement, national security, privacy and commercial interests. At the same time, that policy must be pursued in light of the realities of a global economy. This issue cannot be considered in a vacuum any more than any other economic issue.

The reality is that encryption products are rapidly multiplying in the global market. At the end of 1997, we estimate there were 656 encryption products in 29 countries outside the United States. There are major producers in Germany, Ireland, Canada, Israel and Great Britain. They are competitive with anything U.S. producers can make. And they can supply almost all the needs of computer networks.

And most of these producers do not need an export license if they want to ship encryption software -- a tremendous market advantage. Our policy, ironically, encourages the growth of foreign producers at the same time it retards growth here.

The truth is that while our policy goal -- balance -- is the right one, our implementation has been a failure. We have not been able to agree -- amongst ourselves or with the business community -- on how to reach that balance.

We have not been able to agree on what products can be exported, on how to implement the policies that we have announced, such as that concerning financial institutions. And we have not been able to agree on what we want to encourage companies to do or on what we want Congress to do.

In turn, our own paralysis has made it difficult to persuade other nations to pursue policies similar to ours. Without the cooperation of other nations, the global market is rendering our policy obsolete. And I fear that will soon make our products obsolete as well.

The lack of agreement is caused by the unwillingness to compromise. There are solutions out there. Solutions that would meet some of law enforcement's needs without compromising the concerns of the privacy and business communities. But I fear our search has thus far been more symbolic than sincere.

The cost of our failure will be high. Law enforcement is foregoing the opportunity to have some problems addressed, while effectively forcing our producers to go overseas or fall off the cutting edge of the market.

The ultimate result will be foreign dominance of the market. This means a loss of jobs here, and products that do not meet either our law enforcement or national security needs. We are headed down a lose-lose path. And we have to get back to win-win.

We've talked a lot about this for several years. We can talk some more. But without a commitment on all sides to settle for less than 100 percent, we are no closer to resolution than we were when we began.

So, I say to you today that I intend to make a renewed effort to achieve that willingness to compromise inside the government. And I hope all of you will do the same among your colleagues.

Let me close on this. Tonight, I travel with President Clinton to South America, as we work to bring free trade to the hemisphere. Seventy years ago, Herbert Hoover -- one of my predecessors -- was our first president to ever visit South America. Ironically, he went there to inaugurate air mail service.

Knowing President Clinton, he will head straight to a school, to check our e-mail service. He knows, better than anyone, that in the information age, no matter where you live, we can widen

the circle of opportunity, so more people can make more out of their lives.

That is what this report is all about. It shows -- clearly -- that technology is re-shaping this economy and transforming businesses and consumers.

We have made gigabytes of progress. And, yes, there are more challenges ahead. So, I look forward to working, together, to forever change the face of commerce, to provide more economic opportunities, and to empower consumers as never before.

Thank you very much.